RESEARCH AND DEVELOPMENT PLAN FOR THE

LARGE AND SMALL LIVESTOCK MEAT INDUSTRIES IN SOUTH AFRICA

RED MEAT RESEARCH AND DEVELOPMENT SA (RMRD SA) PLANNING COMMITTEE (R&D) CATTLE AND SMALL LIVESTOCK

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1 INTRODUCTION

1.1 INDUSTRY VISION

To support profitable and sustainable large and small livestock sectors to contribute to the national economy, to social and environmental wellbeing.

1.2 RESEARCH MISSION

To provide the South African large and small livestock sectors with the latest scientific advancements to maintain their global competitiveness.

To develop world-class and credible research, development and technology transfer programmes on the following:

- **Programme 1: Sustainable natural resource utilisation**
- **Programme 2: Competitiveness through improvement of livestock and forage (to improve sustainability, food security and efficiency of resource use)**
- **Programme 3: Anticipation & mitigation of agricultural risks to create a resilient red meat sector**
- **Programme 4: Sustainable animal health and welfare for the red meat sector**
- **Programme 5: Solutions, processes and technologies that will enhance the production and processing of animal products**
- **Programme 6: Consumer and market development of the red meat sector**
- **Programme 7: Commercialisation of the emerging sector**

1.3 IMPORTANCE OF THE LIVESTOCK INDUSTRY

Ruminant livestock are important to humankind because the world's vegetation biomass is mostly high in fibre. Only ruminants can convert this high-fibre vegetation into high-quality protein sources (i.e. meat and milk) for human consumption as well as animal fibre (wool and hair). Livestock agricultural activities are the world's largest user of natural land resources and southern Africa is no exception. In South Africa, approximately 84% of the surface area is available for agricultural activities, but only 13% of this area is arable. The greater part of South Africa (71%) is only suitable for extensive livestock farming. Therefore, the primary beef cattle and small livestock farming in South Africa is largely extensive.

Because 71% of South Africa's agricultural land is only suitable for livestock farming, towns in rural South Africa came into being largely because of the livestock farming activities in the district. Therefore, economies of the majority of towns and the sustenance of the associated mostly poverty-stricken peri-urban communities are dependent on the income generated by commercial and emerging livestock farmers in the district. In addition, livestock is critical for many of the poor, often contributing to multiple livelihood objectives and provide means to alleviate poverty.

The livestock sector is making a substantial contribution to the GDP generated by agriculture as indicated below:

- Field crops – 24.6%
- Horticulture – 26.6%
- Livestock – 48.8% (of which approximately one-third (or 16%) comes from beef cattle and small livestock)

The commercial livestock sector consists of more than 38 000 farms that employ about 250 000 people, with an additional 1.5 million direct dependants. South Africa's emerging and communal farmers comprise about 1,4 million households that are involved in livestock production, with an additional 10 million dependants. The livestock sector therefore directly supports close to 13 million people (20% to 25% of the population).

1.4 HISTORY ON THE FUNDING OF RESEARCH AND DEVELOPMENT

Since the 1930's, when the Meat Board supported the developmental research of Dorper sheep, the organised red meat industry in South Africa contributed financially to research and development (R&D). Through subsequent years, the Meat Board and various individual organisations such as livestock breeders' societies funded the establishment and functioning of livestock improvement schemes. These included the central performance testing stations for beef cattle and research facilities (at universities and the Meat Industry Centre at Irene), that contributed to the execution of numerous research projects – many leading to post-graduate qualifications of research personnel.

Subsequent to the demise of the Meat Board, the South African Meat Industry Company (SAMIC), the Red Meat Research and Development Trust (RMRDT) of South Africa, and since 2006, the Red Meat Industry Forum (RMIF) of South Africa contributed financially to research and development concerned with red meat production processes and products derived from red meat-producing livestock. The red meat industry does not perform research itself but outsources the task to recognised research institutions such as institutes of the Agricultural Research Council (ARC), universities and provincial departments of agriculture.

Research and development provide new insights and solutions to current and future challenges. Research findings enable and stimulate product development and technological advancement leading to innovation. It forms the essential scientific foundation for any industry and is important to guide consumer education. Due to the complexity and dynamic nature of the South African red meat industry, coupled with a diverse consumer base and socio-economic class mobility, there is a need to continue investigating and understanding the needs of the industry and the consumer, which should be addressed proactively. Agricultural research and development contribute to:

- The enhancement of agricultural productivity;
  Improvements in the sustainable use of natural resources;
- Increased food availability and affordability to the consumer;
- Increased dietary diversity; and
- Adequate nutrition and good health in the long term.

2 RESEARCH AND DEVELOPMENT PROGRAMMES FOR NOVEMBER 2020 AND ONWARDS

The Red Meat Research Development South Africa (RMRD SA) Planning Committee identified seven programmes during a strategy workshop in 2018. It was anticipated that these programmes would form the basis for future research priorities.

Research implies the furtherance, assimilation and improvement of knowledge in the agricultural and related sciences through original and other investigations (surveys) and methods of a scientific nature to the advancement of agriculture. Development refers to activities by which knowledge, acquired through research, is utilised. Technology transfer implies the transfer of knowledge, techniques and processes for the application thereof.

Industry experts in the field compiled the programme content, building on the existing RMRD SA research and development plan, which has been in use since 2010.

The programmes and the convenors are summarised in the table below:

Programmes (can be regarded as priority areas)

P1.	Sustainable natural resource utilisation	Mr GM Schutte (RPO) Mr A Mahanjana (NERPO)
P2.	Competitiveness through improvement of livestock and forage (to improve sustainability, food security and efficiency of resource use)	Dr Theuns Laas (SAFLA)
P3.	Anticipation and mitigation of agricultural risks to create a resilient red meat sector	Mr GM Schutte (RPO) Mr A Mahanjana (NERPO)
P4.	Sustainable animal health and welfare for the red meat sector	Dr P Vervoort (NAHF)
P5.	Solutions, processes and technologies that will enhance the production and processing of animal products	Dr G Neethling (RMAA)
P6.	Consumer and market development of the red meat sector	Mr D Olivier (SAFA)
P7.	Commercialisation of the emerging sector	Dr FV Nherera-Chokuda (NERPO)

The following important aspects were considered in designing and documenting the programme contents:

- Cross-cutting information dissemination
- Interdisciplinary research
- Economic impact of return on revenue
- Sustainability with the three pillars, namely environmental, economic, and social
- Integration

3 PROGRAMMES

3.1 PROGRAMME 1: SUSTAINABLE NATURAL RESOURCE UTILISATION

3.1.1 Preamble

Ruminant livestock production is largely based on natural resources (veld), which poses restrictions on the competitiveness of this large and important livestock sector. A full understanding of the dynamics of and interaction between rangeland (veld), pastures, climate and livestock is essential for sustainable livestock farming. Therefore, whether livestock production is based on rangeland in an ideal condition or a poor condition, it is dependent on net forage production.

Support services directed at sustainable rangeland utilisation and management are at present very fragmented. The research and development (R&D) functions and responsibilities are spread among the nine provincial departments of agriculture, the national department of agriculture, ARC, universities, the CSIR, SAEON, Conservation SA, and SANBI. It is clear that biomes and zones of homogenous agricultural potential are spread across provincial boundaries and for R&D to succeed and to eliminate duplication, it is essential that projects should be carried out across provincial boundaries.

Furthermore, there is inefficient communication between research and development organisations. Similarly, communication with the producers' organisations, i.e. RPO, NWGA and SAMGA, is not effective. The present fragmentation within the research community weakens the effectiveness of research as well as extension and technology transfer efforts. Excellent infrastructure is available to serve the livestock producers within the different biomes, but what is lacking is a national focus across provincial boundaries.

The complexity of solving a comprehensive problem such as vegetation deterioration warrants the inputs of various researchers and expertise in all the relevant sub-disciplines of plant, animal and social sciences. The mere fact that rangeland degradation is still impeding sustainable livestock production, in spite of the number of investigations, indicates that research organisations within livestock do not take the problem seriously, or they are not prepared to or unable to put proper prioritisation mechanisms in place when they decide on priorities.

3.1.2 Rangeland condition

Assessing the condition of plant communities is a convenient way of comparison, which also provides a way to quantify and observe spatial and temporal changes within a particular community or vegetation type. While man has little control over the influence of climate and soils on the structure and composition of vegetation, defoliation because of fire and grazing/browsing will influence the dynamics of any plant community. Management of any plant community should be governed by knowledge of its present condition relative to its "ideal" condition in a given environment.

In the present context, the term "rangeland condition" is used to describe vegetation in relation to its long-term potential for livestock production. It is defined as the "state of health of the rangeland in terms of its ecological status, resistance to soil erosion and its potential for producing forage for sustained optimum livestock production". Soil loss may be regarded as an absolute measure of "health" of grazing lands since it is irreversible – except over extremely long periods of time – and it causes reduced productivity and affects future land use options. Vegetation is used to quantify rangeland condition since it is a more sensitive indicator of ecosystem change and is easier to measure than soil. Describing the condition of a sample of rangeland is meaningful only if it is related to some known standard, or when monitored over time, but is complicated because vegetation varies greatly with environmental conditions. Analysing the variation in vegetation composition and rangeland condition across environmental gradients, can reveal important vegetation and environmental interactions.

The aim of rangeland and herd management is to ensure the optimum energy supply to the animal without degrading the ecosystem. However, in reality many rangelands have been degraded. This includes all biomes, which among others, have been seriously eroded by desertification, bush

encroachment and the loss of acceptable plant species. The problem of degradation and the impact on present and future livestock production is by no means new and over the period, commencing with the investigation of the Drought Commission in 1923, much was said and written about rangeland deterioration. However, it is sad to note that many attempts to halt the deterioration have failed, which is of serious concern when considering a livestock strategy. Should this deterioration be allowed to continue, sustainable livestock production would be jeopardised.

Since 71% of the land available for agricultural is suitable only for animal husbandry activities, livestock production is primarily dependent on natural resources, which means that the livestock sector has a prime responsibility to use this valuable but vulnerable natural resource sustainably. History shows that the livestock sector, research institutions, policy makers, and livestock farmers in general have a poor understanding of this concept. Continuing deterioration of the natural vegetation is currently one of the most burning issues in southern Africa, having a negative impact on the competitiveness and efficiency of the livestock sector. It is therefore imperative that role players within the livestock sector (research institutions, national and provincial government departments, livestock farmers as well as the related secondary industries) must recognise that the natural resource is vital to sustain livestock production and that they commit themselves to implement the necessary proposed recommendations.

3.1.3 Rangeland and herd management

Many of the important management decisions a livestock farmer makes relate to the management of the forage resources of the land unit. Both biological and economic efficiency is influenced by a farmer's ability to match animal type and their nutritional requirements to availability and quality of forage on a year-round basis. Animal type as defined primarily through species and breed differences has a considerable influence on the nutritional requirements of animals. Therefore, the type of animal can have an impact on its level of performance and on economic returns of a grazing system, for different rangeland types/forages. The grazing/browsing system affects the intake and quality of forage, and therefore influences the nutritional status of feed available to animals. Intake decreases when rangeland is grazed too short. Regrowth of the vegetation is slower because the leaf area for photosynthesis is decreased and the quality of the forage is lower.

Management choices about forage and grazing systems should consider farmer decisions, such as timing of parturition to match the lactation curve of females to the forage production curve or choosing to graze castrates (steers or withers) rather than breeding females and their offspring. The nutritional requirements of the grazing animals also determine the choices of forage, and should be considered over a period of 365 days when determining the percentage of forage (fodder-flow) used in the grazing system. Grazing different species at appropriate ratios together can increase efficiency of forage utilisation because of differences in behaviour and forage/browse preferences.

A further aim of rangeland and livestock management is to ensure the optimum quantity and quality forage per mm rainfall, which would contribute to optimum livestock production without degrading the ecosystem. Rangelands have deteriorated considerably, as mentioned above, but the challenge is to reverse the situation and to ensure that rangelands improve through sound rangeland and livestock management systems. Evidence indicates that it is possible to implement a rangeland improvement scheme that will ensure long-term economic stability for the pastoralist. The challenge is to change the mind-set of the pastoralist, researchers within the domain of livestock research, and extension advisors and policy makers. They have to accept and give recognition to the importance of the natural resource (vegetation) as the driving force of sustainable and economic livestock production systems. In the context of the aforementioned, efficient livestock production depend on:

- The absorption and photosynthetic conversion of sun (solar) energy to chemical energy (organic compounds) by plants (the better the condition of the vegetation the more efficient the process and therefore the more sustainable and economically viable livestock systems will be); and
- The efficient absorption of chemical energy (organic compounds) by the livestock (influenced by the health, type and genotype of the animal for a specific area) from the plants and the conversion to meat, milk or fibre.

The grassland ecosystem in a rapidly changing environment, as well as global change towards a generally hotter, drier, more variable and risk-prone environment in South Africa, is a scenario that must be taken seriously in the application of grassland management principles, to ensure long-term productivity and profitability of production systems at the lowest risk. The ecologically sensitive arid and semi-arid regions require specialised expertise in effective rainfall utilisation. To attain this, the following should be defined for the different ecological regions:

- The amount of forage produced per mm rainfall under different rangeland conditions.
- The nutritional value of the forage produced under different rangeland conditions and seasonal variability.
- The availability and variation of the forage produced to grazing/browsing animals under various management regimes.
- The biological impact of animal type, numbers and distribution on the functioning of ecosystems under different degrees of degradation.

3.1.4 Matching species, breeds and combinations with the production environment

Unsatisfactory attention has been given to the factors that influence the regionalisation of livestock and livestock production in South Africa, despite a detailed study which was carried out in the 1950's and the information being available at the department of agriculture. Matching livestock to both the environment and the production system is a key challenge in sustainable livestock agriculture, and by integrating information on the production environment with information on species and breeds, livestock farmers will be able to make a more informed choice as to the breed and combination best suited to individual production inputs.

The challenge is not to change the vegetation to suit a specific animal type or production system, but to use the animal type and production systems as determined by the environment. Given the large variation in rainfall and the consequent impact on grazing capacity, the challenge is to exploit this variability and to develop sustainable livestock production systems for the different ecological regions. If the environment (especially rainfall) is analysed, some current livestock production systems within specific regions remains questionable. This relates especially to commercial livestock farming in areas that are not according to recommendations and the requirements of the vegetation.

The pastoralist can employ livestock types or a particular mix of species to achieve specific objectives, e.g. goats to control bush encroachment. Management tools (e.g. fire) can also be employed to manipulate the vegetation to make their structure more suitable for particular livestock.

3.1.5 The potential role of pastures in different types of rangeland

The major role of cultivated pastures in farming systems is to satisfy the nutritional requirements of livestock during periods when the quantity and/or quality of forage produced by rangelands are inadequate. Their primary role should be to provide forage during the periods of food shortage in the fodder flow programme; and increase the total amount of forage and digestible nutrients produced on the property.

The role of cultivated pastures will depend on the nature of the livestock production system and the quality and quantity of forage that is available. The role, therefore, will be a function of the rangeland type.

In sour veld (mainly high rainfall areas), cultivated pastures can:

- Increase the length of the growing season, particularly in the spring and autumn
- Increase the total amount and quality of forage produced on a farm
- Provide high-quality green forage during the winter months (particularly for the dairy industry, using irrigated temperature pastures)
- Provide high-quality forage for carry-over into the winter in the form of forage, hay or silage
- Increase the level of animal production per unit area of land

In sweet veld, on the other hand, the major role of cultivated pastures is likely to be one of the following:

- Provide forage for summer use when rangeland needs to be rested
- Provide hay for drought periods
- Increase the total amount of forage available for animal feeding
- Increase the level of livestock production per unit area of land

In mixed veld, the major role of cultivated pasture is likely to be as follows:

- Provide forage in early summer, when it is often in short supply
- Provide feed during the summer in order to rest the rangeland
- Provide high-quality forage during the winter months
- Increase the level of livestock production per unit area of land

3.1.6 Forage production planning and livestock production systems

The efficiency of any pastoral system primarily depends on the following factors:

- The amount, quality and seasonal distribution of forage production, which is a function of soil type, the amount and seasonal distribution of rainfall and the availability of irrigation
- The proportion of the feed consumed by animals
- The efficiency with which the animals use the feed consumed

The objective should be to match feed demand with forage supply. Whereas the general principle of forage production planning applies to all pastoral livestock enterprises, each has distinctive characteristics that merit special attention. These specific requirements are a function of the system being adopted within each enterprise, and for the system to operate effectively, a particular set of conditions needs to prevail irrespective of where in the country that system is used.

3.1.7 Alternative feed crops

Given the current state and limited potential of some vegetation resources over much of South Africa, and the low productivity of the national livestock herd, alternative feed crops should be established as a priority. It is important to realise that rangeland and cultivated pastures can play complementary roles in providing quality feed to livestock and markedly increase forage production. There is undoubtedly considerable untapped potential for cultivated pastures in many parts of the country. A strategy to develop this potential would make it possible to increase forage production and improve productivity and efficiency of livestock to such levels, that South Africa can become self-sufficient in livestock products and also compete in the international arena.

South Africa is impacted by the following global factors, which inform and justify an initiative to promote the utilisation of alternative feed crops, namely:

- The growing negative effects of global warming are a reality.
- The growing demand for water is exceeding the scarce and limited water resources.
- The competition for limited water resources is favouring human consumption (total use).
- The effects of recurring and increasingly persistent droughts or feed shortages for animals.
- The dense and often impenetrable, infestations of alien invader plant species on several hundred thousand ha of natural pasture (veld).
- High levels of unemployment and the lack of viable opportunities to support livelihoods.

Cactus pears is one such an alternative fodder crop. it ideally adapted to drier conditions in large parts of South Africa, yielding large volumes of cladodes and fruit. They are efficient users of water and versatile multi-use crops with a range of proven applications for humans and animals.

P1 Elements for sustainable natural resource utilisation

ELEMENTS/CHALLENGES	OUTCOMES/OUTPUTS	INDICATORS
1 Sustainable natural resource management	Competitiveness of the extensive livestock sector Optimisation of production per unit area (kg meat/ha) of pasture systems Improved forage management strategies to maximise efficiency in livestock production systems with minimum negative impact on the environment and biodiversity of the habitat	A full understanding of the dynamics of, and interaction between rangeland pastures, climate and livestock Recognition that livestock production, whether from an ideal rangeland condition or a poor condition is dependent on net fodder production
2. Veld monitoring and management	Veld management strategies to maximize the productivity of veld and to rehabilitate non-productive areas Management strategies to reduce enteric methane and nitrous oxide emissions and water use	Environmentally sound management of livestock on veld types to maximise economic efficiencies in livestock production, while avoiding negative impacts on the environment
3. Ecosystem sustainability (decision support systems)	Decision support tools to inform the stock farmer in time of environmental risks (e.g. drought and/or floods) and extreme events (e.g. fire)	Enhanced decision-making by farmers to minimise the negative consequences of extreme events
4. Environmental protection	Information and methodologies to maintain ecosystems and wetlands to prevent erosion and pollution Information and methodology to reclaim eroded and polluted resources	Protection of the environment (in terms of ecosystem, wetlands, and prevention of erosion and pollution) and maintenance of biodiversity
5. Restoring the value of grasslands/rangelands	The environmental and economic value of grasslands is restored, while its social and cultural functions are preserved Increased carbon sequestration in biomass, improved climate change resilience and improved production efficiency	Widespread neglect and degradation of grazing land has been reversed
6. Livestock and forage genetic resources	Knowledge about forage genetic resources Development of new knowledge and technologies to increase the productive capacity and usefulness of plants as forages All livestock breeds and strains characterised in terms of scientific principles Systems and models dealing with breeding plans for small populations of livestock species to counter inbreeding	The production potential of rangelands is optimised by making available adapted, nutritious, and highly productive forages Breeding objectives and animal and forage genetic resources dissemination plans, to secure the commercialisation and utilisation of animal and forage genetic resources

3.2 PROGRAMME 2: COMPETITIVENESS THROUGH IMPROVEMENT OF LIVESTOCK AND FORAGE (TO IMPROVE SUSTAINABILITY, FOOD SECURITY AND EFFICIENCY OF RESOURCE USE)

3.2.1 Preamble

It is important that the needs of red meat producers be identified and that research programmes maximise financial gain for the producer. At the same time, scientific advancement must be considered and take place in the whole process.

Efficient cattle, sheep and goat management, reproductive efficiency, animal welfare, parasite control, pasture management and effective use of genetic technologies to increase profitability are the key issues facing producers in South Africa.

This research programme can therefore be defined by the utilisation of the principles of animal nutrition, reproduction efficiency, livestock improvement, disease control, forage and veld management, and economics in order to support profitable animal production by integrating research into farming practice.

It means there is a need for livestock research and development, to think holistically and consider the economic outcome of the research for the producer. The possible focus areas are indicated and described below.

3.2.2 Reproduction

Reproduction is an important basis affecting the economics and profitability of cattle enterprises. It forms the basis of genetic herd improvement, transferring genes from one generation to the next and is central to weaning more calves.

The following aspects must be taken into consideration in cattle, sheep and goat reproduction programmes:

- Bull/ram/buck management - to sire viable progenies in each mating season (including feeding and health practices)
- Cow/ewe/doe management practices to conceive and rear calves/lambs/kids to weaning each season after puberty and rear calves/lambs/kids every year for the rest of her productive life
- Practices for heifers/replacement ewes/does to achieve target mating weight and condition scores to help realise acceptable calving/lambing/kidding intervals and lifetime productivity
- Maximising survival rates and growing weaner calves/lambs/kids and to reach profitable weaning weights
- Health and welfare practices to maximise growth and reproductive rate (developing holistic environment-friendly animal health practices)

3.2.3 Genetics

Genetics determines the production potential of cattle, sheep and goats. Using the best available genetics allows producers to potentially improve the contribution that cattle/sheep/goats make to enterprises profitable. Important profit drivers that are related to animal performance are influenced by the 'genetic makeup' of a herd.

Consideration in cattle, sheep and goat breeding and genomics technologies programmes should include the following:

- Development of methods to select animals adapted to their environment to improve profitability
- Development of more accurate and affordable genomics technologies to enhance the accuracy of breeding values and accelerate genetic gain for producers to more profitable beef/sheep/goat farming enterprises
- Improvement in reproduction breeding values
- Development of affordable DNA and genomics testing methods for breeders and producers to accelerate genetic gain

- Breeding towards poll herds with the use of genomics
- Methods to increase accuracy of performance testing
- Maximising genetic improvement in a beef/sheep/goat breeding enterprise for profitable production.
- Development of relevant breeding objectives for cattle, sheep and goats

3.2.4 Animal identification

The following two developments are important:

- Robust and affordable electronic identification and recording technology to allow producers to manage their herds more economically and practically
- A sustainable national animal identification and traceability system (integrating the unique stud breeding section's official identification system with the current general brands identification system, in order to prevent duplication)

3.2.5 Nutrition

In respect of nutrition, the following aspects are important:

- Practices to optimise the use of natural veld in different ecological regions in South Africa within the climate-changing challenge
- Development of grass-fed production systems for cattle, sheep and goats
- Identifying the mineral imbalances in planted pastures and veld and address identified deficiencies with appropriate supplements
- Development of additional feeding systems for seasonal and drought (periods of feed shortages) conditions
- Development of practices to optimise the use of crop residues in the different ecological regions
- Development of drought (periods of feed shortages) management practices
- Development of sustainable feedlot practices

P2 Elements for competitiveness through improvement of livestock and forage

ELEMENTS/CHALLENGES	OUTCOMES/OUTPUTS	INDICATORS
1. Breeding and genetics (including genomics)	Increased accuracy of animal improvement / performance testing methods (genomic EBV's) Breeding methods to identify adapted animals in different environments (landscape genomics) Breeding aimed at polledness Improving reproduction selection methods Identification of genes or genetic markers related to economically important traits or adaptation Marker identification and quantitative trait loci (QTL) detection for identification of internal and external parasite resistance/tolerance Development of affordable genomics technologies to accelerate genetic gain for more profitable production	Increased profitability and sustainability through breeding Properly accepted selection criteria and breeding objectives to accelerate selection response for profitable production Increased accuracy of animal improvement methods Liaison with genomics working groups to identify research projects
2. Reproduction efficiency	Bull/ram/fertility improvement practices Maximising weaning percentage practices, calving/lambing intervals and lifetime production Behavioural and physiological understanding of climate-related effects such as heat stress on livestock reproductive efficiency and overall productivity Health and welfare practices to maximise growth and reproductive rates	Increased enterprise profitability and sustainability as a result of improved reproduction
3. Nutrient intake and utilisation	Natural veld improvement and cultivated pasture programmes to increase animal production Feeding practices for grass-fed production systems Identifying and rectifying mineral imbalances in veld and pastures and evaluate feed additives Development and evaluation of cost-effective supplement feeding practices Methods to maximise the use of crop residues Development of sustainable feedlot feeding practices	Increased enterprise profitability and sustainability as a result of improved nutrient utilization
4. Animal identification and traceability	Development of an affordable animal identification system Implementation of a national traceability system	Traceability of animals and animal products
5. Systems approach to livestock production	Studies of the whole enterprise and production cycle of animals Understanding of species' interaction (including wildlife) in the farming enterprise Understanding of integrated crop/animal production systems Decision support systems to assess the impact of selection decisions on the efficiency of the production systems because of the interaction of many economically relevant traits	Sustainable production enterprise through the best allocation of limited resources, fulfilling an important coordination function between the different disciplines of animal production
6. Unlocking the potential of livestock production through technology transfer and training	Evaluation and development of technological methods to transfer information to producers	Well-planned, accessible, and managed information databases; production manuals; and educational material Assistance programmes and training for emerging and commercial producers

3.3 PROGRAMME 3: ANTICIPATION AND MITIGATION OF AGRICULTURAL RISKS TO CREATE A RESILIENT RED MEAT SECTOR

3.3.1 Preamble

Ruminant livestock production is largely natural resourced-based, which poses concomitant restrictions to the competitiveness of the livestock sector. Traditionally extensive livestock farming is implemented in areas with a lower agricultural potential, specifically unsuited for crop production. Such areas are notorious for inherent risks regarding sustainable production, for example low and erratic rainfall patterns, frequently occurrence of natural disasters such as droughts and floods (climate change), predation, livestock theft and security.

Official support services committed to address droughts are highly fragmented. Early warning systems for drought detection, drought management and drought classification are not in place and hampered by lack of clear policies. The provincial departments of agriculture lack the necessary expertise and knowledge to develop functional mitigation strategies for drought and other risks within the different production areas. The impact of droughts does not recognise artificial borders, differs greatly between biomes and for the commercial and communal livestock sectors. Therefore, policies to identify and address the risks have to be implemented at national level and not at provincial level.

3.3.2 Predation

Ruminant livestock utilises veld (natural pasture or rangeland) as a major feed source. The veld is grazed by ruminants, namely domesticated cattle, sheep and goats as well as indigenous wildlife and is also utilised by other herbivores species, such as domesticated equines and several wildlife species. Thus, domesticated and wild herbivorous species play an important role in providing food security.

Of equal importance is the large and medium-sized carnivorous predators that have been part of the South African landscape for centuries and implicated for predation losses. However, losses attributed to predation on livestock farms and wildlife ranches are poorly quantified. Recently, predation losses on sheep and goats in five provinces were estimated at more than ZAR 1.39 thousand million annually. In another study, the predation losses for beef cattle in seven provinces is estimated at more than ZAR 383 million annually. A third study concluded that the negative impact of predation on wildlife ranches in South Africa was comparable to those for livestock. Predation losses are ascribed to black-backed jackals, caracals, leopards, brown hyenas, cheetahs and vagrant dogs. Back-backed jackal was the predominant predator, but in Limpopo and North West Provinces, leopard was the top predator.

Predation on livestock farms and wildlife ranches falls within the general ambit of agriculture, in close participation with relevant environmental/conservation authorities. Solutions to manage the challenges regarding human-wildlife conflict in South Africa call for a common South African institutional memory. Important information is currently kept in different official databases by nine provincial and national departments. Apparently the sources are filed without being integrated and often also in total isolation from each other. The overwhelming majority of information on predation and hunting of predators is held privately by a large number of specialist predator hunters and farmers and with no real integration with other private and public sources of information.

The founding of the Predation Management Forum (PMF) in 2009 was a momentous step, but the PMF remained only a forum to unite the different livestock and wildlife producers' organisations for a common purpose and action, namely predation management. It is important that the PMF urgently engage with other role players in a system of coordinated predation management (CPM). These role players include among others the national and provincial departments of environmental affairs and agriculture, universities that could make a scientific contribution, scientific research institutions and meaningful representation by specialist predator hunters.

Farmers and government should be equal partners in this venture, each with specific responsibilities. The government is responsible for policy, coordination, extension, training, research, monitoring and effective communication, while the livestock farmers and wildlife ranchers are responsible for protecting their animals and control predators. An important element of the system is an institutional

memory or management information system (MIS). It is the pivot for a common source of information, planning, leadership and guidance with predation management and prevent fragmented and uncoordinated actions. The CPM should form part of the official structures of the national department of agriculture, with good liaison and coordination with the national and provincial counterparts in environmental affairs.

Good information regarding predation and appropriate control methods are important components of a system of CPM. The institutional memory serves as central information source and should provide practical answers on the following type of questions:

- Areas where predation losses are reported (species involved)
- Is there a relation between reported cases of predation and the predation management?
- Is there a decline in reported cases of predation following predation management?
- What are the results achieved with different predation management methods?
- Which relevant questions must be resolved through directed scientific research?
- Who are the recognised and proven role players (e.g. specialists in managing predators)?

The current approach to manage predation is fragmented and uncoordinated. The alarming scale and impact of predation on livestock farms and wildlife ranches calls for a focused and coordinated predation management and research and development programme (R&D) to reduce (mitigate) the negative impact of predation and specifically to manage and human-wildlife conflict. Urgent revision of the enabling legislation pertaining to different tiers of government and specifically impeding regulations are required.

The PMF held a workshop on 21 February 2019 at the Nelson Mandela University (NMU) to develop a framework that will give direction to research and training/extension, which will be practical for all to support, and actively engage and participate in. Tertiary institutions, predation specialists, national departments of government (environment and agriculture) and provincial conservation authorities, attended the event.

Research projects conducted on predation management by tertiary institutions such as the Nelson Mandela University, UNISA and the Universities of the Free State, Cape Town, Mpumalanga and Fort Hare were presented and concern was expressed that predation losses was apparently increasing.

A research model used by the fruit industry for setting priorities, funding models and, involving stakeholders served as an example for predation research. It was emphasised that such a model or organisation is grower-focused and expert-based, it is addressing current and anticipating future challenges, and that all the processes begin and end with communication. The workshop supported the advice of sound communication with all stakeholders, including policymakers. What is required is a formalised structure that will address the gaps identified by producers, researchers (from the *Scientific Assessment*) and the government. These gaps should ultimately address environmental, societal and economic needs.

3.3.3 Livestock theft

Contrary to commonly held beliefs and perceptions, livestock theft is not limited to a particular continent, country or area. It is a global phenomenon that manifests on various scales and dimensions, occurring since livestock herders first tamed the aurochs in 7000 BC. Livestock theft, livestock producers in South Africa have tended to assume the role of victims, subscribing to the myth that the police should be able to prevent crime, and all crimes are blamed on the inefficiency of the criminal justice system.

Agriculture is an extremely important economic contributor to the social well-being of South Africa. Producers need to take control of their own destiny in relation to livestock theft. In this regard the livestock theft prevention forums that have already been established should be used to protect the agricultural sector in general and red meat producers in particular.

The phenomenon of livestock theft clearly cannot be generalised, as it differs in extent between regions and provinces. Nevertheless, it is the role and responsibility of the National Livestock Theft Prevention Forum to inform the general public of its efforts to reduce the scourge of livestock theft.

3.3.4 Climate change

The uncontrolled anthropogenic (man-made) release of greenhouse gasses (GHG) into the atmosphere is thought to be the primary cause of a systematic and unprecedented increase in sea and surface temperatures. The major greenhouse gasses are hydrogen (H), carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (NO_2), with smaller amounts of volatile and synthetic substances. Administrators, politicians, scientists and public society are primarily concerned about the emissions of CO_2, CH_4 and NO_2, because other emissions are small in comparison or, in the case of hydrogen; we cannot do much about it, at least until very recently. Of the three gases, CO_2 is the most abundant, but the global warming potential of CH_4 is about 23 times more than that of CO_2 and that of NO_2 about 310 times more, resulting in them being important participants in the greenhouse emission family. Whereas CO_2 release results mostly from non-agricultural activities (power plants, deforestation, transport, oil and gas production and manufacturing), CH_4 results primarily from organic fermentation, enteric fermentation of plant material in the digestive tract of animals and fermentation of their waste (e.g. manure, sewage sludge), and NO_2 from nitrogen fertilisation. Gaseous animal emissions are therefore the concern and responsibility of agriculture and livestock farming in particular. Burning of veld (primarily grass) in specific livestock production systems is also a concern because it releases CO_2 into the atmosphere.

Climate change represents a feedback loop within which livestock production both contributes to the problem and suffers the consequences. The impact of global warming and continued uncontrolled release of GHG thus has twofold implications for R&D and management:

1. The continuous increase in temperature is predicted to have a direct effect on:

   - Water supply
   - The future distribution of livestock species and breeds
   - Their adaptability to increased heat load and otherwise
   - Incidence and type of diseases
   - Feed supplies
   - Grazing potential
   - Food (nutrition) security

   This is because of changes in temperature, relative humidity, rainfall distribution in time and space, and changes in ecosystem, biome composition, woody species encroachment and alien plant invasion.

2. With reference to agriculture and livestock production, the responsibility is to limit the release of GHG (the carbon footprint) and water use (the water footprint) in order to ensure future sustainability. This can be done by implementing new or adapted production systems; by the use of known and new technologies that can limit GHG emissions, water use and waste; by employing technologies to turn waste into assets; and by promoting sustainable human diets with low environmental impacts. The challenge facing R&D is to support livestock farmers in developing new and adapted technologies to attain this goal.

3.3.5 CO_2 and South Africa's changing biomes

Among global drivers, the rising carbon dioxide (CO_2) level is the most likely candidate driving the changing balance between grasses and woody plants, and is likely to be a very important contributor to vegetation change across Africa.

Increasing CO_2 can improve tree growth and the CO_2 fertilisation effect should allow responsive species to cope far better with fire and browsers than in the past. Long-term burning experiments in the Kruger National Park and Eastern Cape have shown striking increases in three dominant woody species, *Vachellia karroo, Dichrostachys cinerea* and *Terminalia sericea*. Negligible change was recorded in Kruger from the 1950s to the 1970s, but from the 1970s to the early 2000s, there was a

ten-fold increase in the number of *Terminalia sericea* and an eight-fold increase in *Dichrostachys cinerea*. These changes occurred in spite of the same fire treatments over the entire period. The change in tree response is most likely a result of a global driver, the inadvertent effects of CO_2 fertilisation. No comparable changes were seen in *Acacia nigrescens* in semi-arid savanna, therefore the CO_2 fertilisation effect is not a general one. Screening of CO_2 responsiveness is needed for a wider diversity of species to establish which species are likely to become natural invaders.

An important message of the CO_2 effect on woody plants is that land practices that were effective in controlling trees in the past, may be ineffective today and in future. Yet management practices do clearly influence ecological trajectories of land cover change. With innovative thinking, we have far more potential to manage our future ecosystems to the most desirable state than, say, nations in the north where global warming is transforming the environment. Alternatively, we can passively accept the changes and suffer the uncertain consequences of our changing natural environment.

3.3.6 Land cover – changes and economic consequences

The change in land use can affect important ecosystem services. For example, large increases in trees can significantly increase water use by vegetation, thereby reducing the amount of water entering rivers and wetlands.

Increasing tree cover in game parks reduces their appeal to visitors as game viewing opportunities are affected and the sense of place is altered. This not only reduces the tourism potential of an area, but also forces managers to increase the amount of time and money spent on clearing bush.

Grazing land is impacted. For example, in Namibia it has been calculated that bush infestation affects 26 million hectares and has led to a 60% decline of commercial livestock over the past 40 years, causing losses to the national economy. Farmers not only lose grazing land, but also face additional bush-clearing costs. On a positive note, the additional wood provides a potential economic benefit and can be used as a source of clean energy.

Alien plant invasion in areas like the fynbos biome is converting large natural areas, reducing water yield and damaging these natural areas. For example, a study on alien plant invasions in some parts of fynbos areas showed that alien invasion of catchment areas could result in a 30% loss of water provision to Cape Town.

3.3.7 Droughts

Droughts are normal phenomena in South Africa. A range of factors, including the increasing effects of global warming, drives droughts. Therefore, planning for inevitable droughts must form an integral part of all long-term planning of livestock systems. It requires an early-warning system and best practice models for the different production areas. In its basic permutation a drought manifests it by a growing shortage of plant material on veld available for grazing/browsing livestock. The incidence and effects of such droughts, which are driven my climatic factors, must not be confused with the serious consequences resulting from irresponsible overgrazing of the veld.

P3 Elements for anticipation and mitigation of agricultural risks to create a resilient red meat sector

ELEMENTS/CHALLENGES	OUTCOMES/OUTPUTS	INDICATORS
1. Predation management	A functional management information system (MIS) that is functioning as a national asset and available to all users Information is updated in real time on issues related to biological, physical, economic and social factors to ensure coordinated predation management A coordinated system of predation management is developed and implemented	Relevant information regarding predation and predation management methods is collated, analysed and disseminated to guide the specialists in predation management Research needs are prioritized and communicated with all relevant role players A reduction in the cost of predation, indirect (prevention of predation – non-lethal/lethal methods) and direct costs (losses of livestock and wildlife/game) that increase profitability.
2. Livestock theft prevention	Baseline database and relevant information on the extent and impact of livestock theft in South Africa. The institutional memory will serve to inform a system of coordinated livestock theft prevention.	A national database is available for use by all role players and stakeholders to inform strategic and tactical planning for livestock theft prevention management. This can result in reducing the impact of livestock theft
	Technology and services available to assist in livestock theft prevention, e.g. animal identification, traceability and DNA Technology	Animal identification systems that are cost effective, easy to use, robust, reliable and secure (e.g. RFID ear tags). Appropriate software systems for accessibility by industry and relevant institutions (e.g. SAPS) to expand management possibilities associated with animal identification, that can monitor unauthorised movement of animals. DNA technology that can be a deterrent for stock theft (e.g. Lid Cat) and for forensic investigations
3. Climate-smart livestock production (adaptation and mitigation for sustainable livestock production)	Understanding of the behavioural and physiological climate-related effects such as heat stress on livestock reproductive efficiency and overall productivity The effect of climate change on production (weaning weight and post-weaning performance) and fertility is quantified	The effects of climate change on production and reproduction are understood and mitigation strategies are developed
4. Breeding for adaptation and to reduce the environmental impact	Breeding and release of new forage and pasture cultivars with higher nutritive quality, less CH_4 emissions during rumen fermentation, resistance to diseases and pests, and tolerance to limiting conditions (soil fertility, drought and low water availability, high temperatures)	New forage and pasture cultivars available, with higher nutritive quality and resistance to diseases, insects and tolerances to limiting conditions (low fertility, drought and low water availability, heat stress etc.) and competition from other plants (weeds and mixtures) to optimise the efficiency of utilisation of veld by livestock
	Breeding objectives/selection criteria that (1) improve cow-calf efficiency, (2) increase production per animal unit by improving productivity, and (3) result in less GHG per unit of product. Alternative feedlot traits (breeding objectives) that will improve efficiency and reduce the environmental impact Early-in-life and other indicator traits and selection criteria/breeding objectives to improve fertility in beef cows	Reduction in the carbon and water footprint from livestock due to improved productivity, including fertility.
5. Manipulation of nutrition/ nutrients to reduce methane/ nutrigenomics	Prediction models developed to estimate methane production from feed quality and nutritive characteristics Use of feed additives (e.g. Ionophores) and other methods to enhance propionate production in the rumen at the expense of methane as hydrogen acceptor	Long-term strategies to suppress methane production, without detrimental effects on the performance of the animal, have been developed. Methane production by ruminants is reduced via nutritional approaches

6.	Baseline information – carbon and water footprint; effect on biomes and land cover	Techniques to accurately measure GHG, carbon sequestration and the water footprint Database of national and regional emission figures that is regularly updated according to international (IPCC) specifications in order to evaluate carbon sequestration and the water footprint Methane results primarily from enteric fermentation of plant material in the digestive tract of animals and its emission is a concern and its should be reduced in livestock farming.	The livestock sector understands the release of GHG (i.e. the carbon footprint) and water use (i.e. the water footprint) and has developed strategies to ensure future sustainability
		Effect of climate change on the biomes, land cover, nutrition and food security in terms of ruminant feed availability, and stability of human food supplies is understood	The effect of climate change on food securityis understood, since climate change is associated with changes in temperature, relative humidity, rainfall distribution, etc.
7.	Effect of climate change	Seasonal/early warning systems are developed that can inform farmers in time of the prospects of the coming year/season	Farmers adapt the strategies according to the expectations of the coming year/ season, and thereby mitigate the effects of climate change.
8.	Creating an enabling environment – policy/legislation, programmes, implementation plans	The implications of a carbon tax and offset system for the red meat industry in South Africa are quantified	Proper evaluation of policies and trade agreements to measure the possible implications for the industry
		Policies are developed that are conducive to growth and wealth creation in the red meat industry, as well as protecting the environment Models and systems are in place to determine the impact of exogenous and policy changes	Support to government during trade negotiations that involves the red meat industry

3.4 PROGRAMME 4: SUSTAINABLE ANIMAL HEALTH AND WELFARE FOR THE RED MEAT INDUSTRY

3.4.1 Preamble

Animal health and welfare in South Africa fall under the control of the Department of Agriculture Forestry and Fisheries (has since June 2019 changed to Department Agriculture, Land Reform and Rural Development) and veterinary services (under various departments) in each of the provinces. The World Organisation for Animal Health (OIE) proficiency evaluation of veterinary services highlighted various deficiencies in the current structure of veterinary services in South Africa. This has led to a number of disease conditions re-emerging in South Africa that require urgent attention by more modern approaches. These diseases, among others, include foot-and-mouth disease, East Coast fever, brucellosis, PPR, contagious bovine pleuropneumonia, etc. They occur in the Southern Africa Development Community (SADC) region and require constant vigilance and elimination.

Furthermore, new challenges are being faced by the red meat sector on various fronts. On the animal health front, the emergence of quality assurance guarantees by various levels of consumers also need to be taken into account if market share is to be maintained or expanded. These include food pathogens, residues of an ever-increasing list of chemicals, antimicrobial resistance to antibiotics and freedom from disease.

The interaction of production animals with the environment and game species, especially with climate change, presents new disease challenges and potential epidemics. Producers will have to be aware and be prepared for these scenarios.

New and more holistic solutions to existing and newly emerging disease situations will have to be found. The reliance of animal health on chemical control of pathogens, the development of resistance of pathogens to these chemicals and the increasing cost of developing new chemical substance that can be used in pathogen/disease control, are all contributing factors.

The welfare of farm and wild animals is coming under more intense scrutiny by better informed consumers. Although great strides have been made in improving the welfare of our domesticated species, these practices will need to be made more transparent and a trusted and audited traceability system will have to satisfy the national and international consumer.

Animal health is of the utmost importance for the financial success (profitability) of farmers, which will naturally lead to food security in South Africa and the Southern African sub-region.

Substantiated disease control, residue and antimicrobial resistance (AMR) data that can be easily accessed and audited, will become even more important in order to facilitate international trade of products of animal origin.

Therefore, effective disease control strategies, residue monitoring and AMR monitoring form the basis of the future of animal production in South Africa. Research and development should concentrate on these factors to create an enabling environment for livestock producers to flourish and provide a safe and high-quality source of protein for an ever-increasing and demanding population.

P4 Elements for sustainable animal health and welfare for the red meat industry

ELEMENTS/CHALLENGES	OUTCOMES/OUTPUTS	INDICATORS
1. Animal welfare	Practical improvement of production systems to advance welfare on South African farms and communal animal production systems	Establishment of farming and processing practices that lead to the introduction and maintenance of acceptable animal welfare standards, according to good farming practice and profitability. (This is also essential for ensuring consumer acceptance and international trade in animal products)
2. Animal/pathogen/environment interactions (climate change)	Development of a comprehensive risk assessment and information system for disease control including pathogen resistance tracking Advising farmers on combatting pathogen resistance through proven technology and research findings	Knowledge of all the contributory (sufficient cause) factors, which contribute to the establishment and severity of diseases, to understand and control important diseases
	Identify the changes in the distribution of livestock diseases, disease vectors and parasites, as a result of climate change	Understand the immunological response, including at cellular and molecular level, to allow for better vaccine development Knowledge of vector/host/pathogen interactions that allow for the understanding of the epidemiology of diseases and thus enabling risk assessment
3. Diagnostics	Updated and new diagnostic technologies for the FMD virus, especially SAT strains, bovine brucellosis and Johne's disease.	The improvement of existing or introduction of new diagnostic technology to enable the rapid, precise, sensitive, reliable, practical and cost-effective identification of a range of diseases
4. Disease control strategies	Development of new vaccines initiated and existing vaccines improved	Effective, reliable and cost-efficient vaccines become available, using appropriate available technologies
	Control strategies developed that are sustainable, biologically sound, economically justifiable, ecologically acceptable, and internationally recognised	Alternative and complementary strategies are available to control diseases on a holistic, sustainable and integrated basis
	Development of a functional traceability system for livestock in South Africa	Animal identification and traceability system(s) that are cost-effective, easy to use, robust, reliable, and secure

3.5 PROGRAMME 5: SOLUTIONS, PROCESSES AND TECHNOLOGIES THAT WILL ENHANCE THE PRODUCTION AND PROCESSING OF ANIMAL PRODUCTS

3.5.1 Preamble

The consumer's decision to buy meat products forms the basis of and is the initiating event in the subsequent development of the red meat industry value chain. Due to the heterogeneous composition of consumer groups, consumers have widely divergent expectations of the product. Their understanding of "value" is the most important measure, i.e. the quantity and quality of the product relative to other types of food and consumer commodity options. In this value package the consumer requires a reasonable price in a marketing service that is attractive and contains the necessary information. Ultimately the consumer eats meat because he/she enjoys it.

The quantity and quality characteristics of red meat that eventually reach consumers are affected by one or more of the various pre-slaughter and post-slaughter factors. These factors are the genetics, physiology and environment of the animal, the slaughtering process; and finally the storage, processing, marketing and consumption conditions of the meat products.

3.5.2 Quality and value-adding

New knowledge is needed to understand the genetics affecting product development and to improve control and manipulation of physiological systems supporting muscling, growth, metabolism, and mammary function. Research will focus on identifying genes that influence product, factors directing nutrient partitioning toward protein and less fat to improve efficiency, enhanced nutrient composition, and improved meat tenderness in livestock products.

Innovative processes should be created and existing ones adopted to manufacture new or value-added products. Application of these innovative technologies could expand the range and value of livestock products and reduce the ratio of cost of production to market value.

3.5.3 Product safety

Among the desirable qualities of foods, is the absence of chemical residues, pathogens and spoilage organisms. Research is required for reliable and rapid methods to detect and eliminate pathogens and reduce the risk of chemical residues from drugs, food additives, herbicides, pesticides and environmental contaminants in or on livestock throughout the pre-harvesting and post-harvesting processes. Improved techniques and management procedures to extend product shelf life for both formal and informal markets are urgently needed. Monitoring and service programmes should focus on quality surveys, establishment of sustainable surveillance programmes, meat safety systems and the use of microbial indicators as food safety and quality standards to ensure safe foods.

3.5.4 Nutritional value

Information on the nutritional composition of foods and bioavailability of nutrients is essential for food programmes, preventative medicine and dietetics, and the provision of appropriate diets for individuals and communities. Extensive information is required for key, restaurant, fast and indigenous foods. These, in addition, need to be sensory-appraised to determine consumer acceptance and, where applicable, to recommend modification.

3.5.5 Alternative meat products

New technologies to convert processed by-products into useful value-added products are essential. The development of useful products from low-value and waste products such as slaughter offal and manure will increase the overall efficiency of utilisation.

3.5.6 Antimicrobial resistance

Red meat safety problems can cause either human illness or economic losses and threaten the international competitiveness of agricultural products. Red meat safety, and in particular the control of food-borne pathogens and residues, must therefore be an important concern in research programmes. Red meat safety links with quality/value to support food security and a healthy diet. Studies to maximise quality/value and identify nutritional and medicinal attributes in indigenous and other substances are also important.

P5 Elements for solutions and technologies that will enhance the production and processing of animal products

ELEMENTS/CHALLENGES	OUTCOMES/OUTPUTS	INDICATORS
1. Quality and value-adding	Consistency of quality ▪ Genetic variation in meat quality ▪ Improved eating quality ▪ The role of low-stress handling and transportation	Increased understanding of the factors that influence the tenderness and taste of red meat, towards consistency of eating quality
	Classification simplified	Applicable technologies are available
	Effects of dry ageing of older cattle Access to consistent information to enable informed consumer choices	Alternative options are available for the consistency of tenderness in older cattle
2. Product safety, zoonosis and nutritional value	Decontamination and other techniques to improve shelf life Early detection (reliable and rapid methods), monitoring and elimination of pathogens	Decontamination and other interventions to improve shelf life is applied or accepted in South Africa
	Improve design and production processes in the production and processing of animal products	Major changes in design, slaughter and dissembling techniques to improve meat safety is available
	Relevance of current methods of meat inspection for *T. saginata* and *T. solium* Inspection techniques and interpretation, inclusive of invasive techniques (e.g. shoulder cuts) which influence product safety, is being addressed	Major changes occurred in production systems and process control to decrease the incidence of measles and increase product safety
3. Nutritional value	The composition, quality and bioavailability of nutrients in red meat and red meat products is quantified Information of nutrient density of red meat and red meat products	Extended dietary guidance to enhance public confidence in animal food supply and to improve the scientific basis for more effective food assistance programmes by making available a comprehensive database to dieticians and nutritionists
4. Alternative meat products, including 5th quarter (red meat products and by-products)	Improved carcass yield with emphasis on new products New technologies to convert by-products, e.g. micro-rendering/composting with investigation into safety of products	Useful products from low-value and waste products such as slaughter offal and manure to increase the overall efficiency of utilisation
5. Antimicrobial resistance	An evaluation of current use pharmacological products in red meat production Technology transfer in the responsible use of veterinary products Disease risk management as part of safe meat production	Pharmaceutical products are used responsibly and practises, monitoring programs and consumer assurances are in place for both local and international clients

3.6 PROGRAMME 6: CONSUMER AND MARKET DEVELOPMENT OF THE RED MEAT SECTOR

3.6.1 Preamble

Red meat research and development forms part of the essential functions identified by the Red Meat Industry Forum (RMIF) as crucial to maintain a viable red meat industry. In the past few years the RMIF's members and its constituents became more interested in the research and development done by Red Meat Research and Development SA (RMRDSA). Research and development form an integral part of the red meat industry and any industry per se. The focus of the programme is therefore to revisit market and consumer development in the red meat sector. Market and consumer development are not research elements as such, but rather operational elements. The specific focus of this programme would therefore tend to favour development rather than research.

3.6.2 Market development

It is imperative to understand the exact context and within which parameters this programme focuses on market development. "Market development is a strategic step taken by a company to develop the existing market rather than looking for a new market. The company looks for new buyers to pitch the product to a different segment of consumers in an effort to increase sales." (The Economic Times)

Market development is a two-step process to tap the "untapped" market. As an initial step, the research of internal and/or external markets should be done as well as a segmentation analysis. The second step would then be to identify the market segments that are worth pursuing.

It is an attempt to use the existing product (South African red meat) or service to attract new customers. The goal is to expand the reach or tap into a different segment or unexplored market, and in this case it is to reach previously unexplored or inaccessible markets or segments.

3.6.3 Consumer development

The second pillar of the programme rests on the consumer. A consumer is regarded as the king in modern marketing. In a market economy, the concept of the consumer is given the highest priority, and every effort is made to encourage consumer satisfaction.

However, there might be instances where consumers are generally ignored and sometimes they are even exploited. Therefore, consumers come together to protect their individual interests. It is a peaceful and democratic movement for self-protection against exploitation. Consumer movement is also referred to as consumerism. The aim of this portion of the programme would be to investigate the extent of consumerism among the South African and international consumers, and the status of the red meat industry's efforts to meet the consumer's needs.

Advertising and technology are the two driving forces of consumerism. Advertising is connected with the ideas and thoughts associated with the product, which influence the consumer to buy the product. Through advertising, the consumer gets the necessary information about the product he wants to buy.

Technology is improving rapidly. It is necessary to check the environment on a daily basis because it is dynamic in nature. Products should be manufactured using new technology to satisfy consumers. Old and outdated technology will not help manufacturers to sustain their businesses in the long run.

In its most recent statutory levy application the RMIF requested a levy for consumer communication and education on the following basis: "The South African domestic market is the largest market for South African beef, lamb, mutton, and goat meat. Over the past decade, growing income levels, sustained trends of urbanisation and improved living standards have supported dietary diversification in South Africa, resulting in the inclusion of more protein in typical diets and rapid growth in meat consumption." (BFAP Baseline Agricultural Outlook 2017–2026).

Consumption is expected to expand and thus consumer communication and education remain a core focus for the RMIF. Communication and education activities are undertaken on behalf of the South African red meat industry and emphasise the nutritional and health qualities, the full enjoyment value, versatility, and convenience of South African red meat products in balanced diets.

The educational data is communicated across the spectrum of consumers and their families to build and maintain a positive image of South African red meat as a healthy, enjoyable, safe food choice that is sustainable in the long term.

It is clear that consumer education and communication are a very significant part of the research and development environment. Until recently the RMIF based its consumer information and communication on its own views of what needs to be communicated and not necessarily what the consumer would like to know. It is imperative form the development outlook going forward to include surveys to put an end to expensive guesswork and focus on the real consumer. Therefore the aim is to reassess who, what, and where our markets is, and the true facts regarding it.

P6 Elements for consumer and market development of the red meat sector

ELEMENTS/CHALLENGES	OUTCOMES/OUTPUTS	INDICATORS
1. Market development and trade, including export	Identifying possible international markets Review possible export markets accessible to South African red meat producers, including bench-marking Create the unique selling proposition that SA red meat needs to compete internationally and produce in a cost-effective way, thus optimising profits throughout the value chain Create a sustainable red meat framework and certification model for international participation – South African red meat standard	The slowdown in national consumption is turned around International markets, which are currently unexplored, is explored and stimulated
2. Consumerism and customer behaviour	Developing a survey to understand the mind-set of the South African and international consumer of red meat	The red meat fraternity gains a better understanding of its consumers, and will be better equipped to exploit the market
3. Consumer education and development	Making the nutritional value of red meat known to consumers, using scientific research in an understandable format	The red meat fraternity opens up on issues that were previously considered taboo in a manner where they can dictate the narrative, rather than trying to explain one another's narratives

3.7 PROGRAMME 7: COMMERCIALISATION OF THE EMERGING SECTOR

3.7.1 Preamble

The small-scale and emerging sectors consist of mostly semi-commercialised producers, subsistence farmers and households that have limited access to resources. This sector holds at least 40% of the livestock and could be developed to improve national food security. The ability of smallholder farmers to exploit the full potential of their livestock is limited by infrastructure, limitations in management, inadequate feed resources, and inadequate strategies for genetic improvement of their livestock and record-keeping. Farmer time is used ineffectively, and as a result many either remain trapped in unsustainable systems or they retrogress.

The current South African land reform policies promote disaggregation of land in order to attain the transformation mandates in land ownership. However, for the newly-established as well as existing smallholder farmers to be competitive in the mainstream markets, they require economies of scale to complement established commercial systems on equitable terms. About 4,9 million ha of land was acquired for agricultural purposes and settlement and the target for 2030 is to have at least 8,4 million ha transferred in order to improve food security. That land needs to be farmed in a sustainable manner.

This calls for the adaptation of farming systems and strategies using trans-disciplinary and participatory approaches to achieve the National Development Plan (NDP) goals.

3.7.2 Context of the emerging sector in South Africa

The areas of focus for R&D are the formerly commercially farmed areas, or under-utilised land that was allocated to decongest communal areas that are now degraded and underperforming agriculturally. The department of agriculture, land reform and rural development is prioritising farmer support through infrastructure and service support together with partners like the Land Bank and other industry players. Research, however remains the scope of industry and partners in development. The status quo on land utilisation is not fully understood and integration of farmers in the value chain is still limited to primary levels. Most of the areas are, however, in semi-arid environments and mostly suitable for grazing. There is a critical need to speed up the pace of transformation in the red meat industry to change lives for the better and assist businesses in the value chain.

3.7.3 Target goals in commercialisation

The target goals for commercialisation are as follows:

- To actively engage small-scale and emerging commercial farmers in the technology-driven red meat production businesses
- To increase animal productivity and enterprise profitability through breeding, genetics and production system management
- To develop strength and resilience so that farmers become reliable market players

3.7.4 Cross-cutting research and development programmes

The cross-cutting issues, identified from programmes 1 to 6, are as follows:

- To improve efficiency of production systems
- To model projections of livestock business growth
- To develop and implement systems for rural disaster management (climate)
- Structured training and mentoring of livestock farmers in application of agriculture technology
- To initiate and implement online farmer register aligned to input and output markets and regulatory framework
- To support new business development aligned to technology-based agriculture

P7 Elements for commercialisation of the emerging sector

ELEMENTS/CHALLENGES	OUTCOMES/OUTPUTS	INDICATORS
1. Capacity development	Knowledge and skills development	Improving soft and hard skills management and technical skills developed
2. Management of natural pasture management	Rangeland condition assessment and rehabilitation (including management of invasive species)	Protection of the environment (in terms of ecosystem, wetlands, and prevention of erosion and pollution) and maintenance of biodiversity Widespread neglect and degradation of grazing land has been reversed
3. Breed improvement	Genomics and technological application to improve animal performance	Breeding objectives and proper gene flow plans, to secure the commercialisation and utilisation of animal genetic resources
4. Nutrition and supplementation	Supplementation programmes for higher efficiency in different production systems	Production potential of rangelands is optimised by making available adapted, nutritious, and highly productive forages
5. Improving efficiency and effectiveness through technological application in production and market access	Improving access to financial services by increasing access • Provision of information: prices and weather, production techniques • Enhancing access to markets by strengthening links between buyers and sellers through mobile trading platforms	Smartphone-enabled services that improve efficiency and effectiveness of livestock operations, while reducing the environmental degradation and carbon footprint Farmers have access to updated information on agricultural practices, weather forecasts and market prices and solutions for reducing production losses

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