VCA4D
VALUE CHAIN ANALYSIS FOR DEVELOPMENT

agrinatura for European Commission

Beef value chain analysis in eSwatini

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January 2019

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LA RECHERCHE AGRONOMIQUE POUR LE DÉVELOPPEMENT

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Value Chain Analysis for Development (VCA4D) is a tool funded by the European Commission / DEVCO and is implemented in partnership with Agrinatura.

Agrinatura (http://agrinatura-eu.eu) is the European Alliance of Universities and Research Centers involved in agricultural research and capacity building for development.

The information and knowledge produced through the value chain studies are intended to support the Delegations of the European Union and their partners in improving policy dialogue, investing in value chains and better understanding the changes linked to their actions

VCA4D uses a systematic methodological framework for analysing value chains in agriculture, livestock, fishery, aquaculture and agroforestry. More information including reports and communication material can be found at: https://europa.eu/capacity4dev/value-chain-analysis-for-development-vca4d-

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The report was produced through the financial support of the European Union. Its content is the sole responsibility of its authors and does not necessarily reflect the views of the European Union.

The report has been realised within a project financed by the European Union (VCA4D CTR 2016/375-804).
Citation of this report: Wane, A., Boureima, F., Ndlovu, F. Morton, J.; 2018. Beef Value Chain Analysis in eSwatini. Report for the European Union, DG-DEVCO. Value Chain Analysis for Development Project (VCA4D CTR 2016/375-804), 136 pages.

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List of acronyms

ALCS: Annual Livestock Census Summary
CH4: Methane
CO2: Carbone dioxide
CO2eq: Carbon dioxide equivalent
DALY: Disability-Adjusted Life Year
E' or SZL : E mangaleni or Lilangeni is the national currency of the Kingdom or eSwatini[1]
EMEP/EEA: European Environment Agency
FAO: Food and Agriculture Organization
ICCPR: International Covenant on Civil and Political Rights
ICESCR: International Covenant on Economic, Social and Cultural Rights
ILO: International Labour Organization
IPCC: Intergovernmental Panel on Climate Change
ISO: International Organization for Standardization
IYSIS: Inyoni Yami eSwatini Irrigation Scheme
Kg: kg
kWh: kilowatt-hour
LCA: Life Cycle Assessment
LCI: Life Cycle Inventory
LCIA: Life Cycle Impact Assessment
LEAP: Livestock Environmental Assessment and Performance Partnership
LUSIP: Lower Usuthu Smallholder Irrigation Project
MDGs: Millennium Development Goals
MoA: Ministry of Agriculture
m3: cubic meter
N2O: Nitrous Oxide
OSH: Occupational Safety and Health
PDF*m2*yr: Potentially Disappeared Fraction (of species) * square meter * year
SACU: Southern African Customs Union
SANHA: South African Halaal Authority
SAPAWU: eSwatini Agricultural, Plantation and Allied Workers Union
SDGs: Sustainable Development Goals
SMI: Swazi Meat Industries
SNL: Swazi Nation Land
SWADE: eSwatini Water and Agricultural Development Enterprise
TDL: Title Deed Land
TUCOSWA: Trade Union Congress of eSwatini
UNDP: United Nations Development Programme
VGGT: Voluntary Guidelines on the Responsible Governance of Tenure
WFP: World Food Programme

[1] The Lilangeni is strongly pegged to the Rand the national currency of South Africa. The exchange rate of the Lilangeni/Rand was volatile during the year 2016, but generally weakened against the major currencies. The local unit ended the year 2016 at E13.63 to the US dollar, and E14.35 to the Euro. During the first quarter of 2017, the Lilangeni strengthened against the major currencies; averaging E13.23 to the US dollar and E14.10 (Central Bank of eSwatini, Annual Report – April 2016 March 2017).

Overall purpose

EC/DEVCO is involved in supporting investment projects and policy dialogue (within budget support or other assistance schemes). Value chains (VC) are a major channel for agricultural development. They represent an operational framework for engaging with farmers and business. Analyzing VC allows understanding of important impact pathways and tracking of how development actions contribute to SDGs and EC/DEVCO strategic objectives.

Goal of the methodology: To provide evidence-based elements (supported by indicators measured quantitatively or based on expert assessments) allowing answers to **4 framing questions**:

- **What is the contribution of the VC to economic growth?**
- **Is this economic growth inclusive?**
- **Is the VC socially sustainable?**
- **Is the VC environmentally sustainable?**

Information in accordance with these key objectives will serve the EU international cooperation and development strategy as well as all interested decision-makers involved along the chain.

The analytical process is based on four steps: functional analysis, economic analysis, environmental analysis, and social analysis. Functional analysis is a common starting step and is refined throughout the study, benefitting from and informing the other analyses. The three other types of analysis are run in parallel, with important common elements (especially in data collection, e.g. data gathering jointly by the economic and environment specialists).

The purpose is to gain insights, in a process with stakeholders, of the way the VC is working regarding its competitiveness and viability and its impact on the 4 framing questions.

- **The goal is to provide decision-makers with a range of information that relates to sustainable development strategies.** It is oriented to the needs of EC as an aid provider, informing also policy makers and stakeholders.[2]
- **The expected output will be informing on the 19 core questions and formulating the appraisal on the 4 framing questions.**

A methodological decision was made not to aggregate the knowledge elements into one global appraisal or a single indicator. Informing decision-makers on each of the 4 framing questions will allow them to make their own judgement.

Furthermore, the expert appraisal on these 4 framing questions must consider a set of 19 core questions that shed light on actual dimensions of impact.

[2] It is not intended to deliver a full scientific study work on all aspects of the VC but may open the possibility to be complemented on some relevant issues by other works (e.g. emphasis on technological or management diagnostic at some stages of the chain, further understanding of the stakeholders perception on some issue such as climate change, etc.); however this will be done additionally and independently to the consultancy contract, unless specific circumstances are clearly set with DEVCO/C1.

Executive summary

As with many countries in Sub-Saharan Africa, the livestock sector in eSwatini is characterized by a strong dualism between "commercial" and "communal" livestock keepers and between "modern" and "traditional" systems. For a long time, livestock production systems in communal land has been the subject of several myths and misconceptions. In the best-case scenario, comments like "livestock are part of us", "you cannot separate us from livestock" were often heard, with "livestock" referring pre-eminently to cattle. In the worst-case scenario: "this is a practice of another era that deteriorates the environment; its actors are contemplative and conservative; its activities are archaic, backward, useless, irrational, disrupting and most of all economically inefficient, and its contribution to the national economy ill-defined," etc. Some such clichés remain very much alive in eSwatini. In the face of such bias, one of the main objectives of the economic analysis on livestock systems in eSwatini is to rigorously examine the viability of the livestock value chain and the potentials for increasing its performance (efficacy and efficiency) in a sustainable manner. It is therefore important for development orientated research, and its related interventions, to be, not just technically feasible and socially acceptable, but also economically viable and environmentally sustainable. That is the pursued objective in the framework of the VCA4D developed by the EC/DEVCO.

However, analysing the economic performance of the Swazi Beef Value Chain requires a clear identification of the objectives of all stakeholders of the chain with a focus on small-scale production, the starting node of the chain. Generally, there are two main objectives. The first objective posits that the ultimate finality of livestock activity is to produce milk and meat products that are marketable on national and international markets. The second asserts that their true vocation is to guarantee food security and to secure livelihoods. Combining the two objectives to improve both the performance of livestock activity and actors' income would be ideal. In practice, the general trend is to make livestock production meet the needs of national demands, and even the needs outside eSwatini's border.

Whichever the case, choosing either of the two objectives stated above would determine the type of economic evaluation to conduct. The EC/DEVCO has opted for the approach that provides evidence-based elements (supported by indicators measured quantitatively or based on expert assessments) allowing answers to **4 framing questions**:

- **What is the contribution of the VC to economic growth?**
- **Is this economic growth inclusive?**
- **Is the VC socially sustainable?**
- **Is the VC environmentally sustainable?**

How has this study been undertaken?

This comprehensive study combines economic, social and environmental approaches is based on an extremely in-depth analysis of literature on the livestock sub-sector in eSwatini, and occasionally in Sub-Saharan Africa more generally, and primary data collected by the team of experts as well as on the mining of secondary data collected by NGOs, multilateral institutions, State technical departments and research institutions.

The EC/DEVCO and the team of experts first met in Brussels on the 6th and 7th September 2017 to discuss on methodology to implement and appropriate software to use. Then, interviews were held with many actors of the beef value chain during two field visits (from September 21, 2017 to October 6, 2017 and from November 7 to 17, 2017) to pinpoint as accurately as possible the main quantitative and qualitative indicators as well as their dynamics.

Reasoned analysis was undertaken based on the information available from development and research institutions. To finalize the study, the observations and comments that were made during a debriefing meeting with DEVCO were then integrated to improve the economic, social and environmental analyses.

The Kingdom of eSwatini is geographically and demographically a small landlocked country that hosts a population of over 1,018,499 people, among which 47% of males and 53% of females. This country is bordered by South Africa on the north, west and south, and Mozambique to the east.

Over the two last decades, the real GDP growth is dominated by the tertiary sector (48% on average) followed by the secondary sector (38%) and the primary sector (11%) which is continuing to decline even if agricultural activities continue playing an important role as a source of exports. Weather shocks sharply affected the primary sector in 2014/15 and 2015/16 seasons which still largely depend on rainfall, while irrigated systems faced severe difficulties as dam levels fell to significantly low levels for supporting effective irrigation. Despite this negative event on the livestock production side (high mortality rates), the country reversely experienced a livestock marketing bounce back as farmers who are usually cautious in livestock markets destocked their cattle in 2015 and in the first half of 2016.

eSwatini's trade is highly and increasingly dependent on South Africa (in 2016, 81% of total imports in 2016 and 67% of exports and in 2017, 85% for imports even with an expected decline of exports to 60%). The main exports of eSwatini include beef meat to neighbouring countries and mostly in Norway with which formal trade agreement frame the trade relationships.

80% of rural households in eSwatini own livestock. Despite its economic and cultural importance, a profound dualism remains perennial in the primary sector as well as the land tenure system. Even if perimeters remain unclear both population and policy and economic dynamics tend to displace the borders, the Swazi National Land (SNL) also called communal land occupy 60% of the territory, the Title Deed Land (TDL) 39% and the Crown Land 1%. The communal systems are characterized by open grazing, low off-take rates (both slaughters and sales), and low technical efficiency measures (calving rates, mortality rates etc.).

Relationship between SNL cattle production and rural livelihoods in general is the proportion of the SNL population who own cattle. The proportion of homesteads owning cattle may be anywhere between 40% and 50%, with considerable regional variations.

eSwatini's ruminant sector is dominated by cattle. The national herd has stagnated at about 600,000 head that fits the country's carrying capacity. However, the beef value chain in eSwatini presents a complex structure that could be divided into four stages. The primary stage for cattle production, characterised by non-market and market-oriented small producers and ranches on SNL and TDL; a secondary one for fattening operations by feedlots, and state-owned or private ranches; a tertiary one for the slaughtering and processing operations (abattoirs, butchers); and a forth dealing with distribution operations (retailers, supermarkets, butchers, meat shops, etc). Some integrated ranches operate at various stages and each group differs as to expectations, norms and daily practices.

The amount of beef produced from commercial cattle slaughtered at 33% in 2017, from home slaughtered at 57% and from export industry monopolistically dominated by the Swazi Beef Industry at 10%. However, beef imports remain relatively high to satisfy growing local demand for beef products.

What is the contribution of the VC to economic growth?

For the economic analysis and as for many countries in Sub-Saharan Africa, the contribution of the beef value chain in the overall national wealth generated in eSwatini, is usually underestimated. The total annual value of the beef value chain is **E' 1.204 billion**, its **direct** and **indirect** contribution to eSwatini's GDP is **2.0%** both at constant 2011 prices and at the current value. The beef value chain contributes **32% to the overall Ag GDP** of the country.

Through the taxes collected in the chain (that also benefits from State subsidies), the beef value chain positively impacts the public finance with a contribution of **E' 59.6 million**.

However, with a system based on export of high value beef product mainly to Norway and import from South Africa and Mozambique to meet with a growing local demand, the beef chain contributes negatively to the balance of trade with a **deficit of E' 329.8 million**.

Regarding the economic sustainability of the beef value chain at the international level, the situation is mixed as the **Domestic Resource Cost (DRC) of 1.660** indicates an inefficient use of local resources. The **Nominal Protection Coefficient (NPC) of 1.171** shows that the beef value chain is fully protected while the **Effective Protection Coefficient (EPC) of 0.629 shows that the net impact on output and input of government policy is to constrain the beef value chain, to have a value added in market prices37% lower than the value added without transfers (as measured in world prices).** Thus, **transfers as the difference between market prices and international prices, are more important on the inputs than on the output**.

Despite its valuable contribution to the GDP, the beef value chain does not escape the overall country's situation characterized by a pronounced uneven income distribution. The tabulated **Gini index for the Beef value chain is largely higher than 50% reaching 80%** during our investigation period.

Is this economic growth inclusive?

The lack of inclusiveness of the value chain could be explained by the strong dualism in the whole system. This led the market-oriented component of the chain to develop formal contractual arrangements for which the non-market-oriented component is not well prepared. Most smallholders in eSwatini still have an objective function that is a composite utility function that balances their short-term consumption needs and long-term herd building strategy to meet future consumption. Consequently, this opportunistic approach vis-à-vis the market has a serious impact on income generation and inequality. The complexity of the Beef value chain in eSwatini is also reflected by the variety and diversity of the tacit and implicit arrangements between the main actors. These could be **hierarchical** as observed at the level of integrated business (ranch farming), **contractua**l notably when formal actors are involved (ranch farming, beef export business) as well as **market-driven** when actors bargain to buy or sell animal products.

The beef chain in eSwatini shows great potential in job creation for the country as it provides **direct waged employment to 62,067 people**, **almost 13.5%** of the total labour force. Among them, **58.7% work part-time** while **41.3% benefit from full time remunerated jobs**.

However, these 62,067 individuals remunerated in the beef value chain do not count smallholder households who keep their own cattle. It should be noted that in the livestock sector and more specifically in small-scale households, the non-remunerated workforce remains an important component of the reality of the work in the primary sector.

Is the VC socially sustainable?

Questions on the social sustainability of the beef value chain must be interpreted very differently for the Swazi Nation Land and the Title Deed Land. 40-50% of the rural Swazi population, dispersed over the entire SNL, practice cattle production which at least intermittently sells into the beef value chain, and its social and cultural importance reaches further still. It is not therefore always possible to distinguish between social aspects of the value chain and social aspects of the rural economy in general.

Working conditions in the value chain are generally positive, due to the relatively strong legislative framework which applies to formal sector enterprises, with regulations on, as minimum, wages and occupational safety and health generally respected or exceeded. No major risks were identified. In the SNL traditional role expectations govern the labour of cattle production (for example paid herders live as quasi-family members). The chief risk is that rural youth may increasingly drift away from cattle production. Mitigating measures would include continued observation of international norms and enforcement of policies, monitoring/research on working conditions in small and informal businesses, and training for youth on skills needed in the value chain.

On **land and water rights**, while a large-scale shift in use of SNL areas to commercial ranching is unlikely under current economic conditions, there is a current lack of transparency on acquisition of use rights for commercial investment on the SNL (and compensation for it). This presents some risk of effective expropriation, damage to livelihoods and knock-on increases in grazing pressure elsewhere in the system.

The risk is exacerbated by the long-running failure to approve a national policy on land. For the SNL, many observers assert that the communal nature of grazing access *per se* presents a risk, but the bigger risk highlighted by our study is that of encroachment on communal grazing lands by homesteads and cropping. Mitigating measures would include broader and deeper policy discussion on a land policy that can serve growth objectives while protecting SNL livelihoods, and measures to slow down urban-rural migration and consequent additional pressure on grazing lands.

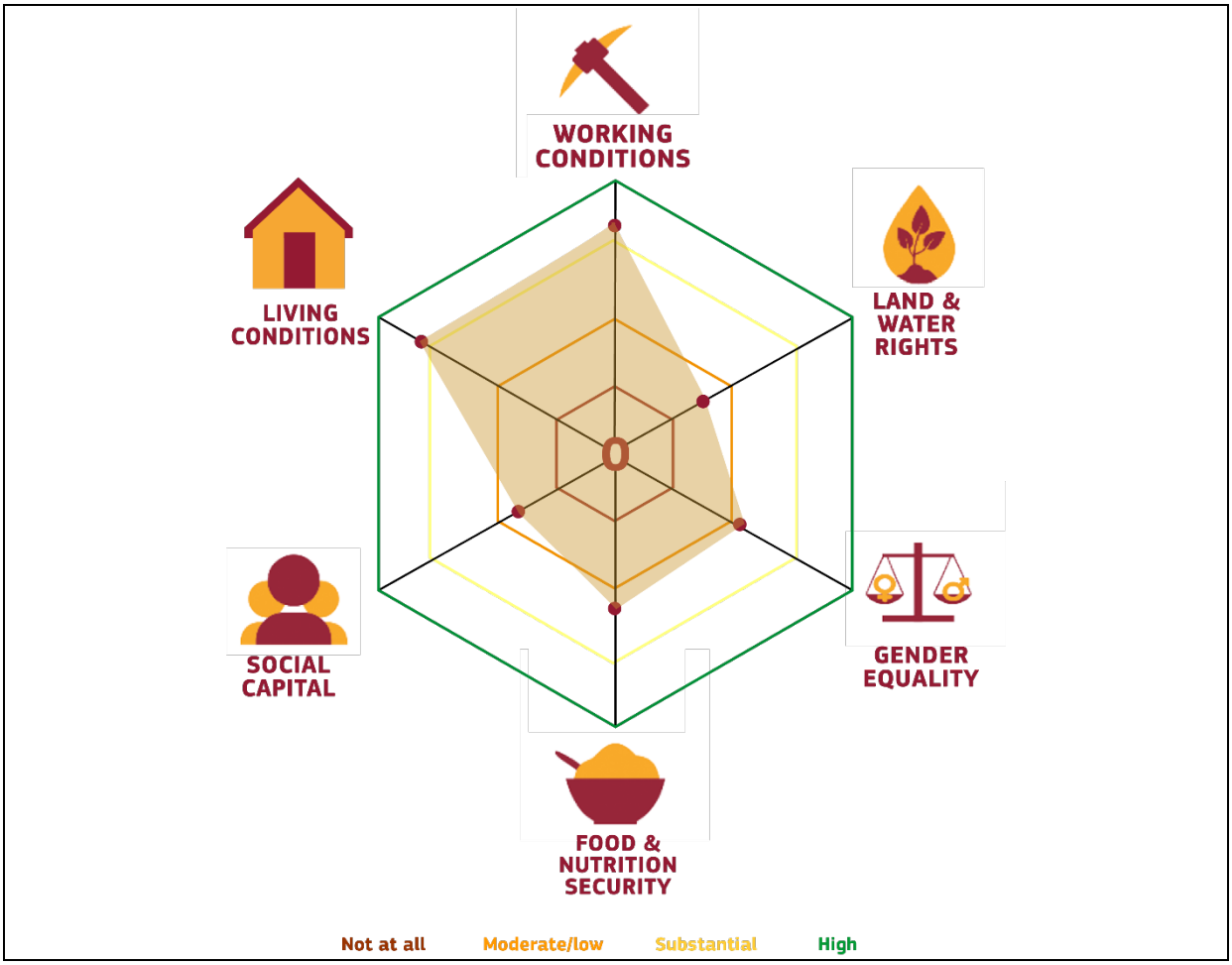
On **gender equality**, there are significant risks of continued exclusion of women from value chain roles other than cattle production on the SNL, and exclusion from opportunities for improved cattle production (including reduced drudgery), and from participation in household and public decision-making. These risks are rooted in traditional structures of rural Swazi society, and to some extent are being addressed long-term by encouragement of girls' primary and secondary education. More immediate mitigating measures would notably include value chain skills training for women, and improved provision of services and credit to both women and men cattle producers on the SNL.

While national indicators of **food and nutrition security** are low, there is evidence that cattle-ownership is associated through various mechanisms with better food and nutrition. *Well-managed* initiatives to increase offtake from the SNL through improved calf survival and faster growth of male animals to a marketable weight might increase the food security of cattle-owning households, and possibly increase the proportion of such households in the rural population. If not well designed, there might be risks to equity. Mitigating measures would include erasures for improved efficiency and equity in the beef value chain, more policy recognition of nutritional benefits of SNL cattle production, and better drought management policies.

On **social capital and information**, the authors found very low levels of farmer organization in either cattle production or primary marketing (despite successful examples of collective action in other spheres), and very low levels of trust in the value chain, with associated risks of missed opportunities for improved cattle productivity, and improved efficiency and equity of the beef value chain. Mitigating measures would include, research on reasons for absence of producer associations, accelerated development of market information systems for SNL farmers, and establishment of industry fora with representation from along the value chain, including SNL farmers. In the longer term it would also be important to continue to develop local planning institutions, at chiefdom level and higher.

On **living conditions**, including health services, housing, water supply, sanitation and education, eSwatini is making general progress. Participation in the beef value chain for rural people is either neutral or positive (especially in the case of education) for these aspects of well-being, and the authors see no major risks for development of the value chain.

The social analysis is summarized in the following figure:



In terms of economic inclusivity, further development of the beef value chain has the potential to reach a very substantial proportion of the rural population, although it is unlikely ever to reach the poorest in the rural areas and will have to be supplemented with many other forms of development, including social safety-nets and small ruminant development. Development of the beef value chain can build on knowledge and skills in an activity already well-known to the population.

For the social sustainability of value chain development, certain policy principles must be respected:

- Recognition of the multi-functional nature of cattle in Swazi livelihoods, including the importance of draught power, manure as fertilizer, family consumption of milk, and cash income to meet urgent household needs.
- Recognition of the strong seasonality of SNL cattle supply, in large part an effect of the use of cattle to pay education fees. Ways should be found to work with, rather than against, this seasonality.
- Recognition of both the potential of communal management of grazing and the current threats to it, including encroachments by homesteads and cropping.
- Respect for farmers' knowledge and existing objectives, a principle often lost in the development imperative to train farmers and mold their behaviour.
- Recognition of the structural nature of drought, which will only increase with projected climate change, and the need for specific policies to manage the effects of drought on the livestock.
- Recognition of the current low levels of information and trust within the value chain, requiring both well-designed market information and longer-term measures such as fora for discussion between different value chain actors.

In the environmental analysis, the so-called Life Cycle Assessment (LCA) methodology has been used to quantify the environmental impact of 1 kg of beef carcass produced in the two main Swazi beef production systems namely the Swazi Nation Land (SNL) and the Title Deed land (TDL) systems.

For each production system, two scenarios were considered:

- The production, the slaughtering and the distribution of beef in eSwatini for the local market.
- The production, the slaughtering and export of the beef to the EU Market. For the export scenario, the transport of the beef from the Matsapha export-licensed slaughterhouses to the South African boarder by refrigerated truck was considered.

To collect the needed data to perform the analysis, a data gathering template has been developed. It includes all the value chain stages from the feed production until the distribution/the export through the farming, the fattening and the slaughtering. For each stage of the value chain, the main inputs taken from the nature (natural water, land…) and the techno-sphere (feed, energy, tap water, chemicals…) and the outputs (beef, emissions, wastewater…) are considered. This input-output information is collected mainly from the literature (secondary data) and from national stakeholders.

For the production phase, the national herd composition (including the percentages per animal category with respect to the age, the average weight and the sex) has been considered for the two production systems (SNL and TDL). Furthermore, a whole farm modelling approach has been used to estimate the input consumption, and the corresponding produced live weight beef, with respect to the productivity performances (birth rate, mortality rate, off-take rate…) of the two production systems for a one-year period. The direct on-field emissions (methane from enteric fermentation, methane from manure management, N2O emissions from grazing and volatilisation, NH3 and NOx emissions from nitrogen excreted by the animals) have also been considered. IPCC 2006 Tier 1 default emission factors have been used to calculate these on-field direct emissions because of the lack of country-specific data.

For the fattening phase, two scenarios were looked at:

- A three-month fattening scenario has been considered for the SNL system. The data from this scenario is collected from a cost-benefit analysis of fattening operations performed by the Swazi Ministry of Agriculture. However, the feed efficiency of this analysis and the duration seem to be very optimistic and the induced results should be interpreted with caution.
- A more realistic feedlotting scenario has been considered for the TDL system. Detailed primary data on the fattening operation including site specific feed efficiency were collected from one of the most important commercial ranches in eSwatini. This second scenario is more realistic and would reflect a more realistic contribution of feedlotting operations to the overall impact of the Swazi beef value chain.

For the slaughtering operations, primary data were collected from a small local slaughterhouse. The contribution of the slaughtering phase is almost zero. The variation of the size will not influence the results. If we were comparing different abattoirs, then the size would be more important.

This data was used to model the slaughtering of an animal from SNL that was distributed on the local market. Unfortunately, no physical flows (energy, water, chemicals, wastes…) were found for the sole export licensed slaughterhouse. Secondary data from a detailed cost benefit analysis of an Ethiopian export slaughterhouse have then been used as a proxy to model the slaughtering of TDL animals for the export market. The use of this proxy should be considered when interpreting the results. However, the contribution of the slaughtering process to the overall impact is low. The carcass weight percentage which is one of the most important parameters of this phase is the same as in Swazi slaughterhouses.

The beef distribution in local butcheries has been modelled with primary data collected from a local butchery. For the export scenario, the impact of a refrigerated transport of the beef from the Matsapha export slaughterhouse to the port of Durban was considered.

An economic allocation (distribution of the generated impacts between the different co-products of a product system) based on the unit prices of the different co-products and the mass balance of a slaughtered cattle has been used as suggested by the Cattle Model Working Group of the EU Product Environmental Footprint project. 89% of the overall impacts are allocated to the beef carcass. The remaining 11% are divided between the offals', the hide, the head and the hooves.

Finally, the ReCiPe 2016 calculation method has been used to calculate the impacts of the two production systems on the climate, the human health, the resource depletion and the ecosystem quality (Huijbregts et al, 2016). The following results have been obtained:

- Climate change: 99.74 kg Co2eq/kg beef carcass and 55.87 kg CO2eq/kg beef carcass respectively for the SNL and the TDL production systems
- Human health: 1.06 E-04 DALY/kg beef carcass and 6.78 E-05 DALY/kg beef carcass respectively for the SNL and the TDL production systems
- Ecosystem quality: 4.57 E-06 Species.yr/kg beef carcass and 6.83 E-06 Species.yr/kg beef carcass respectively for the SNL and the TDL production systems
- Resources: 1.30E-01 USD2013/kg beef carcass and 5.06E-01 USD2013/kg beef carcass respectively for the SNL and the TDL production systems

The analysis reveals that the TDL production systems has lower impact than the SNL production system on climate change and human health, but it is the opposite trend when it comes to ecosystem quality and resource depletion. The relatively higher impact of the TDL production system on the ecosystem quality is mainly due to the higher land occupation in the commercial ranch (more than three times higher than the national average). However, the higher impact of the TDL production system on the resource depletion should be interpreted with caution. It is mainly due to the feedlotting for which detailed primary data have been used for the TDL system while a more optimistic/unrealistic scenario was used for the SNL. A sensitivity analysis has revealed that alternative feeding systems (developed by the University of eSwatini) could help reduce the impacts of the TDL system on climate, human health and resource depletion by respectively 13%, 19% and 81%.

Is the Swazi beef value chain environmentally sustainable?

eSwatini is a small landlocked country with limited available land, water resources and animal feed. The major part of available water resources is used for irrigated crops. The TDL production system seems to be more environmentally friendly when dealing with climate change and human health. However, this production system is more resource intensive than the SNL system. Compared to the values in the literature, the climate change impacts of the TDL system is comparable to the results of beef value chain in different countries. The impact of the SNL system on climate seems to be slightly higher than literature values. This is mainly due to its low technical performance and the low off-take. Both TDL and SNL systems could become more environmentally sustainable with improved technical performance (higher birth rate, lower mortality rate, improved feed efficiency…) and good herd management practices (higher off-take rate, enhanced grassland management, development of sustainable alternative feeding options…).

Risk analysis on the Swazi Beef Value Chain

Investigations made during our fieldwork in eSwatini as well as an in-depth analysis of the literature led us to realize the main risks that can constraint the growth sustainability in the different nodes of the beef value chain and to provide some insights about actions that could be implemented for risk management.

Risk related with	Inputs	Production	Aggregation and processing	Marketing
Climate change (drought, floods)	SIGNIFICANT	SIGNIFICANT	MEDIUM	LOW
Animal diseases	SIGNIFICANT	SIGNIFICANT	LOW	LOW
Bushfires	LOW	SIGNIFICANT	LOW	LOW
Market prices	SIGNIFICANT	MEDIUM	MEDIUM	SIGNIFICANT
Conflicts	LOW	SIGNIFICANT	MEDIUM	MEDIUM
Enabling environment	MEDIUM	MEDIUM	SIGNIFICANT	SIGNIFICANT

Risk management options

- Strengthening early warning signs and response
- Increase awareness and training in weather forecasts (media, institutions, rural communities).
- Broaden the current dissemination of seasonal and short-term weather forecast, and warnings.
- Refine and downscale seasonal and short-term weather forecasts, and seasonal monitoring.
- Improve ground data-based validation for seasonal monitoring.
- Customize a eSwatini risk View and launch a broad reflection on drought insurance instrument.
- Broaden and formalize the involvement of rural communities in early warning/early response.
- Strengthening the climate resilience of smallholder systems
- Promote broader adoption of Conservation Agriculture
- Promote adoption of Farmer-Managed Natural regeneration
- Promote farmer adoption of effective water harvesting practices.
- Scale up Community-based resource Management
- Promote integration of small animal husbandry into cropping systems.
- Promote household gardening.
- Strengthening management of rangeland and livestock resources
- Promote the development of local fodder production.
- Build-out of underground rainwater storage & water harvesting infrastructure.
- Launch a broad reflection on the reform of dipping systems in the context of climate change as well as on possible mobility of livestock in view to avoid potential conflicts.

Conclusions and recommendations

As result of the beef value chain analysis, we would recommend implementing policies, strategies and actions to revitalize the sector after several crises mainly related with weather conditions and markets.

1. Enhanced baseline studies to fill several fundamental knowledge gaps on the economic, social and environmental context of cattle production in the SNL.
2. Study on seasonality in cattle marketing.
3. Coordination of existing data collection on livestock as the existing situation whereby the Annual Livestock Census Summary collects data only on livestock-owning homesteads and thus has no comparator figures for total households, whereas Agricultural Censuses gather information on all rural households but present major problems of interpretation for livestock-related data, needs to be examined, and opportunities for synergies through modification to protocols identified.
4. Establishment of a value chain forum to overcome lack of trust within the value chain.
5. Implementing an inclusive approach to building information production, knowledge sharing and investment through innovation platforms.

6. Implementing a Livestock Master Plan for eSwatini to characterize the current demand and supply situation for livestock products; to develop technical and economic assessment of current production systems and value chains, as well as new emerging systems and value chains; to provide analysis of future livestock trends and impacts on national development objectives without increased investment; and future trends and impacts expected with increased investment.
7. Measuring post-production losses in livestock value chains and improving value chain performance.
8. Designing improved technologies and best practices, complemented with endogenous knowledge to address technical and institutional constraints that limit productivity and market access.
9. Promotion of innovative animal health delivery systems and facilitate the implementation of best health interventions that reduce disease burden in livestock.
10. Increasing the availability of quality feed biomass both at household, national and regional levels and improving on farm feed utilization and husbandry practices to support livestock productivity gains and generate livelihood options around feed and fodder value chains.
11. Increasing livestock market development initiatives.
12. Developing contingent markets that support livestock value chain stakeholders to cover some category of risks related to climate variability that could be direct factor and/or aggravating factor of other risks (conflicts, land competition, economic, social, etc.). The main objective is to reach a short-term recovery effect.
13. Improving the environmental performance per mass unit of beef by enhancing herd technical performance.
14. Developing alternative feeding systems with cheaper and locally available resources to make fattening accessible for small farmers.
15. Combining life cycle assessment with additional rangeland assessment methods to better assess the impacts of the beef value chain on the ecosystem quality and to better manage the quality and productivity of rangelands.

1. An Overview of the Swazi Economy in Relation to the Primary Sector

The Kingdom of eSwatini is a landlocked country bordering South Africa on the north, west, and south, (430 km), and Mozambique on the east, (105 km). The country's area is about 17,364 km^2. The country is a member of several international organizations including the African Union, the Commonwealth of Nations, the United Nations, and most importantly, the Southern African Customs Union (SACU), which provides substantial government revenues through transfers, which derive from customs duties and excise tax collections. However, this dependency on SACU transfers, which are quite volatile, greatly challenges the country, contributing to deteriorating fiscal balances and internal debt as well as public expenditures, particularly those devoted to education, public health, and social grants to vulnerable groups (World Bank, 2014).

The Swazi economy is very closely linked to the South African economy, as evidenced by almost exclusive commodity trade exchange, inflexibility in monetary policy with the pegging of the country's national currency (*lilangeni*[3]) to the South African Rand, and domestic income earning supplemented by worker remittances from the Republic of South Africa despite a sharp decline in labour migration.

The 2016 the population of eSwatini was estimated at 1,467,152. Excess mortality due to chronic diseases that in turn affect average life expectancy (52.1 years) led to a relatively weak growth rate of 1.08% in 2017. Almost 52% of the population are under the age of 20. The population density is estimated at 68 people per square kilometre and the distribution remains unevenly concentrated in valleys and plains due to the mountainous terrain of the country. With a national GDP of 3.5 billion US$, the country is regarded as a low-middle income country. Despite this categorization, the country faces numerous challenges including poverty with 63% of Swazis living below the national poverty line. Chronic food insecurity and chronic diseases trap can lead to a downward spiral (WFP, 2017).

Despite its status as a lower middle-income country, eSwatini is ranked 148th out of 188 in the 2016 Human Development Index and 128th out of 188 countries in the Gender Inequality Index that illustrates inadequate women's empowerment and their lack of inclusion in formal economic activities (UNDP, 2016).

About 77% of Swazis (52% of women and 48% of men) rely on smallholder farming for their livelihoods (WFP, 2017). The farming activities remain significantly impacted by the El Niño-induced drought so that about 159,000 people suffer from food insecurity during the lean season. This situation, due to a combination of reduced income opportunities and poor agricultural performance, could lead to high reliance on purchases, with relatively high food prices (WFP, 2017).

This lower middle-income economy is also characterised by a relatively high proportion of poverty remaining stable over the years. Approximately 42% of the population lives on less than $1.90 a day, 63.1% on less than $3.10 a day, and 63% under the National Poverty Line (World Bank, 2017). In addition, the country still has long-standing income inequality even though the Gini index declined at a moderate rate from 60.5 index in 1994 to 51.5 in 2009 (World Bank, 2017). The Ministry of Agriculture provided a recent document that stated that the richest 19% of the population controls 56% of total income, while the poorest 19% controls only 4.3% (MOA, 2016).

1.1 Economic Growth and Sectorial Performance

Macroeconomic conditions in eSwatini have deteriorated since 2013. At constant 2011 prices, the country experienced decreasing GDP until it shrunk by 0.6% in 2016. This situation can be explained by the decline in agricultural production, agro-processing, power generation, and water supply due to prolonged effects of the drought episode. Reduced customs receipts from SACU for the fiscal year 2016-2017, lead to strong fiscal deficits when the government maintained the same level of public expenditures, which created unfavourable regional circumstances which were also factored in.

[3] Abbreviated either SZL or E' (for the plural form Emangaleni).

In 2017 the Swazi National Statistical Services expected a rebound and recovery in macroeconomic indicators. Meanwhile, the IMF forecasted a slower pace caused by a region-wide drought for that same year. In terms of real GDP that measures the value of economic output adjusted for price changes (i.e. inflation and deflation), expectations remain cautious; a slight rebound is anticipated in 2019's macroeconomic issues after 2018's expected negative result. The IMF has warned about the risks to public debt sustainability that could result from the unchanged trend of public expenditures and tighter monetary policy closely pegged to the South African currency (IMF, 2017).

	2011	2012	2013	2014	2015	2016	2017(f)	2018(f)	2019(f)
GDP at constant 2011 prices (E' billions)	36.0	40.0	44.5	48.8	52.6	54.8	58.8	63.4	69.1
GDP at constant 2011 prices (% change)	1.9	3.4	4.6	2.8	1.9	-0.6	1.7	3.4	3.9
GDP at current prices (US$' billions)	5.0	4.9	4.6	4.5	4.1	3.5	3.8	4.5	5.3
GDP at constant 2011 prices (US$ billions)	5.0	4.5	4.0	3.7	3.2	2.6	2.7	3.0	3.4
GDP per capita at constant 2011 prices (E 1.000)	33.7	34.5	35.6	36.2	36.4	35.8	35.9	36.7	37.8
GDP per capita at constant 2011 prices (US$ 1.000)	4.7	4.2	3.7	3.3	2.9	2.3	2.4	2.6	2.9
GDP Deflator	100.0	107.3	114.3	121.8	128.9	135.3	141.8	148.8	156.1
Exchange rate (E'/US$)	7.3	8.2	9.7	10.9	12.7	15.5	15.3	14.1	12.9

TABLE 1 - ESWATINI: SELECTED GDP INDICATORS, 2011-2019
Sources: Swazi National Statistical Services.

Over the past 16 years, the real GDP growth has been dominated by the tertiary sector (48% on average). Wholesale and retail trade boosted this sector, followed by the development of real estate activities, public administration and military defence, and educational as well as financial and insurance services. While the secondary sector also remains prominent (38%) thanks not least to manufacturing (food processing, textiles, and apparel), the share of the primary sector (11 %) has increasingly declined even as agricultural activities continue to play an important role as a source of exports.

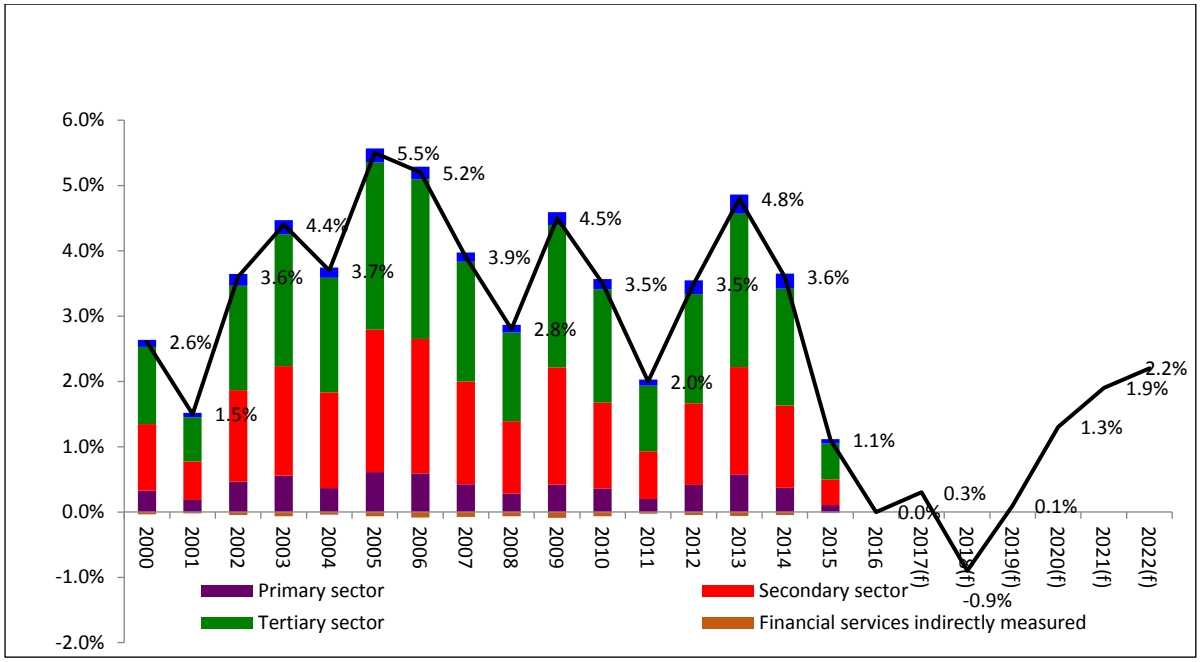


FIGURE 1.1: ESWATINI-CONTRIBUTIONS TO REAL GDP ANNUAL GROWTH (%).
Sources: Swazi National Statistical Services (2000-2016) and IMF real GDP forecasts (2017-2022).

The mild drought experienced by the country in the 2014/15 and 2015/16 seasons strongly affected the primary sector, which remains largely dependent on rainfall, while irrigated systems faced severe difficulties as dam levels fell to significantly low levels unable to support effective irrigation. The maize production on the Swazi Nation Land (the SNL, see below for further explanation) dropped by 60% to 33,460 metric tons in 2016's harvest, whilst cotton production fell below 200 metric tons. Sugarcane production also declined by about 20%.

Curiously, there has been a reverse effect in the livestock sector, where despite high mortality rates in animal production, farmers who are usually cautious in selling animals were led to destock their cattle in 2015 and in the first half of 2016, during which the trends observed previously, remained relatively strong. The forestry sub-sector benefitted from trees planted after the 2007/08 forest fires that would be available for harvest, thereby demonstrating the forestry sector's economic dynamism.

The secondary sector, comprised of manufacturing, electricity, water supply, and construction, suffered from the drought episodes and is expected to decline by half in 2016. The production of primary crops decreased, and this situation impacted manufacturing of sugar production. Fortunately, the other manufacturing components not linked to the agriculture sector partially compensated for the decline of agro-processing. The reduction of water availability indeed affected hydro-based electricity, even though a medium-term recovery (accompanied by above normal rains driven by another weather phenomenon, La Niña) is expected. The construction sector, which has been performing well in the post fiscal–crisis of 2010/2011, remains dependent on public orders and is weakened by the decline in SACU revenues. The alerts received from the IMF could push the government to exercise greater care over public expenditures. However, ambitious investment plans, particularly for infrastructure (such as the Rail Link project), constitute grounds for optimism for a medium-term recovery.

The tertiary sector seems to be less affected even though support services to the primary and secondary sectors, such as transportation and finance, could be indirectly impacted. Indeed, wholesale and retail trade, tourism, education, health, and other services can grow independently but at a slow pace given the stagnation expected in wholesale and retail trade, as well as the real estate subsector.

Considered a lower middle-income country with a GDP per capita of about US$3,500, the Kingdom of eSwatini remains particularly vulnerable to multifaceted internal and external shocks as well as significant structural challenges.

Nearly 63% of Swazis live below the national poverty line. Furthermore, eSwatini still faces a widespread high HIV prevalence rate, maintaining a very weak life expectancy and high-risk level for women and youth (although new infections have now fallen sharply). Unemployment remains high and relatively unresponsive to growth, contributing to elevated income inequality (IMF, 2017). The World Food Program declared that almost 13% of the Swazi population would need food aid during the lean season due to the combination of reduced income opportunities and poor agricultural performance. eSwatini's economic reliance on agriculture and livestock persists.

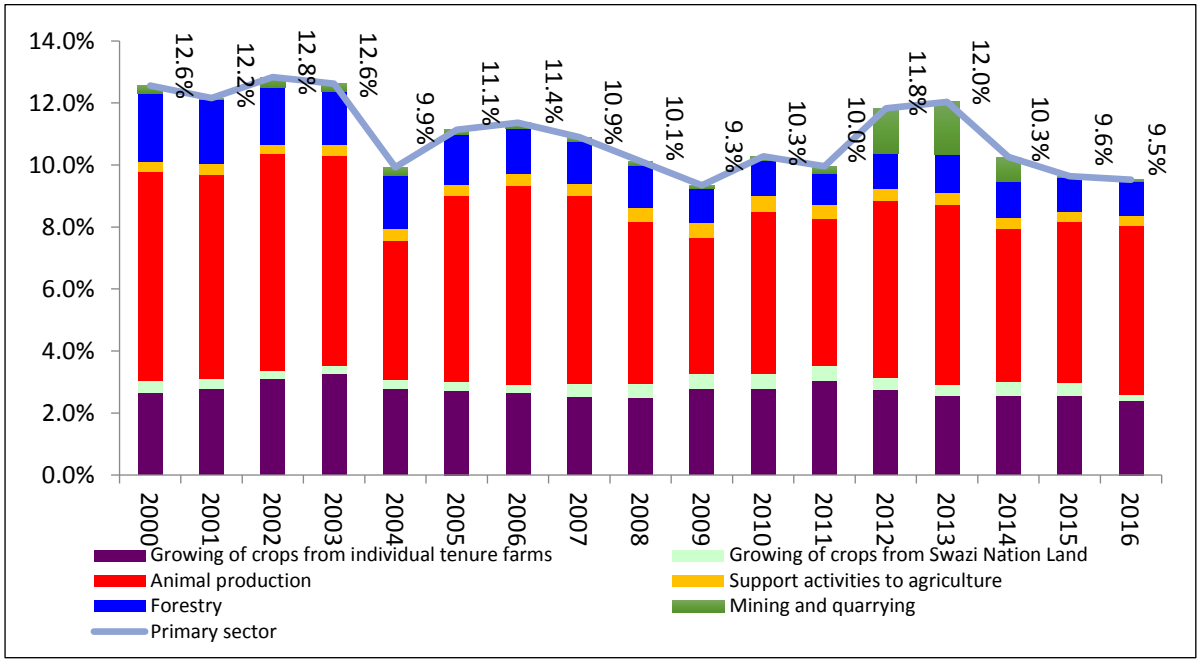


FIGURE 1.2: CONTRIBUTION OF PRIMARY SECTOR TO GDP BY ECONOMIC ACTIVITY AT CURRENT PRICES (%).
Sources: authors' calculations from Swazi National Statistical Services (2000-2016).

1.2 eSwatini's External Trade Patterns

Because of its geographical position and its surface area, the Kingdom of eSwatini is characterized by an outward-looking economy largely dependent on external trade, of which the livestock sector is no exception. In general, eSwatini remains open to foreign trade. eSwatini is a member of regional unions (SACU, COMESA, and SADC) and has signed agreements granting it preferred access to large developed markets (AGOA-United States and Interim EPA since June 2009 with the EU), as well as emerging markets (MERCOSUR). The country often uses the local currency's depreciation to facilitate favourable export conditions.

eSwatini is relatively well-integrated into international trade. Its trade is highly dependent on South Africa (81% of total imports in 2016 and 67% of exports in 2016). In 2017, this trade integration consolidated. The dependency on South Africa is expected to reach 85% for imports despite an expected decline in exports from 67% to 60% (World Bank, 2017).

The external trade balance remains positive overall; the country has a net surplus of $272 million. The main exports of eSwatini include sugar, wood pulp, beef, and drink concentrates. eSwatini is a net importer of food, fuel, and machinery. The main trading partners are South Africa, Mozambique, Kenya, Nigeria, Zimbabwe, Tanzania, United Kingdom, Angola, and Spain, each of which accounted for more than two percent of eSwatini's exports by value in 2016.

Partners	Exports 2016		Imports 2016		Balance in value in 2016
	in value	in percentage	in value	in percentage	
World	**1,571,994**	**100%**	**1,300,168**	**100%**	**271,826**
China	8	0%	49,067	4%	-49,059
India	307	0%	32,040	2%	-31,733
Singapore	53	0%	23,034	2%	-22,981
Ireland	1,795	0%	16,473	1%	-14,678
Japan	444	0%	10,532	1%	-10,088
Taipei, Chinese	62	0%	8,698	1%	-8,636
Germany	1,636	0%	7,817	1%	-6,181
Hong Kong, China	154	0%	5,919	0%	-5,765
South Africa	1,053,537	67%	1,058,894	81%	-5,357
Russian Federation	588	0%	4,823	0%	-4,235
Switzerland	459	0%	4,673	0%	-4,214
Egypt	16	0%	4,028	0%	-4,012
Canada	161	0%	3,712	0%	-3,551
Belgium	1,100	0%	3,594	0%	-2,494
Malaysia	48	0%	2,170	0%	-2,122
Lesotho	3,673	0%	5,721	0%	-2,048
Zambia	14,795	1%	2,737	0%	12,058
Namibia	14,552	1%	885	0%	13,667
Botswana	14,286	1%	509	0%	13,777
Uganda	16,197	1%	8	0%	16,189
Spain	25,654	2%	5,964	0%	19,690
Portugal	23,119	1%	515	0%	22,604
Angola	24,636	2%	1	0%	24,635
United Kingdom	28,913	2%	2,963	0%	25,950
Tanzania	35,751	2%	8	0%	35,743
Zimbabwe	39,739	3%	84	0%	39,655
Mozambique	51,067	3%	2,884	0%	48,183
Kenya	62,030	4%	127	0%	61,903
Nigeria	69,802	4%	23	0%	69,779

*TABLE 2 - TRADE BALANCE WITH THE TOP 30 PARTNERS FOR ALL PRODUCTS (US DOLLAR *1,000.*
Source: International Trade Centre Trade Map.

2. Functional analysis of the Swazi beef value chain

2.1 eSwatini's livestock production

Eighty percent of rural households in eSwatini own livestock, making them a very important economic and cultural component of the country (Swaziland Ministry of Agriculture, 2016).
eSwatini is divided into four climatic regions that strongly influence farming practices:

1. In the west, the Highveld (the location of the capital city, Mbabane) occupies 33% of the country's total land area with an average altitude of 1,300 metres and an annual rainfall ranging from 1000 mm to 2700mm.
2. In the centre of the country, the Midlevel lies at an average 700 meters above sea level with rainfall ranging between 450mm and 1380mm per annum, forming the most densely populated region. The Highveld and the Middleveld combined account for the major food crop-producing area of eSwatini.
3. The Lowveld is very vulnerable to drought episodes, has an average elevation of 200m and average rainfall between 200mm and 2000mm, and is less populated than other areas. This land is currently used for commercial irrigated crop and livestock production
4. On the eastern border of the country, the Lubombo Plateau has an average elevation of 600m.

eSwatini's increasing drought conditions during these past years have resulted in many weather-related stresses. With the El Niño phenomenon in 2014 that coincided with a sharp rainfall shortage, the expected rainfall has sharply declined during these past five years.

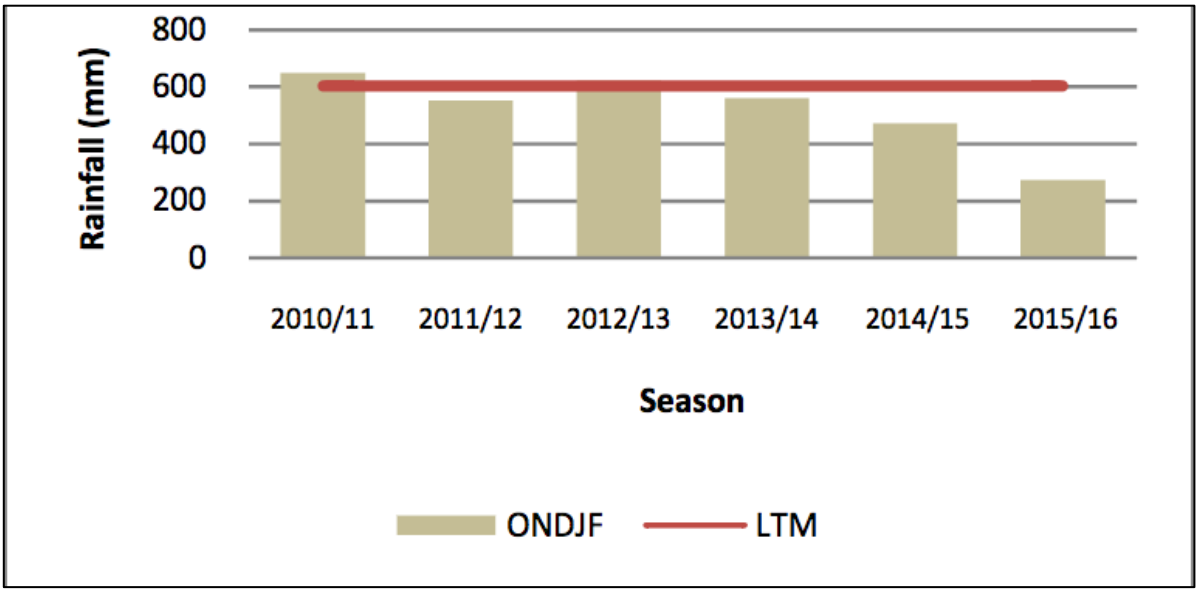


FIGURE 2.1: DEFICIT OF EXPECTED RAINFALLS FROM OCTOBER TO FEBRUARY (ONDJF) ABOVE LONG TERM MEAN (LTM)[4].
Source: eSwatini Meteorological Services, 2016

As with several other countries of Southern Africa, the agricultural sector and the land tenure system that underlies it are characterised by a profound dualism (Mushala et al. 1998). Approximately 35% of the country is classified as Title Deed Land (TDL), a heritage of the land granted to settlers of European origin during the early colonial period (especially between 1875 and 1907 – see Kuper 1983). Swazi individuals and companies following independence acquired much of this land. However, it remains strongly distinct as freehold land, freely saleable to Swazi individuals and to companies with a majority Swazi shareholding. The Swazi Nation Land (SNL) by contrast, is managed (or as some observers would put it unmanaged) under a modified version of the customary system, which is discussed below.

Sources disagree on the proportion of the country's land area accounted for by the SNL. The Livestock Development Policy (LDP) of 2016 gives a figure of 80% of the land area of the country while the Government's

[4] That is, long-term average annual rainfall within one century.

2016 updating of the World Bank's beef value chain study (hereafter GoS/WB 2016) gives 60%. An older study by Mushala et al. (1998), using 1989 government figures disaggregated by District, gives 56% SNL, 43% TDL and 1% Crown Land (mainly urban). The lines between TDL and SNL are not entirely clear, and both population, policy and economic dynamics tend to displace the borders. Crown Land is a third category of land: Mushala et al. (1998) limit it to urban land, but the authors were shown various areas of rangeland referred to as Crown Land. The Tibiyo (a fund controlled directly by successive monarchs – see Kuper 1983) has incorporated some purchases into the SNL, but some land is referred to specifically as Tibiyo land and kept separate from the SNL. As shown below, SNL land can be used by commercial enterprises and development projects under certain conditions. On the other side of the coin, there are clearly several quasi-traditional farmers and livestock owners using TDL.

On the SNL, for ordinary household crop cultivation, the local Chief can assign the usufruct of land. Such grants do not include the right of sale or transfer, though there may be informal sub-letting, and are in principle revocable. The usufruct rights can in practice be inherited by a man's sons or widows. There is some recent literature on how this system affects perceived tenure security and investment in productivity (Stringer 2009, Orchard et al. 2017). For more commercial uses, the Chief, in council with his advisors, can assign, with varying degrees of formality up to and including 99-year leases, usufruct of land.

For grazing on the SNL, there is very little recent written information. Mushala et al. (1998) write of a presumptive right of any Swazi (implicitly in the ethnic sense) to graze livestock anywhere on the SNL. The authors were told in various focus group discussions (FGDs) that the right to graze was limited to those living locally and in most cases to those coming under the Chief (there are 392 Chiefdoms in the country). A tighter constraint is the compulsory dipping system, whereby all cattle must be dipped in or sprayed with an acaricide solution on a regular basis (weekly in the rainy season in most areas) at the diptank where they are registered –there are somewhat fewer diptanks than Chiefdoms. It is relatively easy to have cattle re-registered to another diptank (and not that difficult for a household to relocate to another Chiefdom), on a long-term basis. There is a suggestion that it is possible to move cattle between areas on a more short-term basis, e.g. cattle being moved to the Highveld during drought in the Lowveld.

The communal nature of the grazing system is a source of considerable concern to many outside observers, who associate it with overgrazing and land degradation. Further discussion of this issue is found in Section below, with attention to another important driver, homestead encroachment.
An important question concerning the relationship between SNL cattle production and rural livelihoods in general is the proportion of the SNL population who own cattle. Reliable figures for this variable are not easily available in national statistics, as the Annual Livestock Census Summary, which otherwise provides good disaggregated information on cattle numbers and numbers of cattle-owners, does not include any figure for all SNL households. Orchard et al. (2017) for two Middleveld areas, present a figure of 47% of total SNL households owning cattle. That figure is compatible with a calculation based on ALCS figures for cattle-owners, and unpublished figures from the 2012/13 Agricultural Censuses for all SNL homesteads. A homestead is a group of one or more households that remain under the authority of one man (or in some cases one woman) and may include the households of several wives if polygamy is practiced, or the households of adult sons, or both. In FGDs it became clear that in some areas there is on average more than one cattle-owner per homestead, ***we would estimate that the proportion of homesteads owning cattle may be anywhere between 40% and 50%, with considerable regional variations***. More reliable data on this question will be very important for discussions of the poverty impact of beef value chain development.

For the SNL households that do own cattle, they have multiple values. Cattle have an extremely strong cultural significance in Swazi society, which is referred to constantly not only by ordinary livestock-keepers but also by senior policy-makers in the Ministry of Agriculture, parastatals etc., and even by commercial farmers of European origin. Comments like "livestock are part of us", "you cannot separate us from livestock" were made frequently to the authors, with "livestock" referring pre-eminently to cattle. In addition to their social significance and sales for cash income, cattle are also traditionally used for milk, ploughing, hauling, food, and manure as fertilizer of family gardens that contribute to the food security of most of rural households.

The following table shows the degrees to which SNL rely on livestock products for cash income, varying strongly by livelihood zone, and by wealth category. For very poor and poor households, livestock-related income is likely to be relatively insignificant, though this is less the case in drier parts of the country.

	Very Poor	Poor	Middle	Better-Off
Dry Middleveld	2	16	8	22
Moist Middleveld	2	2	13	17
Highveld	2	2	31	33
Timber Highlands	2	2	10	10
Peri Urban	1	1	1	5
Lowveld	16	47	20	17
Lubombo Plateau	0	28	16	20

Table 3 - Livestock Sales and Livestock Product Sales (Combined) as Percentage of Household Cash Income, by Livelihood Zone and Wealth Category. Source: underlying data from eSwatini Vulnerability Assessment Committee, provided by Mduduzi Gamedze

The next table shows reliance on livestock products in household diets, which attains 20% among the better-off households in several of the livelihood zones.

	Very Poor	Poor	Middle	Better-Off
Dry Middleveld	0	4	8	18
Moist Middleveld	0	3	8	19
Highveld	0	3	8	12
Timber Highlands	0	7	14	21
Peri Urban	0	0	0	6
Lowveld	0	7	7	17
Lubombo Plateau	0	7	7	6

Table 4 - Livestock Products as Percentage of Household Food Sources, by Livelihood Zone and Wealth Category . Source: underlying data from eSwatini Vulnerability Assessment Committee, provided by Mduduzi Gamedze

The above tables show that livestock, principally cattle, are an important source of direct consumption and cash income, for different wealth categories in different areas. Beyond these are two other very important values. The importance of ***draught power*** has been underestimated in policy documents. 2012/13 Agricultural Census data suggest (though interpretation is difficult) that homesteads using oxen for ploughing represent 40% of all homesteads, and those using their own oxen represent 41% of cattle-owning homesteads. Orchard et al (2017) for two Middleveld areas, show a rise in households using cattle for draught from 42% to 50% in one, but a fall from 24% to 0% in the other. ***Manure is an important output of cattle***. Given the low volumes relative to cropped area, and the difficulties of transportation, there is a strong suggestion that manure use is concentrated on home vegetable gardens (data from our Maphoko focus group, also from Orchard et al. 2017), contributes to dietary diversity and the nutrition of children, and is this especially valued by women.

The tables below show two sources of information on the relative valuation of the different outputs from cattle. The first is from Orchard et al. (2017) based on two different Middleveld locations, with longitudinal data from 2002 and 2014.

	Engcayini			Kabhudla		
	2002	2014	Change	2002	2014	Change
Tradition	10	24	+14	9	63	+54
Bank	14	4	-10	42	34	-8
Food	73	30	-43	58	37	-21
Manure	10	61	+51	3	44	+41
Draught	42	50	+8	24	0	-24

Table 5 - Responses to the question "What are the reasons you keep cattle" (%, multiple responses allowed). Source: Orchard et al. 2017

The second table is derived from a ranking of outputs/production objectives, using pictorial cards, from our focus groups.

Maphoko Men	Maphoko Women	Lwandle Men	Lwandle Women	Plateau Men[a]	Plateau Women[a]	Lowveld Men[a]	Hlathikala Young Men	Hlathikala Older Men	Hlathikala Women
Money[b]	Money	Bridewealth	Ploughing	Money	Security/ wealth[c]	Money	Money	Wealth/ security	Ploughing
Security	Milk	Ploughing	Manure	Security/ wealth	Money	Security/ wealth	Bridewealth	Money	Manure
Cultural reasons	Meat	Manure	Milk	Meat	Milk	Meat	Cultural reasons	Bridewealth	Money
Bridewealth	Ploughing	Rituals and fines	Money	Milk	Meat	Bridewealth	Ploughing	Ploughing	Milk
Ploughing	Manure	Milk	Rituals and fines	Bridewealth	Cultural reasons[d]	Ploughing	Manure	Cultural reasons	Bridewealth
Milk	Security	Meat	Bridewealth	Manure	Manure	Milk	Meat	Milk	Wealth/ security
Manure	Skins	Money	Security	Ploughing	Ploughing	Cultural reasons	Milk	Meat	Cultural reasons
Meat	Cultural reasons	Security	Meat	Cultural reasons	Bridewealth	Manure	Wealth/ security	Manure	Meat
Skins	Bridewealth	Skins	Skins	Skins	Skins	Skins	Skins	Skins	Skins

TABLE 6 - RANKING OF OUTPUTS/PRODUCTION OBJECTIVES, USING PICTORIAL CARDS, FROM OUR FOCUS GROUPS. Notes: a) FGDs conducted in Ministry of Agriculture Office, Siteki b) "Money" interpreted as cash income throughout c) "Security/Wealth" or vice versa interpreted as meaning both a store of wealth and psychological security d) "Cultural reasons" in Siteki interpreted to include court fees paid in kind, and traditional "gifts" to chiefs in return for allocation of land.

Both these tables show the diversity of reasons cited for keeping cattle, and their relative ranking. As a generalisation, women were more likely to rank milk and manure highly, because of the benefits to family nutrition, and bridewealth less highly, but both genders ranked ploughing highly. ***The conclusion is that cattle for SNL smallholders are kept for multiple objectives and generate multiple outputs, of which cash for sales into the beef value chain is merely one.***

Species	Year					
	2011	**2012**	**2013**	**2014**	**2015**	**2016**
Beef cattle	779,751	629,781	622 ,715	615,113	589,405	525,667
Dairy cows	4,667	5,224	4,771	4 ,818	4,835	5,783
Goats	437,596	485,826	458,344	441,137	443,218	501,496
Sheep	16,263	17,294	11,694	15,983	14,969	16,841
Poultry	2,038,930	3,825,900	1,942,480	2,546,343	2,415,138	1,594,079
Pigs	41,794	43,548	38,813	39,808	38,513	42,852

TABLE 7 - LIVESTOCK NUMBERS IN ESWATINI
Source: Department of Veterinary and Livestock Services Annual Reports (2011-2016).

As with most parts of Southern Africa, cattle farming in eSwatini contributes to rural families' sustenance. Two systems coexist, commercial farming and communal farming, which usually constitute 20% and 80% of livestock, respectively. However, in eSwatini, considering animal reproduction characteristics***, 11% of cows, heifers, and calves are kept in the TDL tenure system, while 89% are on SNL systems.***

Tenure	Animal class /Proportion	Hhohho	Lubombo	Manzini	Shiselweni	Total	Total by tenure system (%)
SNL	Beef Cows	40,539	49,252	54,179	50,049	194,019	
	Beef Heifers	15,836	18,722	19,977	8,578	63,113	
	Dairy Cows	1,005	178	705	265	2,153	
	Dairy Heifers	420	48	222	89	779	
	Calves	13,501	19,439	18,596	8,416	59,952	
	% Cows	32.5	39.33	33.88	15.92		320,016 (89%)
	% Cows & Heifers	23.36	28.5	24.77	13.68		
TDL	Beef Cows	1,682	10,534	7,733	3,646	23,595	
	Beef Heifers	443	3,185	2,937	712	7,277	
	Dairy Cows	274	76	798	347	1,495	
	Dairy Heifers	21	27	207	153	408	
	Calves	398	3,893	2,597	1,499	8,387	
	% Cows	20.35	36.69	30.44	14.84		41,162 (11%)
	% Cows & Heifers	16.45	28.17	22.24	11.99		

TABLE 8 - CALF BIRTHS AS A PROPORTION OF THE ESTIMATED REPRODUCTIVELY MATURE BOVINE POPULATION
Source: authors' calculations from the Department of Veterinary and Livestock Services' Annual 2016 Report.

The communal systems are characterized by open grazing, low off-take rates (both slaughters and sales), and low technical efficiency measures (calving rates, mortality rates, etc.).

Cattle dominate eSwatini's ruminant sector. The national herd has stagnated at about 600,000 head corresponding to the country's carrying capacity.

However, the multifaceted shocks noted from 2013 led to successive declines in cattle numbers (1.0% in 2013, 1.2% in 2014, 4.2 % in 2015, and 10.6% in 2016). The Lubombo and Shiselweni regions registered the most significant declines (respectively 9.0 % and 4.3% in 2015, 26.5 and 17.0% in 2016) while the Manzini region experienced a relatively lower decrease in 2016 (4.2%).

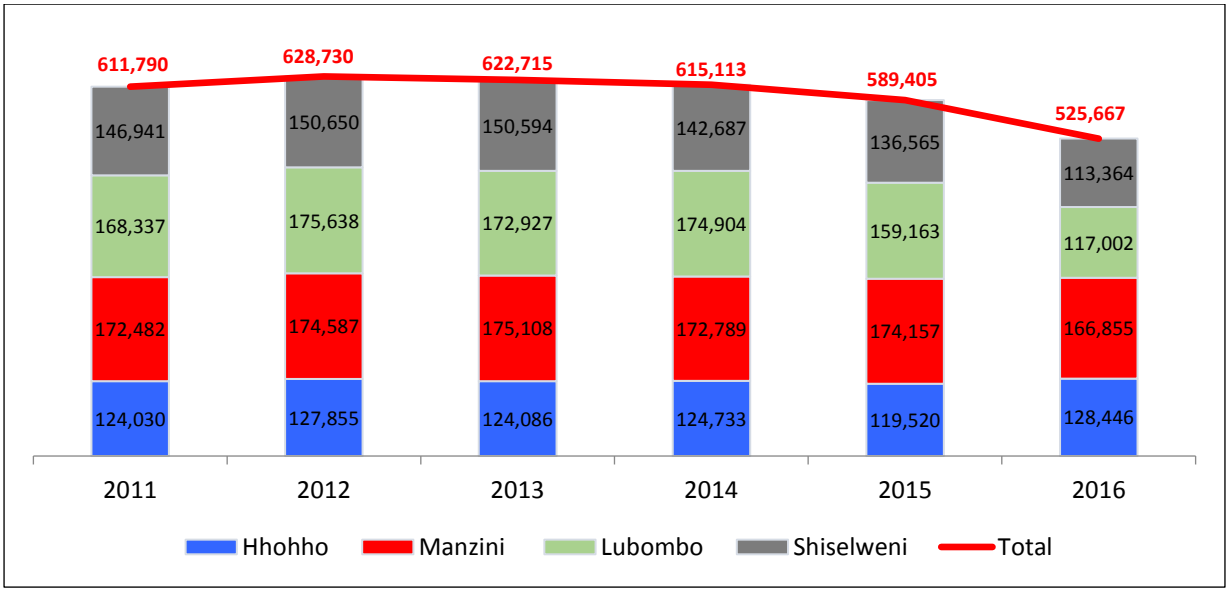


FIGURE 2.2: BEEF CATTLE BY REGION

Source: authors' calculations from Department of Veterinary and Livestock Services (DVLS) Annual Reports (2011-2016).

The drought mainly impacted livestock mortality, which increased from 2013 levels. The total number of deaths rose by 11% in 2014 and 49% in 2015.

A total of 80,602 calves were born from January to December 2015 in contrast to the 85,784 and 102,418 born in 2014 and 2013, respectively. The highest numbers of calves were born in the Lubombo Region followed by Manzini, Shiselweni, and lastly Hhohho. There is a 1:1 ratio in the gender of calves born.

The repercussions of the El Niño phenomenon on the mortality ratios were more visible. The trends observed from 2010 strengthened over the years. Indeed, the baseline cattle mortality observed from August to October increased during the same period in 2015. Calf and cow losses primarily caused significantly higher cattle mortality in 2015.

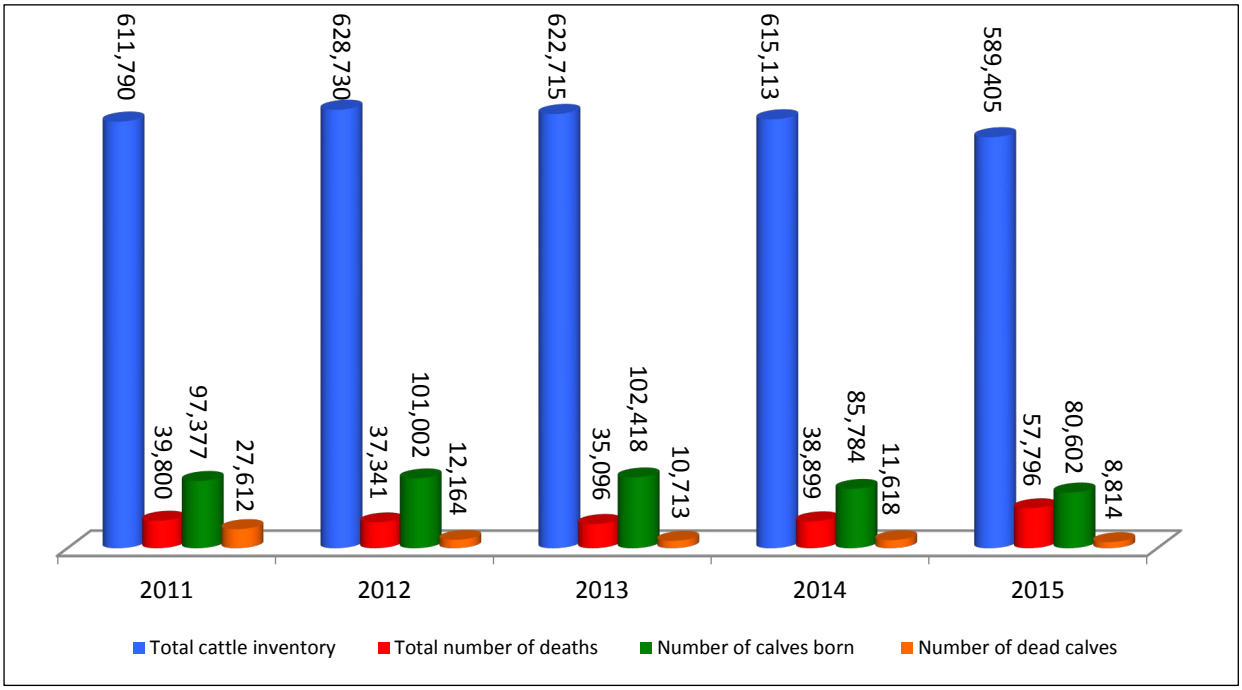


FIGURE 2.3: CATTLE AND CALF MORTALITY AND BIRTHS

Source: authors' calculations from DVLS Annual Reports (2011-2016).

In response to this exceptional cattle mortality, farmers slaughtered more than usual both for home consumption and commercial purposes. The limitations of this strategy led the government to provision water and hay bales to mitigate the drought's effects, including the starvation of the livestock. Government-sponsored auctions and sales conditions helped maintain the cattle's value.

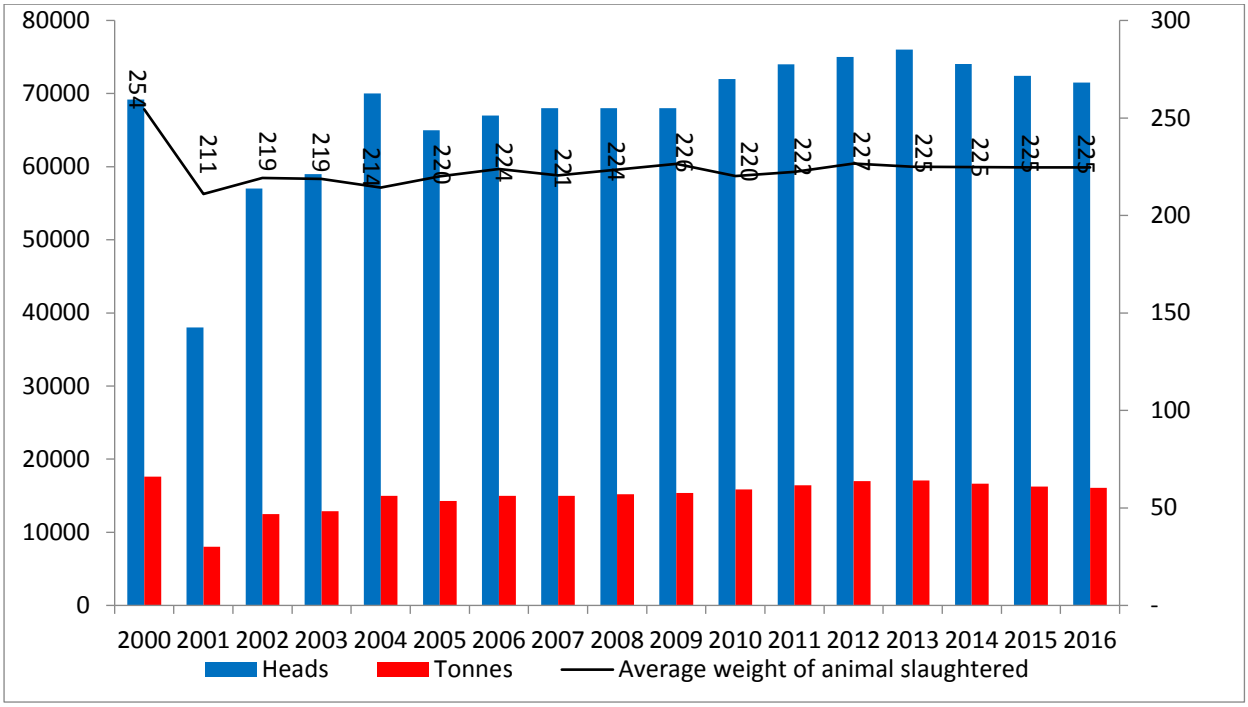


FIGURE 2.4: NUMBER OF PRODUCTIVE ANIMALS/SLAUGHTERED
Source: Authors' calculations on FAOSTAT data.

The animals were slaughtered within national boundaries, irrespective of their origin, providing total meat production (from both commercial and private farm slaughter). Data is given in terms of dressed carcass weight, excluding offal and slaughter fats.

2.2 The Swazi Beef Value-Chain Analysis

The approach used provides a comprehensive study of the value chain that combines the economic, social, and environmental dimensions of sustainability. It analyses detriments to the Swazi beef value chain and identifies opportunities to upgrade that would lead to farms and firms that are simultaneously competitive, sustainable, and inclusive.

A resolutely quantitative approach will allow assessment of how successive activities, conducted by actors and stakeholders supported by various business and public services in a specific context, create value in intermediate and end markets. Clearly, our approach goes beyond a simple description of the role and function, attempting to quantify all cash flows that contribute to value addition, as well as the main environmental impacts of the beef business in eSwatini.

A first step would consist of forming a clear understanding of the external and internal end-markets.

2.2.1 End-markets for Swazi Beef

External End-markets

Export markets for beef products from Southern Africa are slowly opening in the European Union and other international markets. The challenge has been for eSwatini livestock infrastructures to conform to export market standards. Thus, the public authorities designed the beef value chain to meet growing external opportunities throughout the Southern Africa region as well as from European Union markets through a

favourable boneless beef deal that enables the payment of premium prices to farmers. eSwatini benefits from allocated quotas for beef exports to the EU under the Lomé Convention (Sartorius Von Bach et al, 1998). Of course, not all beef value chain actors in eSwatini benefit equally from this agreement, as the value chain is complex, with actors developing various expectations.

The country remains very dependent on foreign demand, particularly from South Africa, since eSwatini receives almost 99% of its imports from its southern neighbour, while sending 12% of its exports of livestock products in turn. The main destination of Swazi livestock products is Norway (57%), a non-member State of the European Union that still observes the EU's import standards. Norway is followed by Mozambique, which receives more than 27% of Swazi exports. eSwatini is an overall net importer of livestock commodities (E. 133.4 billion from January 2016 to October 2017). This positive situation does however conceal many disparities between partners: The Kingdom of eSwatini is a net importer vis-à-vis the Republic of South Africa (E. 284.4 billion from January 2016 to October 2017) while remaining a net exporter with Mozambique (E. 47.3 billion), Norway (E. 99.0 billion), and more modestly with Mayotte (E. 7.6 billion).

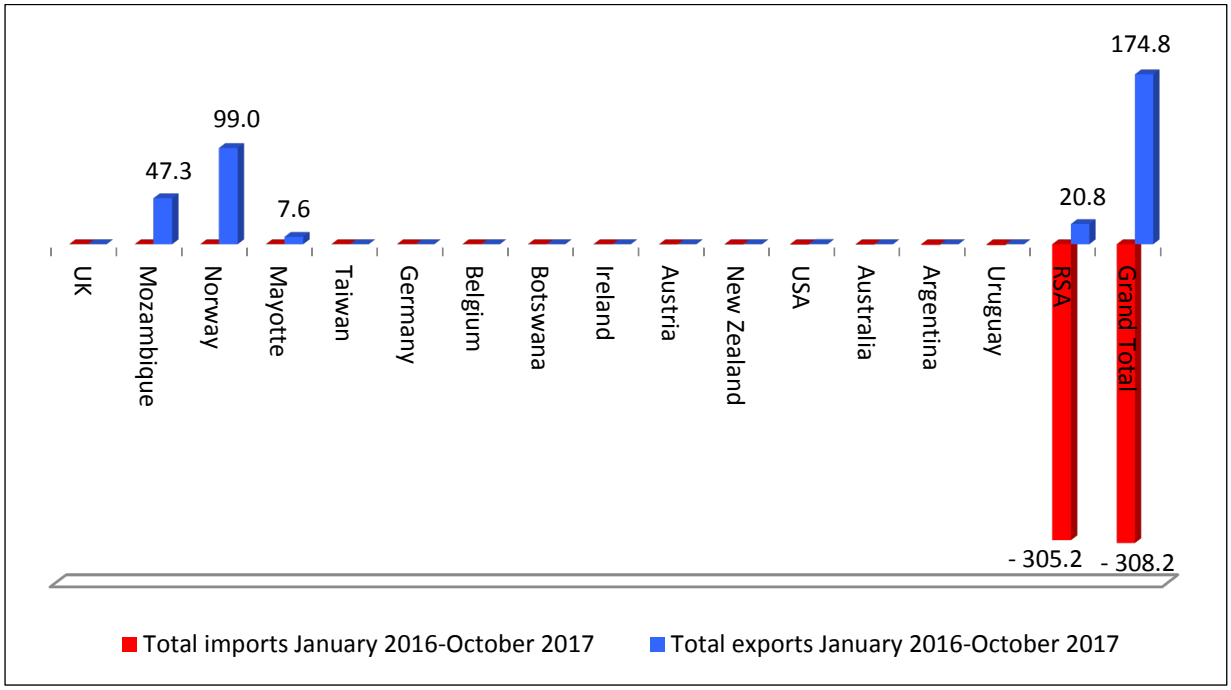


FIGURE 2.5: ESWATINI GLOBAL EXCHANGES
Source: eSwatini Revenue Authority, 2017.

The Swazi foreign trade policy appears to gain a premium in export markets by using preferential market access to the European Union and competing with other countries, while the local demand is met by imports from South Africa. eSwatini has a relatively limited average number of cattle annually slaughtered (50,000[5]) for the domestic and export market, with a potential national herd of 600,000 on average. Globally, the limited amount of available grassland could challenge grass-fed production of beef without growth stimulants, so niche export markets are an excellent opportunity for Swazi farmers to up their beef production efficiency.

The Kingdom of eSwatini benefited from unlimited or quota-free access to EU without interruption for ten years, ending in September 2017. From this date and following a precautionary principle, the Swazi authorities decided on an indefinite ban on all beef exports from eSwatini due to the uncertain serological status of three buffaloes received as a gift from Zambia.

From January 2016 to October 2017, eSwatini exported some specific livestock products (frozen, boneless meat of bovine animals, fresh or chilled bovine meat, live bovine animals, carcasses or half-carcasses of bovine animals, and live or boneless fowls) to European countries and other partners, while importing

5 Average calculations from MOA document (2016).

livestock products from South Africa (frozen carcasses and half-carcasses of swine, fresh or chilled bovine cuts, carcasses or half-carcasses of bovine animals, fresh or chilled bovine meat as well as live cattle).

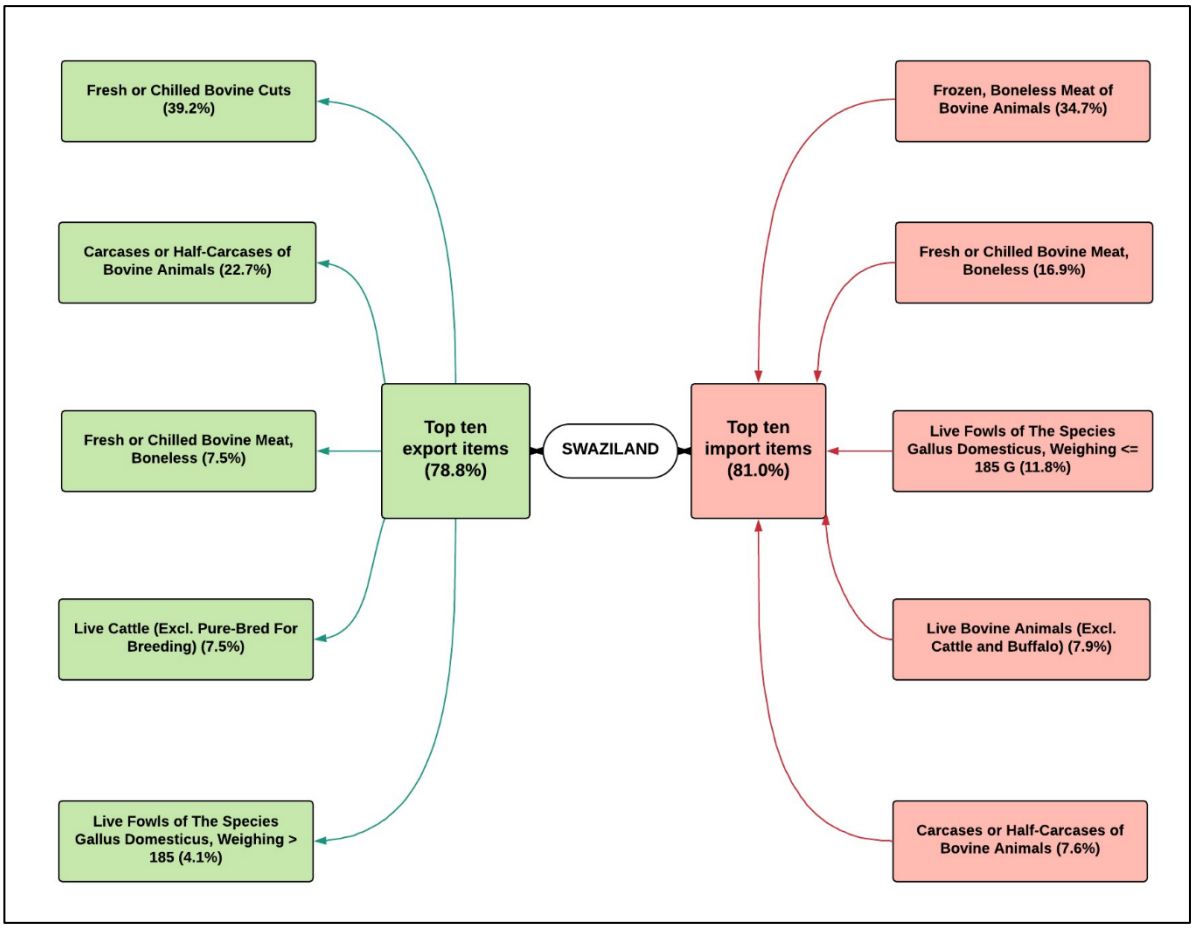


FIGURE 2.6: ESWATINI BEEF PRODUCT EXCHANGES WITH FOREIGN NATIONS.
Source: authors.

Internal End-markets

The level of dependence on imports from South Africa reflects the strength of domestic demand for beef in eSwatini. Although huge potential for beef in the export market has been identified, there is also a shortfall of beef to meet the existing local demand which is satisfied by imports.

2.2.2 Beef Value Chain Map

As beef is produced and flows through the value chain to the consumer, it should accrue value. The value-chain actors (who buy, own, and sell the product) and the service providers (who perform services without taking ownership of the product) all claim a share of the final product value as a reward for their contribution at their stage of the value chain.

The beef value chain in eSwatini has a complicated structure and plays a multitude of roles. The above diagram provides an illustration of complex interactions between all actors and stakeholders in eSwatini's beef sector. This complexity can be addressed either by distinguishing the main actors or the various stages identified in the value chain. In this study, we opt to focus both on different stages (pre-production, production, processing, and distribution, including retailing and consumption stages) as well as on actors by building the operating accounts of the beef value chain's main actors.

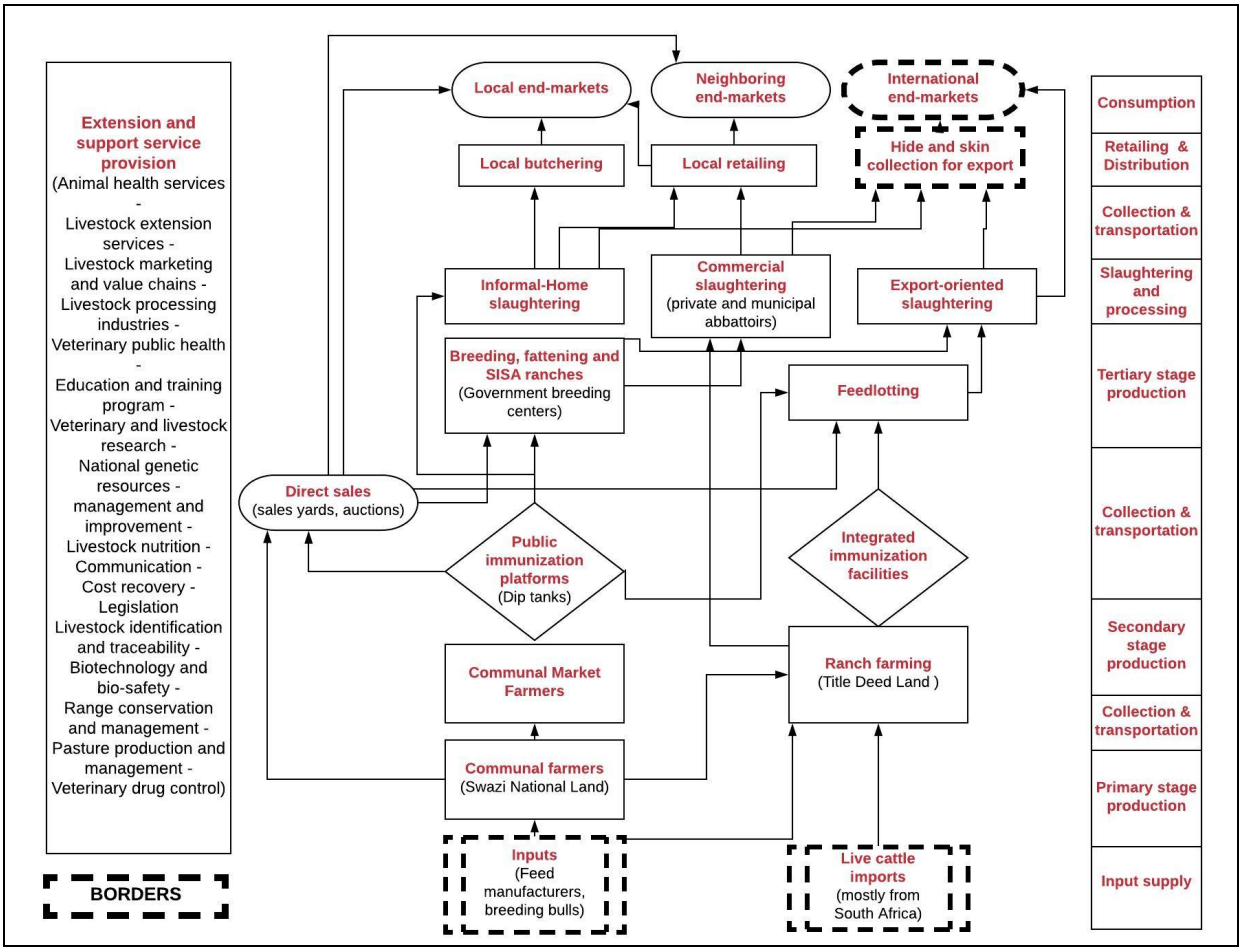


FIGURE 2.7: THE SWAZI BEEF VALUE CHAIN MAPPING
Source: authors.

We first describe the transversal role of government and other institutions in provision of extension and support services.

Extension and Support Service Provision

The government of eSwatini (GoS) plays a crosscutting role in providing extension and support services to the livestock sector including the beef value chain. This function is multifaceted and focuses on current issues facing the livestock sector. The government support could be direct (livestock marketing and value chains, livestock processing industries) or indirect (animal health services, livestock extension services, veterinary public health, education and training programs, veterinary and livestock research, national genetic resources, management and improvement, livestock nutrition, communication, cost recovery, legislation regarding livestock identification and traceability, biotechnology and bio-safety, range conservation and management, pasture production and management, and veterinary drug control). All these tasks are processed through various governmental mechanisms to reach specific objectives (MOA, 2016)6.

[6] This official document describes these main objectives.

Input Supply Stage

The most important inputs are feed and mixes, veterinary services and drugs, and breeding cows to reinforce the herd. At this stage, the Government of eSwatini is a key player. The government developed continuing efforts to provide various services for livestock owners, often free of charge. However, if government programmes were better targeted to address the needs of smaller-scale farmers, they could also significantly contribute to the business of the already more market-oriented larger-scale cattle farms in the private sector. The GoS ensures critical public tasks in the areas of control of animal movement, animal disease control and prevention, and public health (meat inspection). For the whole value chain, the GoS exerts all its prerogatives to ensure an environment which enables development of eSwatini's livestock sector, including the beef sector. There are four main types of cattle-feeding practices used in eSwatini besides free access to grazing and browsing: (1) supplementary feeding providing additional energy and protein to grow cattle at a rate of more than one kg per day in order to fatten them on pasture and get them ready for the market; (2) supplementing with phosphate, salt, and mineral licks to compensate for the lack of minerals; (3) feeding a balanced ration to zero-grazed animals in feedlots; and (4) feeding for survival in drought years just to keep the animals alive. The Kingdom of eSwatini imports live cattle mainly from the Republic of South Africa. An overview of the live animals imported in eSwatini during the last 20 months shows that the live cattle (excluding the pure-bred cattle for breeding) are dominant imports for this segment. It must be noted, however, that in March and August, the country buys cattle from abroad for breeding at the calving time during winter's driest point.

Partner	Items	Monthly Average 2016	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17
RSA	Pure-Bred Cattle for Breeding	13	0	0	550	0	282	0	17	650	0	0
	Live Cattle	1,065	515	607	1,314	2,699	874	433	690	0	1,577	1,414
	Live Bovine	2	0	0	92	0	0	8	0	0	0	532
Live animals		1,080	515	607	1,956	2,699	1,156	441	707	650	1,577	1,946

TABLE 9 - LIVE-CATTLE IMPORTS IN ESWATINI

Source: authors' calculations from eSwatini Revenue Authority.

The carcasses or half-carcasses of bovine animals, fresh or chilled bovine cuts, as well as fresh or chilled boneless bovine meat represent between 71 and 98% of beef imports.

Partner	Items	Average year 2016	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
RSA	Carcasses or Half-Carcasses of Bovine Animals	2,855	3,616	1,824	4,039	3,965	4,133	3,689	3,316	4,080	2,913
RSA	Fresh or Chilled Bovine Cuts, With Bone In	5,552	4,340	4,815	4,872	5,225	6,592	4,607	4,529	5,786	6,053
Botswana	Fresh or Chilled Bovine Meat, Boneless	5	0	0	0	0	0	0	0	0	0
RSA	Fresh or Chilled Bovine Meat, Boneless	803	1,002	1,287	1,064	1,458	971	2,263	949	2,355	1,390
RSA	Frozen Bovine Carcasses and Half-Carcasses	69	74	580	48	149	2	7	1	0	0
RSA	Frozen Bovine Cuts, With Bone In	329	35	1,169	0	687	161	0	611	1,398	665
ralia	Frozen, Boneless Meat of Bovine Animals	3	0	0	0	0	0	0	0	161	0
Uruguay	Frozen, Boneless Meat of Bovine Animals	75	0	0	0	0	0	0	0	0	0
RSA	Frozen, Boneless Meat of Bovine Animals	236	57	1,468	1,278	401	12	176	164	967	94
Frozen and fresh meat (SZL 1000,000)		0.993	9.12	11.14	11.30	11.89	11.87	10.74	9.57	14.75	11.12

TABLE 10 - MEAT IMPORTS IN ESWATINI (SZL1,000)
Source: authors' calculations from eSwatini Revenue Authority

All these cattle and meats are imported in eSwatini through multiple channels, passing all the stages of the value chain from production to end-consumption.

Production Systems

eSwatini's livestock sector could be portrayed as a dual system between commercial and communal livestock keepers and modern and traditional systems. However, in a context of inadequate information, we choose for this study to describe the complex reality of the livestock sector's overall blueprint that can be addressed with the following main categories: the primary stage production characterized by the non-market-oriented small-scale cattle farmers on SNL, the secondary stage production consisting of market-oriented small-scale fattener and traders on both SNL and TDL, and finally the tertiary stage production characterized by the ranch farmers and feedlot operators. These groups differ in their expectations, norms, and daily practices.

Given the lack of comprehensive and consistently updated information on small-scale farming, which is a very important node for the beef value chain, we will use various information sources and triangulate them

to provide as realistic as possible a description of the role and function of smallholders in the beef sector. Data was collected both from primary and secondary sources. The main sources are described below:

1. A rapid survey based on ten in-depth questionnaires was conducted to collect primary data and determine smallholder archetypes.
2. An existing ILRI baseline survey to analyse income received from cattle trading and other activities, involvement in contractual agreements, socioeconomic characteristics, cattle production, marketing practices, and access to credit. ***The ILRI survey was conducted in two steps: an initial study using focus group discussions between October 2013 and February 2014 on 111 people interviewed by ILRI among which 53 are cattle producers, 36 cattle fatteners, and 22 cattle traders***. The ILRI survey was geographically limited to the SWADE project targeted areas in the Lowveld region particularly in the Lubombo and Hhohho Districts.
3. Other secondary information has been gleaned from various organizations in eSwatini including the MoA, the National Statistical Services, the SWADE, Technoserve, SMI, WFP, FAO, and private actors of the beef value chain. Information gathered during a deep literature review consolidated the analysis.

Primary Stage Production: Non-market-oriented Small-scale Farming

Sociologically, most cattle owners are men. Most of the 53 cattle producers interviewed by the ILRI team were men as well. Cattle producers mainly draw their income from cattle activities even if they declare income also from crop sales (sugarcane, maize, vegetables etc.) and other non-agricultural sources. Cattle producers are clearly invested in livestock rearing and diversification in crop production. Few of them can be led to provide slaughtering services.

Most cattle are managed in extensive systems on common grazing land (100% of cattle producers). Swazi cattle farmers who grow crops on SNL lack secure land tenure. Cattle producers indicated the use of a mixed system where grazing prevails when pasture is available with supplementation of crop residues, fodder, and feed during the dry season.

Variable	Level	Cattle producers (N=53)
Type of cattle production (%)	Zero grazing	0.0
	Grazing	100.0
	Mixed	45.3
Type of Grazing (%)	Communal	100.0
	Private	7.5
	Rangeland	34.0
	Zero	0.0
Type of feed used (%)	Pasture	98.1
	Crop residues	60.4
	Sugarcane residues	20.8
	Hay	15.1
	Conserved fodder	7.5
	Industrial Feed	0.0

TABLE 11 - CATTLE PRODUCTION SYSTEM
Source: Mtimet et al, 2015

Given that the ILRI targeted areas are mainly located in the Lowveld, which is very vulnerable to drought episodes but where access to irrigated agriculture is possible, 60% of cattle producers also use crop residues for animal feeding. The use of sugarcane tops remains relatively quite low among farmers although this residue of the sugarcane industry abounds in the region.

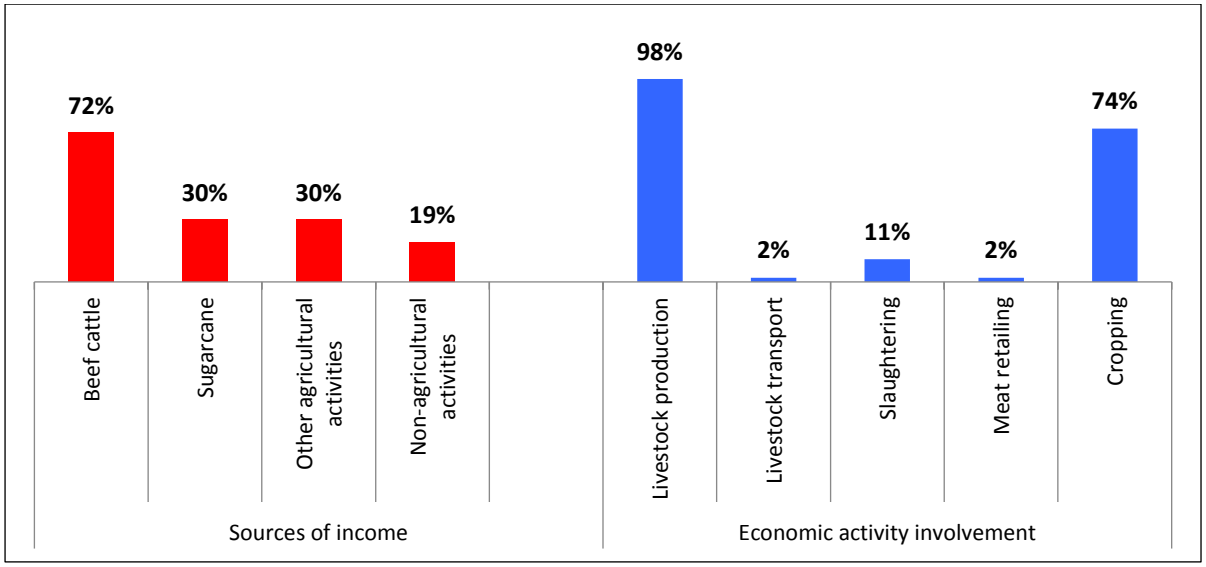


FIGURE 2.8: MAJOR SOURCES OF INCOME AND PRIMARY ACTIVITIES OF THE 53 CATTLE PRODUCERS INTERVIEWED BY ILRI TEAM
Source: From Mtimet et al, 2015. Multiple choice was possible.

Cattle rearing constitutes the main business activity for most cattle producers (98%), with beef cattle providing the main source of income for 72%.

Obviously, cattle producers indicate that they own more cattle in their herds. Here also, it is important to note that cattle production is not an exclusive activity: 51 to 60% of farmers engage in additional goat and poultry activities, respectively. Marginally, only six percent% of cattle producers are involved in piggery activities.

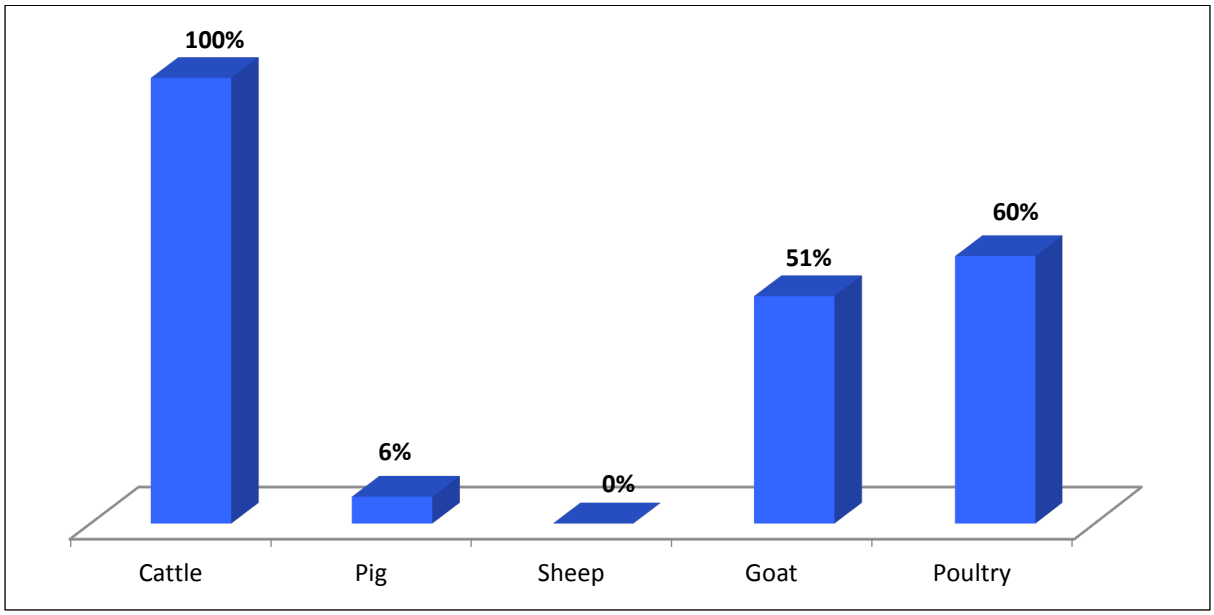


FIGURE 2.9: LIVESTOCK REARING IN THE SMALL-SCALE FARMING SYSTEMS OF THE 53 CATTLE PRODUCERS INTERVIEWED BY ILRI TEAM IN SNL
Source: Mtimet et al, 2015.

All livestock keepers rear cattle. The mean herd size for cattle producers is 17.5 head with a high dispersion of the size herd between interviewees (standard deviation of 14.6), which confirms the disparity of cattle ownership within this category. More cattle producers have female cattle than male cattle; this illustrates the trend against selling female cattle if there are no immediate consumption needs. Forty percent of cattle producers own male cattle older than four years (Min=1; Max=9; Mean=3.4). Results also indicate that most

cattle farmers own young rather than old cattle, which could point to a possible increase in cattle-fattening activities and a possible slightly higher propensity of farmers to sell animals.

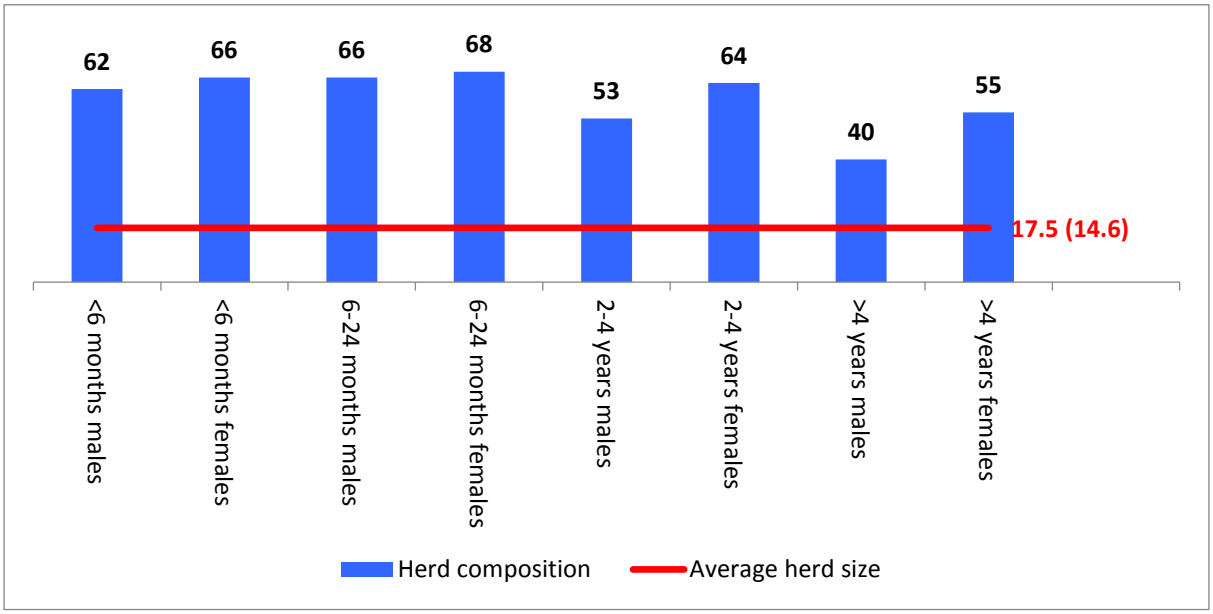


FIGURE 2.10: COMPOSITION OF THE HERD SIZE FOR THE 53 CATTLE PRODUCERS INTERVIEWED BY ILRI TEAM
Source: Mtimet et al, 2015. Multiple selection was possible.

On average, the other business activities provide between E1000 and E2000 monthly to cattle producers. However, herders who do not systematically seek to maximize cash income dominate the primary production stage of cattle in eSwatini. Their objective seems to be to guarantee their own consumption along with other long-term social goals. These herders do not focus on being pinned to increasing potential demand, given that they hold their animals at a value, which already goes beyond a selling price that they can forego. The high percentage of cattle producers (72%) deriving their income from beef cattle does not mean they are market-oriented. As economic actors living under climatic, economic, and social uncertainties, they continue to pursue a composite utility function that balances their short-term consumption needs (for instance household expenditures, school fees, medication etc.) and long-term herd-building strategy to meet future consumption. For these reasons, they participate in the market in an opportunistic way. Market fundamentals are not the primary drivers; cultural, social, and non-commercial factors often play a more significant role in producers' decision to sell. ***As proof of this behaviour, about 2% of cattle producers interviewed by the ILRI project team had not sold cattle in the past two years. Beyond the injunction to cattle producers to commercialize livestock production to derive more income and improve livestock production's economic status nation-wide, their main motivations to sell cattle must be better addressed.***

Understanding the level of assets owned by cattle producers may help to see how they can mobilize these assets to cope with or recover from various shocks.

- Livestock's Ownership

Livestock keeping traditionally provided a degree of social status in eSwatini. Obviously, all cattle farmers interviewed own livestock such as cattle, goat, sheep, and chicken, but even in urban areas most people are livestock owners. Cattle distribution among cattle producers on the SNL ranges from 2 to 74. These figures should be considered cautiously as they are based on declarations that are usually biased given various social and cultural beliefs about counting live assets, as well as economic rumours regarding livestock taxation (Times of Swaziland, 2014). Cattle ownership distribution is skewed with 92% of cattle producers owning less than 40 cattle while only eight percent of them retain more.

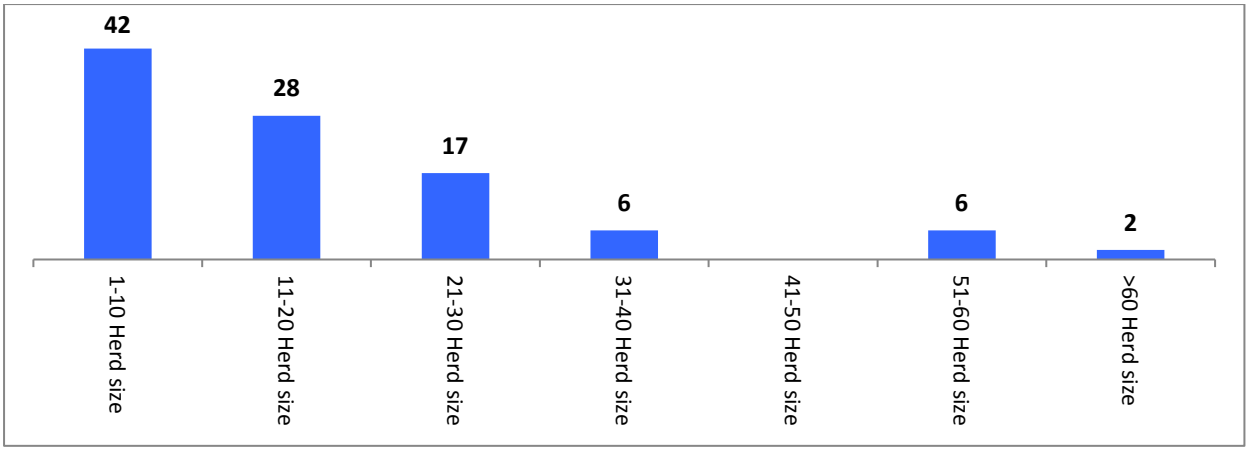


FIGURE 2.11: CATTLE DISTRIBUTION AMONG THE 53 CATTLE PRODUCERS (IN %)
Source: Mtimet et al, 2015.

- Land Ownership

One of the most significant and challenging issues for many smallholder farmers is the lack of secure land tenure, specifically the lack of title deeds on SNL. Cattle farmers usually have usufruct rights allocated by local Chiefs who manage land on behalf of the King. According to Tengetile (2016), the average land size allocated per farmer was two hectares (ranging from 0 ha to 15 ha) while in the ILRI targeted areas, cattle farmers benefitted from an average land size of 3.5 hectares mainly used for household gardens, maize, and cotton farming. A few cattle farmers (13.2%) can be led to share land for farming during the rainy season and for grazing during the off-season (Tengetile, 2016).

- Ownership of Other Assets

The lack of access to land ownership illustrates the difficulties cattle farmers face investing in land productivity through credit facilities. Since they do not hold title deeds to the land, smallholder farmers have no way to use the land on which they are doing their business and making a living as collateral. However, the ability to count on productive assets to obtain food and basic needs during the annual lean season or unanticipated shocks is an important coping strategy for most farmers in Sub-Saharan Africa. Almost all the cattle farmers in the ILRI targeted areas (98%) have a permanent homestead in the SNL where there are no title deeds. Very few of them (around two percent) benefit from income from rental buildings. Twenty-five percent of them own a second-hand vehicle so in general few have useable collateral for insurance or credit.

Asset	Cattle Producers (percent%)
Rental buildings	1.9
Permanent home	98.1
Vehicle ownership	20.8
Land	86.8
Plough	15.1
Bicycle	7.5

TABLE 12 - OTHER ASSETS OWNERSHIP
Source: Mtimet et al, 2015.

Secondary Stage Production: Market-Oriented Farming

Small-scale Farming on SNL

Again, the ILRI survey interviewed 36 cattle fatteners and 22 cattle traders.

The market-oriented process is an important phase to add value to cattle production. In this secondary stage production, there are two primary actors: the small-scale cattle fatteners and the small-scale traders. The latter are not mainly interested in fattening operations.

Cattle production is the main source of income for 67% of interviewed cattle fatteners. On the other side, cattle traders have multiple economic activities, namely in cash crops (sugarcane) and other non-agricultural activities (retailing). Only 45% of them declared cattle trading as their main business activity.

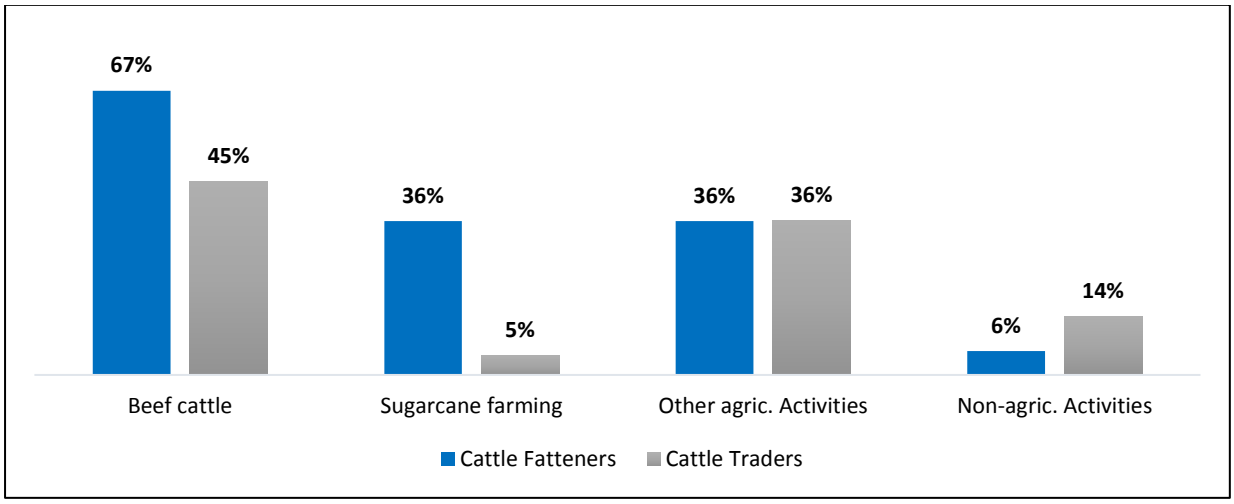


FIGURE 2.12: MAJOR SOURCES OF INCOME AMONG THE 36 CATTLE FATTENERS AND 22 CATTLE TRADERS INTERVIEWED BY ILRI TEAM
Source: Mtimet et al, 2015.

Fatteners are involved in livestock production and cropping. For cattle rearing, they are mostly involved in production and fattening operations. Some of them may perform complementary activities related to transport, slaughtering, or meat retailing. In turn, the other cattle traders are involved in many livestock and agricultural activities with clear behaviour aimed at reducing risk by diversifying their activities and generating additional incomes. They combine livestock production, fattening, transport, slaughtering, up to meat processing, and retailing. For about half of them, cropping remains an important economic activity. In terms of reared livestock species, while traders indicated cattle among the three most ranked species, only 69% of fatteners provided the same response. ***It seems that economic uncertainty around the viability of cattle fattening has led an increasing number of them to abandon this activity.***

Income diversification for both cattle fatteners and cattle traders ranges between SZL1000-SZL2000 and SZL2001-SZL5000 respectively. Cattle trading contributes 40% of cattle traders' overall income.

As for cattle producers, understanding the level of assets owned by cattle fatteners and traders would help to approximate their ability to cope with various shocks. Thus, in terms of endowment, land is the most important asset as most of the respondents derive their livelihood from farm-based activities. The average land size for cattle fatteners and traders interviewed was 2.3 and 3.8 hectares respectively, mainly devoted to agricultural activities (vegetables, maize, and cotton). During the off-season, cattle can graze in the fields. Apart from land and cattle ownership, farmers own various assets such as vehicles, ploughs, and permanent houses that could be decisive in decision-making processes for accessing credit operations.

Asset	Cattle Fatteners (%) (n=36)	Cattle Traders (%) (n=22)
Rental buildings	0.0	9.1
Permanent home	91.7	100.0
Vehicle ownership	25.0	54.5
Land	72.2	77.3
Plough	0.0	4.5
Bicycle	8.0	0.0

TABLE 13 - ASSET OWNERSHIP FOR THE 36 CATTLE FATTENERS AND 22 CATTLE TRADERS INTERVIEWED BY ILRI TEAM
Source: Mtimet et al, 2015.

In terms of livestock ownership distribution, cattle fatteners' livestock ownership is almost distributed for a herd size of up to 40 cattle. Only three percent of cattle fatteners own more than 60 animals.

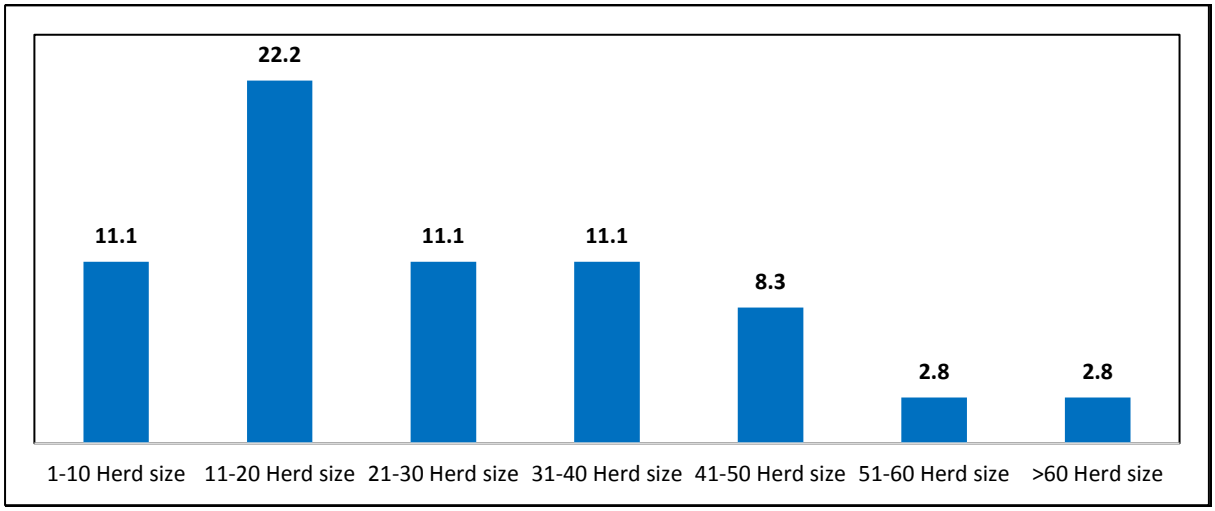


FIGURE 2.13: CATTLE DISTRIBUTION AMONG THE 36 CATTLE TRADERS AND 22 CATTLE FATTENERS (%)
Source: Mtimet et al, 2015.

The mean herd size for cattle fatteners is 18.4, with a high disparity of cattle ownership within this category. Forty-seven percent of cattle fatteners own male cattle and most of them are young (< two years); this situation illustrates a certain propensity to fatten and sell animals. Their figures show that these two actors are slightly different from the non-market oriented (with an average herd size of 17.5) but fundamentally, the small-scale farmers own cattle for various reasons besides market purposes.

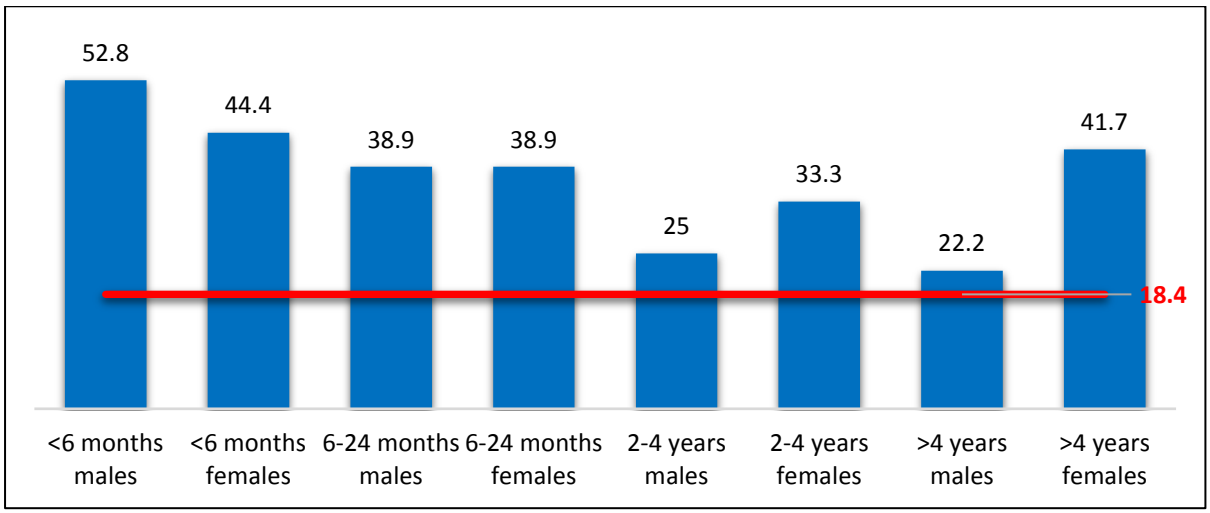


FIGURE 2.14: COMPOSITION OF HERD SIZE (IN RED: AVERAGE HERD SIZE) FOR THE 36 CATTLE FATTENERS
Source: Mtimet et al, 2015.

Two-thirds of cattle fatteners interviewed indicate that extensive systems are the most common, meaning that their cattle are grazed on the SNL. Unlike the cattle producers who keep their animals longer, cattle fatteners seem to be more interested in market dynamics. Twenty-five % of them indicated the exclusive use of stall-feed system (zero grazing), while others indicated the use of a mixed system where grazing prevails when pasture is available, supplemented by crop residues, fodder, and feed during the dry season. Very few of them use industrial feed. This illustrates the interlinked issues involved in fattening operations: access to higher feed quality and low fattening productivity.

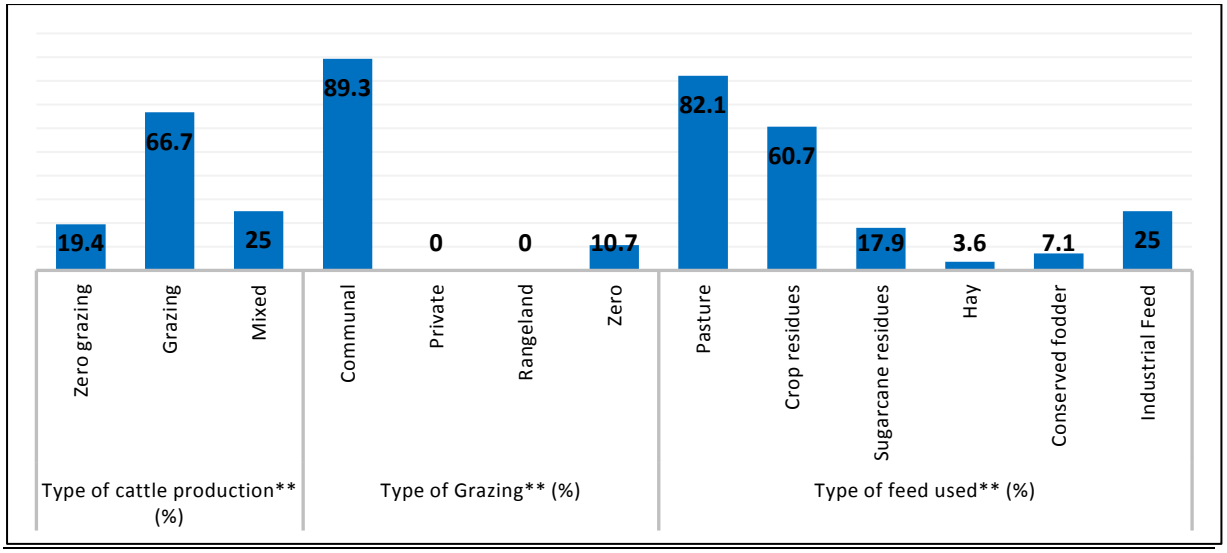


FIGURE 2.15: CATTLE PRODUCTION SYSTEM (36 FATTENERS)*
Source: Mtimet et al, 2015.

** This number corresponds to the fatteners who are currently (during the last 12 months) undertaking fattening activities. The rest of group respondents indicated that they have not been involved in animal production. **Multiple selection was possible.*

Contrary to cattle producers who are reluctant to sell their animals (on average 1.10 animals per year), cattle fatteners considered to be more market-oriented still have very low market sales (on average 1.17 animals per year). ***As expected, cattle traders have the highest number of cattle sold per year (more than 37)***. However, it is important to note a strong disparity in sales between these two categories.

Cattle fatteners mainly sell mature male cattle (three to five per year) that fulfill more market fundamentals while cattle traders' sales vary from weaners up to mature male cattle. They also sell old cows but less frequently.

Variable	Cattle Fatteners (%) (n=36)	Cattle Traders (%) (n=22)
Type of cattle:		
Weaners	16.7	63.5
1-2-year steers/bull	16.7	40.8
3-5-year male cattle	30.6	40.8
Old cows	2.8	22.7
Number sold per year**	18.35 (36.10)	37.52 (47.47)
Price**	20.51(4.88) E/kg	

*TABLE 14 - TYPE OF CATTLE SOLD**
*Source: Mtimet et al, 2015. **Multiple selection was possible.*

Cattle fatteners supply SMI, the biggest meat exporter in eSwatini, as well as several other butchers. Although the same proportion of cattle fatteners (44%) state they use these two marketing channels, they clearly indicate that they give priority to selling to SMI. Only 19% stated that butcheries constitute their first-preference clients. This situation can be explained by oral contractual arrangements existing between SMI and its suppliers and seems to result in more stable relationships even if these verbal agreements may also exist between fatteners and butchers.

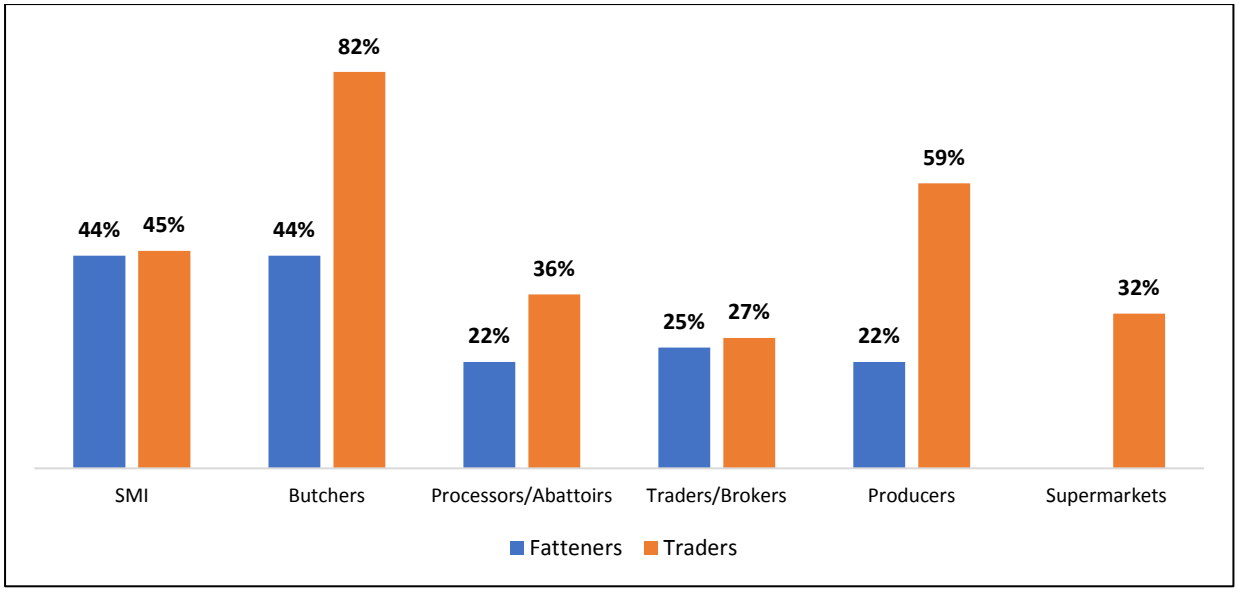


FIGURE 2.16 - MARKETING CHANNELS **MULTIPLE SELECTION WAS POSSIBLE.*
Source: Mtimet et al, 2015.

As for cattle traders, marketing channels are more diversified and dominated, in order of importance, by butchers (82%), cattle fatteners and cattle traders (59%), SMI (45%), processors-abattoirs (36%), supermarkets (32%), and other traders-brokers (27%).

Regarding the selling price, cattle producers sold an animal with an average weight between 180 and 220 kg at an average price of SZL4382.68 while cattle fatteners mostly sold animals based on live weight (in Emalangeni per kilogram), at an average cost of 20.51 SZL/kg (usually for an animal with an average weight between 270 to 310 kg).

For animal sourcing, almost all cattle traders purchased animals from cattle producers that have a crucial role in the beef value chain in eSwatini.

The type of cattle purchased by cattle traders from cattle producers and the reasons/purpose for purchasing are varied. Almost two-thirds of traders purchased weaners, half of them purchased one to two-year-old steers/bulls, and one-third purchased three to five-year-old male cattle, while only 23% of them purchased old cows during the last 12 months. Most cattle traders indicated that they sell the animals soon after purchase, acting as brokers or intermediaries, and more than half of them fatten the animals for later.

Each season there are changes in the number of cattle being purchased or sold. 46% of cattle traders stated that the number of cattle they purchased has decreased compared to previous years, 18% traders have experienced constant purchases, and 14% have recorded an increase in the number of cattle purchased. Cattle traders cited many reasons for the decrease or constant supply of cattle: 64% of traders had credit challenges, 46% cited pricing issues (cattle were expensive, high transaction costs), and contradicting the Swazi situation, only nine percent cited shortage of cattle supply as a reason for decrease in cattle purchase. The mean number of cattle purchased per year by a cattle trader is 52.47.

These various market motivations and behaviours are symptomatic of the complexity of livestock rearing and marketing that makes it difficult to implement a quantitative value chain analysis even by simplifying a lot.

Variable	Definition	Cattle Traders (%) (n=22)
Type of cattle*	Weaners 1-2year old steers/bull 3-5year male cattle Old cows	63.6 45.5 31.8 22.7
Reason for purchase*	Fattening for later sale Sale after purchase Slaughtering and sale Breeding stock	54.5 77.3 31.8 4.5
Changes in no./purpose	Increase Decrease Constant	13.6 45.5 18.2
Reasons for changes*	Feed Credit Pricing issues Market situation Supply of cattle	4.5 63.6 45.5 31.8 9.1
First ranked cattle supplier	Producers Collectors/traders	94.7 5.3
Number purchased per year**		52.47

TABLE 15 - TYPE OF CATTLE PURCHASED FROM CATTLE PRODUCERS
*Source: Mtimet et al, 2015. **Multiple selection was possible.*

Commercial Cattle Production on the TDL

Commercial cattle production on TDL accounts for about 13% of the national herd. Generally, commercial ranches are held under freehold or concession agreements. Beef cattle in TDL are raised for beef production and do not produce milk.

Commercial production systems are medium- to high-input systems characterized by profit-oriented management practices that feature the use of improved genetics and careful attention to improved health and nutrition. Commercial producers also rely heavily on grazing on natural pasture and crop residues to fatten their animals, but they supplement with manufactured feed concentrates, especially during the winter. Although some commercial producers take advantage of public extension services, most of them have their own support services including private veterinarians to vaccinate their animals against diseases and treat them for parasites. Stocking rates are optimized to ensure that animals reach slaughter weight rapidly and cost-effectively.
Tertiary Stage Production: Feedlotting, Breeding and SISA Ranching

- Feedlotting
  A feedlot is a holding where food-producing animals are kept for fattening for a specified period, usually 90 days. eSwatini distinguishes a feedlot that is registered as a single dip-tank and a farm-holding, normally on the TDL, from one which is registered as a kraal within a dip-tank area, normally on the SNL. ***How feedlotting is considered (either as an improved production process or a transformation process) can significantly influence quantitative livestock value chain analysis.***

The feedlotting process is supposed to improve the quality of the beef and dressing-out percentages depending on breed and how the animal is raised. Feedlot feeding can also positively impact the eating qualities of the beef from the consumer's perspective. Fattening cattle should enable farmers to obtain much higher prices for their livestock than selling them skinny, straight off the rangeland. Feedlotting allows farmers on the SNL to fatten cattle enough to obtain high prices from butcheries and abattoirs. At the same time, it would be useful to really assess the effects of feedlotting on farmers' income and other non-monetary advantages. In addition, feedlots have the potential to address the shortage of feed caused by overgrazing

and add a lot of value to cattle available for sale. The smallholder SNL feedlots also known as Smallholder Fattening Units (SFU) are registered by regional veterinary authorities in a process that requires exemption of the animals in that feedlot from attending dipping at a public dip-tank facility as required by law. The number of 'active' SFUs is subject to change from year to year depending on farmer interest and the prevailing economic situation.

Regions	Registered Smallholder Fattening Units as at Dec 2014
Hhohho	44
Lubombo	32
Manzini	11
Shiselweni	5
Total	**92**

TABLE 16 - NUMBER OF SMALLHOLDER FATTENING UNITS (SFU) AS OF DECEMBER 2014
Source: MOA (2014).

In 2003, the GoS and eSwatini Meat Industries (SMI) organized a vast campaign to promote the use of feedlots to finish beef cattle. The country has 166 registered feedlots as of December 2008. However, many have since gone out of business as only 16% of registered feedlots really operated. This continuous failure can be explained both by the high cost of feed and stable beef prices, which caused the number of registered feedlots to fall from 160 to 92 in 2014 until reaching 55 currently, according to the MOA. Despite the existence of many feedlots, cattle in eSwatini is mostly raised by smallholder farmers using communal pastures on SNL where they increasingly face feed issues.

Almost all commercial beef producers in eSwatini, regardless of their size, use a combination of grazing and feedlots. Feedlots are used by smallholders operating on SNL and by commercial farmers operating on TDL. Cattle raised on smallholder feedlots are mainly sold to SMI, which supplies the export market, while those raised on commercial feedlots are destined for SMI but increasingly diverted by the domestic market.

Despite high feed costs, recent feedlot implementation, including inclusive financing and innovative feeding methods as well as well-structured value chains, has shown that feedlotters can make at least E12 000 after tax profit from 20 cattle per cycle (ILRI, 2017).

It is important to note that the GoS launched fattening ranches to attract animals on SNL and to improve them properly with standardized management practices. The GoS also raised incentives to facilitate off-take and then reduce grazing impact and pressure on SNL. The mechanism introduced consisted of charging monthly management fees that can be levied when farmers sell their animals. Unfortunately, this business model proved to be economically unsustainable.

- Breeding and SISA ranching
  The GoS started to promote weaner-based production to increase beef production using the same or fewer grazing resources, facilitating access to breeding ranches. The implicit idea was both to increase the number of cattle available for slaughter and to reduce fluctuations in supply. A bull loan scheme was adopted, providing high quality breeding bulls to consolidate and improve the cattle's genetics. These ranches are used to research feeding, breeding, and nutrition issues. ***All these mechanisms aim to support commercial producers who rely on feedlots and face issues of inadequate feeder stock supplies and excessively high feed costs during certain periods, thus tackling the problem of limited availability and resulting high feed costs.***

Slaughtering and Processing

The MOA-DVLS plays a central role in beef processing with a focus on the sole export licensee SMI (Swazi Meat Industries) that mobilizes 23 highly-qualified experts including two veterinarians, eighteen meat inspectors, and three Labouratory staff. In addition to SMI, the slaughtering sector implies two other processes: home slaughtering and commercial slaughtering.

	Regions	2015							2017
		Bulls	Oxen	Steers	Young Bulls	Cows	Heifers	Total Cattle	Total Cattle
Butcheries and municipal abattoirs	Hhohho	423	606	23	0	504	13	1,569	1,902
	Lubombo	1,299	2,016	296	0	2,373	317	6,301	5,548
	Manzini	3,041	1,447	2,652	0	3,560	211	10,911	7,456
	Shiselweni	122	252	14	0	149	5	542	1,037
	Totals	4,885	4,321	2,985	0	6,586	546	19,323	15,943
Cattle slaughtered at home for home consumption and domestic market	Hhohho	621	2,786	0	731	2,319	153	6,610	7,006
	Lubombo	425	1,560	0	1,063	2,405	251	5,704	4,777
	Manzini	538	2,275	0	685	2,656	302	6,456	7,607
	Shiselweni	690	3,474	0	618	3,631	314	8,727	8,086
	Totals	2,274	10,202	0	3,097	11,011	1,020	27,497	27,476
SMI	Totals	2,455	862	81	2,411	3,056	157	9,022	4,997

TABLE 17 - STRUCTURE AND DISTRIBUTION OF CATTLE SLAUGHTERING IN ESWATINI IN 2015 AND 2017. SOURCE: MOA, 2016.

- ***Home slaughter***: ***a fair proportion of slaughtering takes place at home (51% in 2015 and 57% in 2017)*** meaning that for the domestic market, cattle continue to be slaughtered in unhygienic places such as on rural slabs and under trees in the bush, without officials inspecting carcasses to certify safety for consumption. Cattle categorized as "slaughtered for home consumption" include those slaughtered for traditional ceremonies, parties, and funerals. The total 27,497 cattle slaughtered produced an estimated 4,949.46 tons of beef, valued at an estimated E 96,514,470.00 (unit price of E19.50/kg). It should be noted that most of these animals were from smallholder farmers on the SNL, highlighting the significant contribution of smallholder beef farming to the country's economy and in feeding the nation. In what has become an established trend, cows and oxen were the classes with the highest numbers, respectively; however, this time an influential factor could be the drought, which forced farmers to salvage the value of their cattle rather than watch them starve to death.
- ***Commercial slaughter***: approximately 215 butchers slaughter animals (**31% in 2015 and 33% in 2017**) on a commercial basis. The slaughter slabs process about 16 carcasses per week which are then placed in a cold chain. However, many small butchers would not be able to meet the basic requirements in terms of hygiene methods and processing standards for marketing beyond national borders. These deficiencies push big retailers to emphasize meat imports due to easy sourcing since butchers, with insufficient capacities, sell meat through their butchery outlets.
- ***Export slaughter*** with the Swazi Meat Industries (SMI): the SMI is, by far, the largest slaughterhouse (**18% in 2015 and 10% in 2017 of annual slaughtering**) in the country and the only entity with an export license. It is also presented as the only company in eSwatini that can meet and increase its export quota over the years as well as maintain the AA grade in the British Retail Consortium's Food and Health Standards. The facility is currently running far below capacity of 31,000 tons. In the beef market, SMI appears as a price maker while other competitors develop a strong strategy to leverage lower overhead and operating costs to offer a premium. SMI sells the best-deboned cuts to the European continent and more specifically to Norway (26% by weight), while the remaining portions are sent mostly to Mozambique. Animals processed and sold by SMI originate by ***13 % from local cattle supply provided by smallholders, by 31% from commercial farmers, and by 56% from a feedlot scheme, which is organized and supported by SMI***. Beyond bargaining on quantitative supply, qualitative aspects remain an issue also. For animal sourcing, SMI struggles to incentivize smallholders to engage in business as producers argue that SMI purchase prices are lower than market prices. This encourages smallholders to develop opportunistic approaches vis-à-vis the markets. SMI provides meat to most supermarkets as well as other retail outlets and directly to consumers through the factory gate shop. For the European market, SMI only provides Simunye Beef products. Generally cuts are delivered to Switzerland by sea freight as well as airfreight. The export beef is all registered as Halaal by the South African Halaal Authority (SANHA). Clients from eSwatini and Mozambique can purchase Halaal products directly from the export plant by prior arrangement.

An average carcass mass of 180kg at the lowest carcass grade (GAQ) priced at E 19.50/kg was used to produce a calculated estimate of the monetary value of the beef produced. There is a trend almost like that observed in the cattle slaughtered in municipal abattoirs and butcheries as well as those slaughtered for home consumption. In 2015, there was a significantly higher ($P < 0.05$) number of cows and a significantly lower number of oxen ($P < 0.05$) slaughtered at the abattoir, when compared to previous years. The number of cattle slaughtered at the export abattoir in 2015 increased to 9,022 from 6,343 in 2014. The animal class composition of slaughter cattle from the SNL and the TDL are distinctly different with the majority comprising cows (50%) and bulls (25%) on SNL. In contrast, the young bulls (52%) and bulls (31%) were the predominant classes from the TDL.

Beef Production and Demand

The amount of beef produced from cattle slaughtered in municipal abattoirs and butcheries in the country increased from approximately 3,140.28 tons in 2014 to approximately 3,478.14 tons in 2015. A further 4,949.46 tons of beef was produced from cattle slaughtered at home for home consumption and approximately 1,623.96 tons of beef produced from cattle slaughtered at eSwatini Meat Industries; an increase from 1,141.74 tons in 2014. The amount of unprocessed beef imported solely for domestic consumption has continued to increase annually from the 2,354.98 tons and 3,281.36 tons imported in 2013 and 2014, respectively to the 6,855.20 tons imported in 2015.

The amount of locally produced primal beef cuts exports increased from 434.03 tons in 2014 to 639.14 tons in 2015. In total, the domestic consumption or demand for beef (unprocessed) for eSwatini increased from approximately 12,488.31 tons in 2014 to an estimated 16,267.62 tons in 2015. Considered at the lowest local beef carcass grade (GAQ) price of 19.50 SZL/kg, the carcass value of the domestic demand for beef in the year 2015 was at least SZL317,218,612.82. It should be noted that these figures only refer to beef and not to other processed meats produced from bovine carcasses.

Beef Imports

It should be noted that the monetary values of the classes of meat shown in Table 21 were sourced from SRA data. Prices of the different types of meat vary depending on the source as well as the Rand/Dollar exchange rate at importation.

Year	Chilled Beef (SZL)	Frozen Beef (SZL)	Bovine Liver (SZL)	Bovine Tongue (SZL)	Bovine Offal (SZL)	Processed Beef (SZL)
2012	98,395,370.81	8,368,097.13	2,287,305.17	386,963.97	4,078,620.98	1,088,469.12
2013	83,688,924.90	7,601,370.47	4,033,713.00	413,272.00	5,370,556.00	11,582.70
2014	89,081,592.20	11,499,125.36	5,366,360.04	2,328.41	5,637,460.97	757,271.23
2015	115,813,559.13	9,423,327.69	4,381,742.67	0.00	2,653,847.37	868,524.80

TABLE 18 - CLASSES OF BEEF IMPORTED INTO ESWATINI BETWEEN 2012 AND 2015.
Source: UN Comtrade.

Retailing and Distribution

As with many Southern African countries, three types of retail outlets dominate domestic retail of fresh and processed beef: rural and urban butchers, supermarkets and cash-and-carry stores (modern retail), and restaurants. They are characterized by the diversity of their size and level of sophistication.

3. Economic Analysis of the Beef Value Chain

3.1 Methodology for Study and Economic Analysis

There are three main strands to this methodology:

- Construction of agents' operating accounts, prices, and volumes from field surveys.
- The use of AFA software as a tool for transcribing all sub-sectors, as well as for macroeconomic analysis.
- The formulation of relevant assumptions used for analyses.

Finally, we will present the scope and limitations of the financial analysis.

The construction of the operating accounts was done from combined interviews, some with access to detailed accounting documents and others not.

3.1.1 Construction Principle of the Operating Accounts

3.1.1.A. Informal Sector Agents

Most of the agents upstream or downstream of the sub-sectors (producers, traders) do not keep accounts or face difficulty communicating. Interviews are therefore necessary to gather and triangulate information.

3.1.1.B. Formal Sector Agents

The work, along with agents of the formal sector, consisted of carrying out a complex and exhaustive audit work to distinguish account-processing for tax purposes and those illustrating real flow of livestock products. The task of accessing information in eSwatini produced ambiguities. It also turns out that several companies provided full access to their accounting, which, paradoxically, required longer analysis and processing time.

3.1.1.C. Taxes in the Kingdom of eSwatini

The Kingdom of eSwatini's income tax system is source-based, i.e. income from a source within or deemed to be within eSwatini will be subject to taxation. Taxes are paid in two instalments in advance based on a provisional assessment, which should be at least 90% of the prior-year tax charge. There is no sales -tax in eSwatini. This was replaced by Value Added Sales-Tax (VAT). Value Added Sales-Tax (VAT) was introduced in eSwatini in April 2012. VAT is tax that charged on the consumption of goods and services in eSwatini and on the importation of goods and services into eSwatini. As far as taxes are concerned, we have mainly considered VAT charged on supplies rated by the standard 14%.

We also integrate the amount of taxes paid by formal sector agents which provided us with all official financial statements with positive results.

3.1.1.D. Subsidies, Salaries, Interest charges, Land rental, and Amortization

As far as subsidies are concerned, we only consider the medicines provided by the GoS to farmers in the SNL as a form of subsidy and integrate them in our calculations.

Regarding the salaries, we were only able to integrate the salary declared by the formal-sector agents or the informal ones, even if we are aware of the possibility that some herders could be hired and remunerated by farmers, we were not able to address these amounts properly.
The same approach was adopted for land rental in TDL (as access in communal land is not marketable) and amortization.

3.1.2 Construction Principle of Operating Accounts by Agent

The operating accounts of the software have been filled from the field surveys and from the reality observed with 2016 as the reference year.

The choice was made not to provide accounting lines by estimate in the absence of direct information from the respondents. This approach makes it possible to transcribe faithfully available economic knowledge at a given moment. This therefore leads to discrepancies and a bias for the analysis of all subsectors, but reduces the risk of erroneous information.

It should also be noted that the literature has been heavily mobilized to calculate certain parameters such as off-take rates as well as to develop some accounts like those of modern retailers.

3.2 The Off-take Rates' Analysis

Even if the MoA makes a great effort to establish general production parameters for the beef production systems (birth and mortality rates for instance), a breakdown of these parameters for each production system, and updated information on off-take rates as they are unfortunately missing.

What motivates cattle keeping and cattle rearing in communal areas is not perfectly understood. In most of Southern Africa's communal areas, cattle numbers that are not systematically correlated to environmental factors usually determine beef supply. Cattle supply responds to various factors such as prices that could have an ambivalent effect. In fact, if farmers supply cattle for immediate cash needs, increasing prices could lead them to put fewer animals on the markets. Beyond price parameters, farmers expressed that prompt payment is key in their decisions to sell cattle at auctions, which is illustrative of some failures in the marketing system (Van Renen, 1997; Sartorius Von Bach et al, 1998). This phenomenon persists in Southern Africa and has also been observed in West and East Africa where what could be divided into communal and commercial systems, beyond production aspects, are the market-differentiating behaviours of producers. On one hand, market-oriented producers in commercial systems are profit maximizers who participate in markets to buy livestock as input, fatten them after some time, and sell them as finished products at premium prices while producers in communal systems try to secure both productions and livelihoods overtime considering the uncertain overall context (Benkhe and Scoones, 1983; Wane et al., 2010). The objective function of producers in extensive and pastoralist systems is a composite utility function that balances their short-term consumption needs and long-term herd building strategy to meet future consumption. For these reasons, they participate in the market in an opportunistic way. Market fundamentals are not the primary drivers; rather cultural, social, and non-commercial factors often play a more significant role in producers' decision to sell. A consistent literature on inequality (Sen, 1981, Sutter, 1987; Wane et al., 2009; Mulder et al., 2010) and the vulnerability of pastoral populations (Swift, 1989; Ancey et al., 2009) shows the complexity of farmers' securization, as it is necessary to consider the embeddedness of social and biophysical factors within African extensive crop–livestock systems. So, grazing systems cannot be measured purely in terms of endowments as they continually evolve to accommodate entitlements in an increasingly uncertain biophysical environment and monetized commercial world (Chambers, 1990; Van Dijk, 1997; Bovin, 2000).

The farmers in eSwatini develop wary behaviour that influences the off-take rate and subsequently the value addition chains. A comprehensive work done by the FAO (1998) stated that the off-take rate is 6.3% for farmers SNL. Given the cultural and geographical proximity of South Africa, these figures are still valid today as off-take rates between five and ten percent have been reported in communal areas and 25% in South Africa's commercial systems (Musemwa et al, 2010) even if all this hide spatial disparities notably in endemic diseases areas (van Schalkwyk, 2016). In eSwatini, the Central Bank noted that 6.1% of SNL and 34.2% of TDL cattle is sold in formal markets. Figures provided by FAO, the Central Bank of eSwatini, and the literature on South African livestock sector analysis appear quite different.

Finally, based on figures and assumptions provided by the MoA on the current beef industry in eSwatini, Table 20 was compiled to better describe cattle numbers and the average national off-take rates leading to cattle supply in eSwatini's different tenure systems.

Year	2013	2014	2015	2016
Beef cattle	622,715	615,113	589,405	525,667
Dairy cows	4,771	4,818	4,835	5,783
Cattle population	627,486	619,931	594,240	531,450
Cattle population on SNL (89%)	558,463	551,739	528,874	472,991
Cattle population on TDL (11%)	69,023	68,192	65,366	58,460
Total slaughters	59,971	50,041	55,842	60,760
Commercial slaughters	32,642	23,789	28,345	31,866
Home consumption slaughters	27,329	26,252	27,497	28,894
Average national off-take rates (%)	9.6%	8.1%	9.5%	11.6%
Exports (Mt)*	1,280	1,038	1,126	983
Exports in value (E'1000) *	84,142	73,917	77,804	86,578

TABLE 19 - POTENTIAL CATTLE SUPPLY AND EXPORTS IN ESWATINI
Source: authors' calculations from MoA and SMI (for export data).

According to the annual livestock census conducted by MoA, the stock of cattle continued a downward trend from 2013 to 2016, passing from 622,715 to 531,450 head of cattle. As previously explained, multiple factors including weather issues largely affected the livestock sector's performance in 2015 and 2016 during which cattle numbers annually decreased by four percent and eleven percent respectively.

The total slaughtered cattle, including commercial abattoirs, butcheries, and home consumption, increased by 12% in 2015 and nine% in 2016, influenced by the highest records from commercial slaughters often associated with the formal sector (19% in 2015 and 12% in 2016) as well as with home consumption slaughters (informal sector) albeit at a somewhat more modest pace (five percent both in 2015 and 2016). Drought's persistence has been linked to an upturn in cattle marketing. However, this unexpected effect has led to poor quality of cattle from farmers who anticipated the drought's negative effect on feed resources. Thus, the volume of exports decreased by 12% in 2016 even if the exports in value increased in the same proportion benefitting from the exchange rate depreciation.

For the beef value chain approach, we will opt to focus calculated costs according to the cattle that is really sold by using official off-take estimates[7].

3.3 Construction of the operating accounts

This metric shows how well a company allocates and uses its resources. Investors can tell a lot from changes in this number from year to year in the same business. A growing gross profit, for example, illustrates better use of resources, more sales or lower production costs. Investors also typically compare gross profit numbers from one business to those of a competing business.

3.3.1 At the production stage

The primary stage cattle production is the most challenging node of the Swazi beef value chain. Non-market-oriented small-scale producers on which knowledge is far too fuzzy and sometimes incoherent constitute this

[7] In some countries lacking land laws and with no official land 'ownership', wealthy farmers are taking the opportunity to increase their stock and annex land to hold that stock. In that case, herd growth becomes a key parameter to consider in modeling. EU-DEVCO suggested to use an adjustment that could be a consumable in line for "herd initial stock" and as an output/product "animal" which is the part sold on the market and then "herd final stock" which will consider the increase in the herd size minus the part of sales and the losses (at an average price consider the weighted price/value for different types of animal). Thus, the value generated by the farmer will be the difference between the "herd final stock", "sale", and "herd initial stock", as well as other feeding, labor, and cash costs. In eSwatini, given the small size of the country, herd size cannot be increased indefinitely to serve carrying capacity reasons and competition for land. So, we opted to use the off-take rate given by government services.

key value chain node. The non-market-oriented small-scale farmers graze their cattle on open pastures that are communally owned and managed in the Swazi Nation Land (SNL). Mostly, they do not have individual access rights. It must be noted that these smallholders act both in production and marketing. They usually keep cattle mostly female stock if they have no immediate need for cash.

SNL cattle

The main goals of households in SNL for selling cattle are to make money to cover their usual expenses and ensure food safety. For instance, in countries with strong Islamic influence, the demand for livestock and animal product is very high during the Aid-al-Udha, so pastoralists and agro-pastoralists develop a pure *homo oeconomicus* behaviour to sell as many sheep as possible, beef being kept as savings. Thus, in the same household model, utility maximization is best achieved by increasing cash from sales during specific social and cultural events compared to other strategies. Addressing costs and profits in this context requires developing of a dual approach as suggested for public policies for livestock development in Africa (Ly et al., 2010; Nouala et al., 2011). Market fundamentals are not the primary drivers, but cultural, social, and non-commercial factors also play a significant role in producers' decisions to sell. For all these reasons, building an operating account for these actors remains very challenging due to the difficulty to comprehensively apprehend costs (informality, non-market process weakly addressed etc.). So, we propose very simple operating accounts built by the World Bank and cited by the MOA in 2016 for small-scale farmers in SNL and TDL developing forma transactions with commercial processors and informal ones with small-scale butcheries and abattoirs.

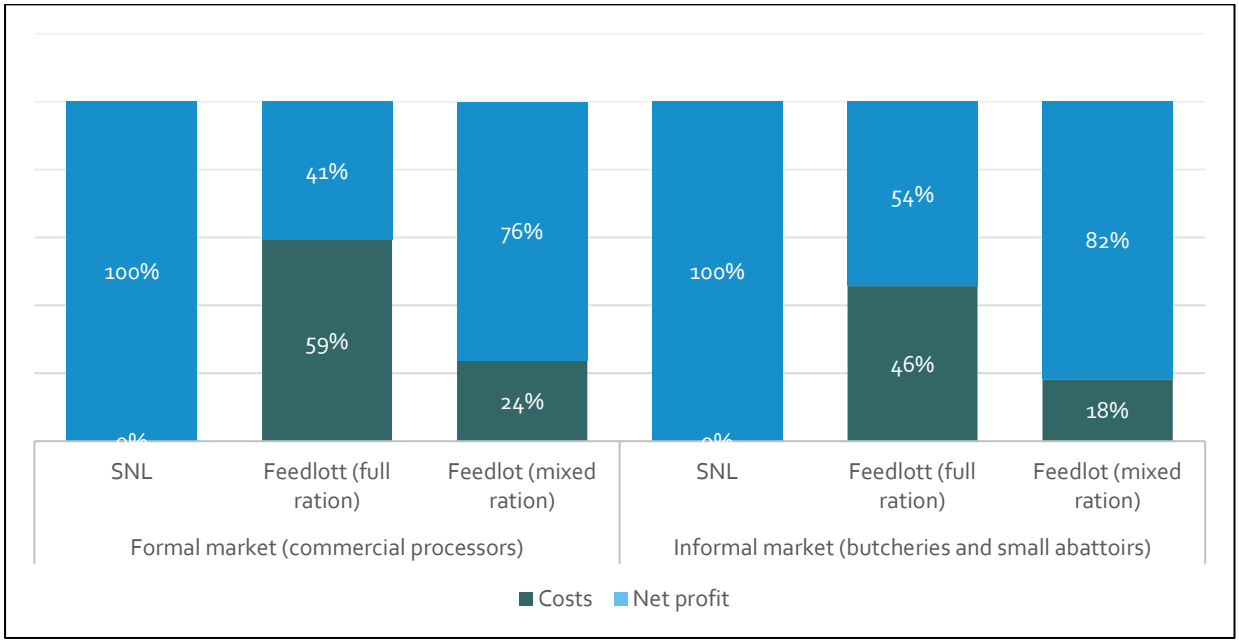


FIGURE 3.1: COSTS AND NET PROFITS OF A TYPICAL SMALL-SCALE FARMING MODEL IN SNL
Source: World Bank from MOA data (2016)

** no opportunity cost of Labour and communal grazing.* *** average selling price per kg= carcass weight of SZL27 for the formal market and SZL38 for the informal market*

TDL Cattle

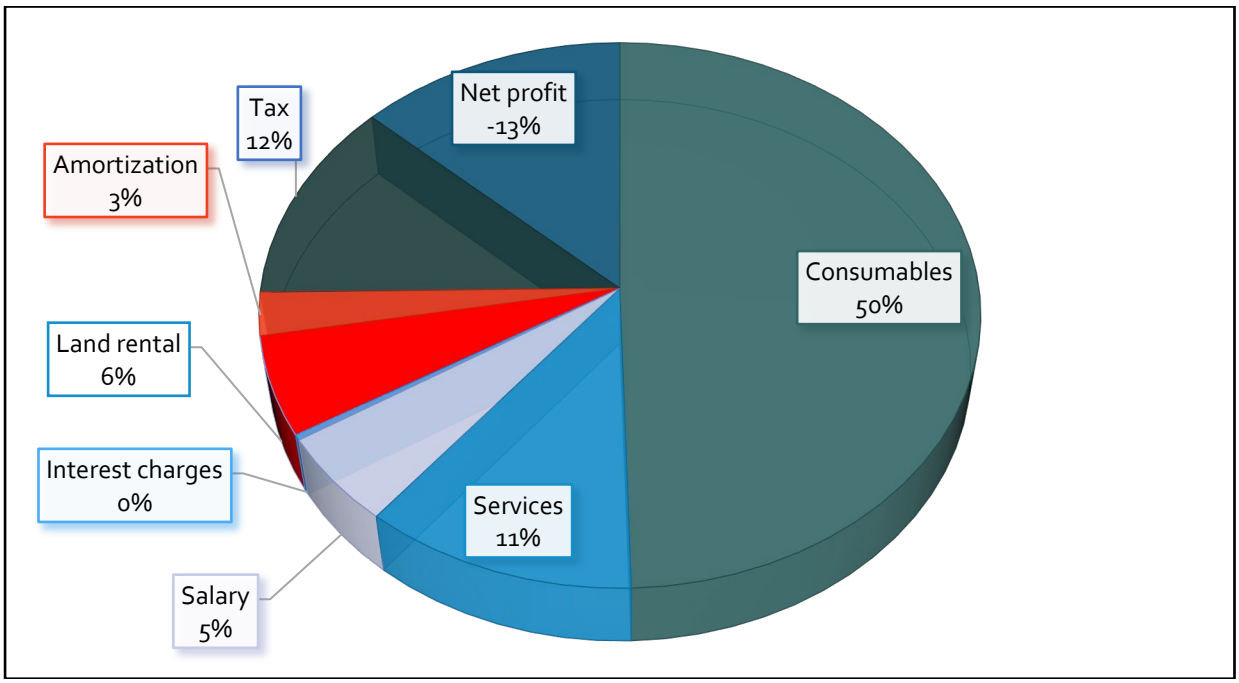


FIGURE 3.2: COSTS AND NET PROFIT OF A TYPICAL TDL FARMING MODEL IN ESWATINI.

Feedlot Cattle

Sourcing feeder cattle for the feedlots is a major challenge which imposes high transactions costs. The process of negotiating on cattle price means that cattle are sometimes bought at prices that will make fattening unprofitable. The unavailability of suitable stock also leads to older cattle, which will not receive premium prices, being purchased. The feedlots are not making money per kilogram of weight gain, as it costs around SZL18.79/day to per cow to keep them in the feedlot, but at the average weight gain rate of 0.77kg/day, they only gain SZL18.36 worth of weight per day. The feedlots make money through buying animals at a low per kilo price as unfinished animals (e.g. SZL16/kg live weight) and selling the animals at the finished price of SZL45/kg carcass weight (at 53% killing out, this equals SZL23.85/kg live weight). The profitability is in transitioning the entire carcass to a higher per kilo price through fattening, not in the weight gain itself. At the current cost structure, ***it is essential that feeder animals are bought at a reasonable price***, and that they will obtain premium prices once fattened.

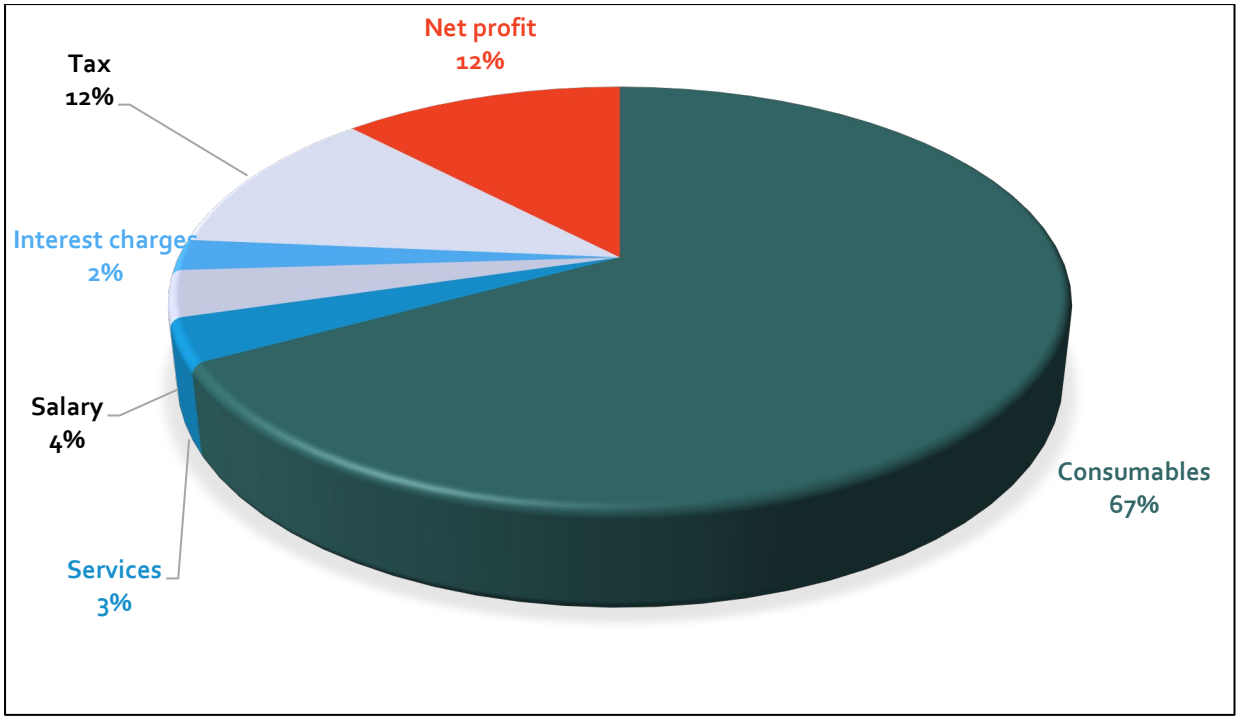


FIGURE 3.3: COSTS AND NETS PROFITS OF A TYPICAL INDEPENDENT FEEDLOT MODEL IN ESWATINI
SOURCE: ILRI, 2017.

By taking an average of animal growth rates, purchase prices, and expenditure from all the feedlots, a 'generic' feedlot was constructed from a farm budget prepared by looking at the average performance of the feedlots and adjusting for what is likely to occur with expenses on cattle purchases, feed, vaccinations, Labour, cattle transport, and other services.

3.3.2 At the Slaughtering and Processing Stage

The slaughtering operations in eSwatini are largely dominated by the presence of the Swazi meat industries which are exclusive to EU-approved beef abattoir and meat processing. The Swazi Meat Industries Limited (SMI) is a company which buys, feeds, and slaughters cattle and pigs. Its products are sold locally (67%), in Mozambique (23%), South Africa (2%), and Europe (8%). SMI's main markets are in eSwatini and Southern Mozambique. SMI buys some of its beef cattle from local suppliers. At some point smallholder farmers supplied up to 30% of the slaughter stock but have reduced their contribution to 15%, perhaps because they are not motivated to wait two to three weeks to recover their money when usually they are going to sell to buy urgent consumption needs or social expenses (weddings etc.).

The farmers' main challenges have been increasing feed costs without alternative plans to control these costs, limited veterinary support, and the introduction of VAT in 2012. Most smallholder farmers are not VAT registered and hence cannot claim to back the VAT. According to the manager of SMI, local production could be improved by supporting farmers who work (and hence can afford to) to improve the genetic quality and productivity of their herds. The farmers also needed technical support, affordable loans, and discounted prices of inputs. Swazi Meats has instituted a loyalty card that entitles farmers who supply them to discounts with major input suppliers.

Large-scale Slaughtering Industry

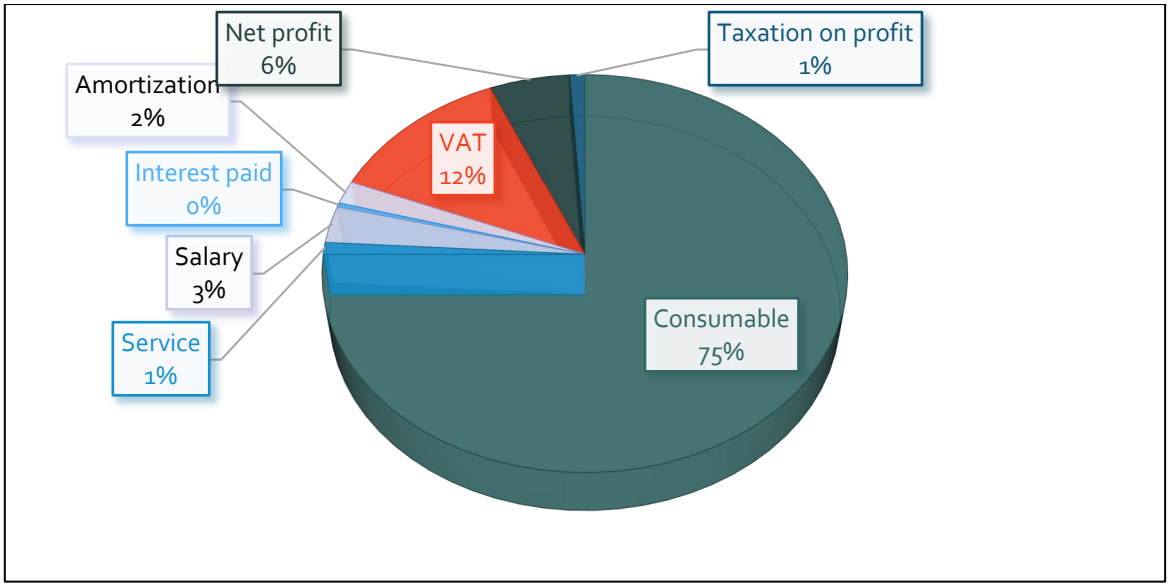


FIGURE 3.4: TYPICAL COSTS AND NET PROFITS OF THE SWAZI BEEF EXPORT INDUSTRY
SOURCE: AUTHORS' CALCULATION FROM THE BEEF INDUSTRY'S ANNUAL FINANCIAL STATEMENT.

SMI sells its products at both the wholesale and retail levels. It wholesales meat to large numbers of distributors and retails meat directly to consumers through the factory gate shop. Other large abattoir operators similarly engage in a combination of wholesale and retail selling. Retail outlets are mainly located at supermarkets and other meat outlets. In rural areas, butchers sell through their butchery outlets.

Small Abattoir

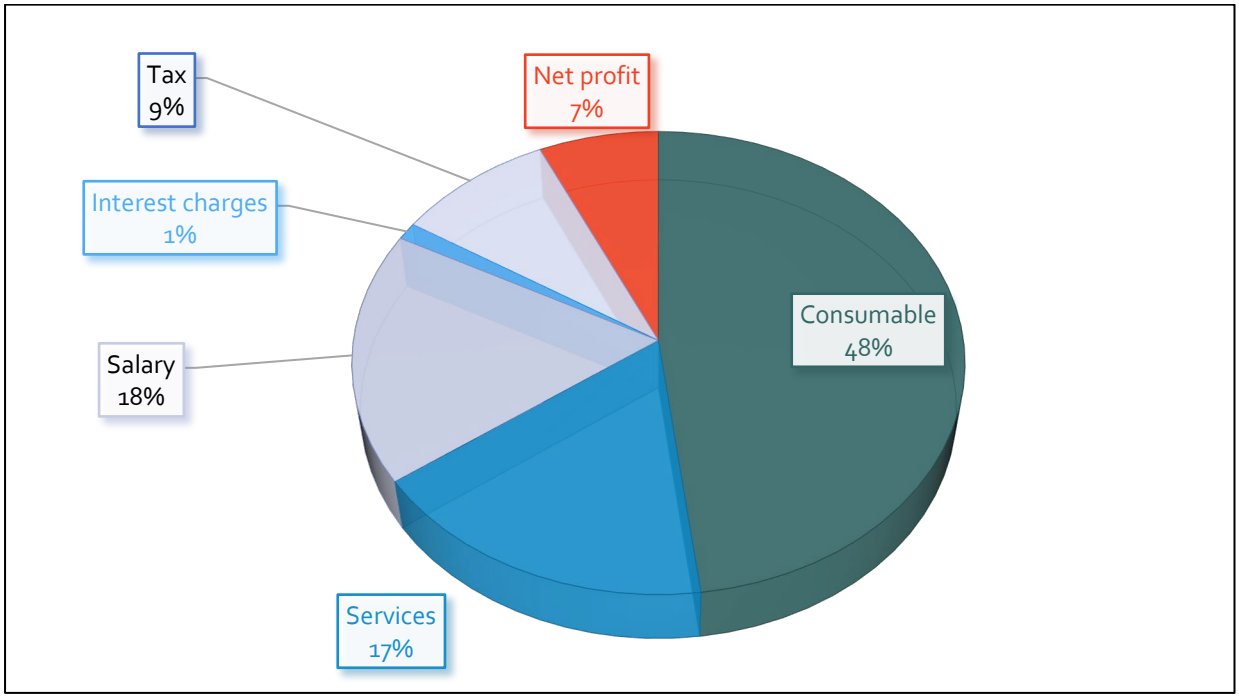


FIGURE 3.5: COSTS AND NET PROFITS OF A TYPICAL SMALL ABATTOIR IN ESWATINI
SOURCE: AUTHORS' CALCULATION.

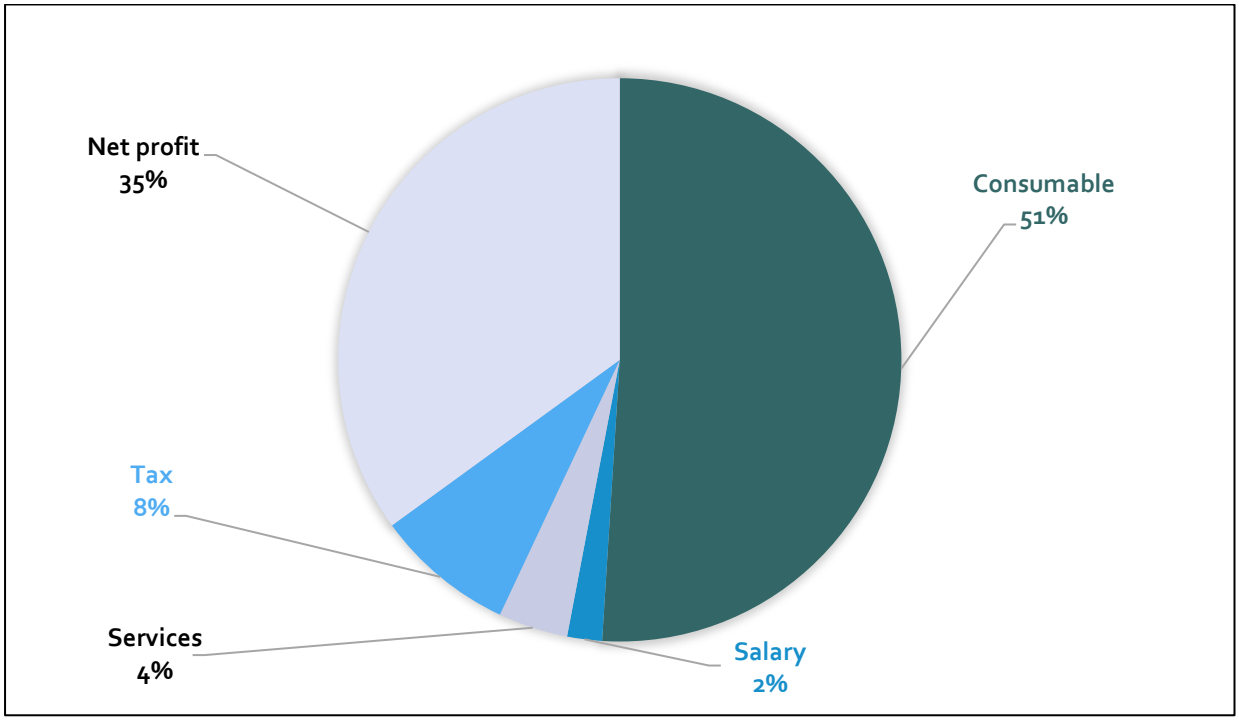


FIGURE 3.6: COSTS AND NET PROFITS OF A TYPICAL BUTCHERY BUSINESS IN ESWATINI
SOURCE: AUTHORS' CALCULATION.

3.4 At the Retailing Stage

In domestic retailing of fresh and processed beef, three types of retail outlets can be distinguished: rural (village) and urban butchers; supermarkets and cash-and-carry stores (modern retail); and restaurants. These outlets vary both in size and in level of sophistication.

The retailing sector in eSwatini is dominated by actors that support local produce and those that import their meat from South Africa so that meat prices in South Africa become relevant in the analysis of meat retailing in eSwatini.

Monthly prices (c/kg)	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16
Class A2/A3	3,527	3,749	3,915	3,835	3,827	3,818	3,759
Class AB2/AB3	3,285	3,619	3,706	3,636	3,616	3,611	3,639
Class B2/B3	2,998	3,316	3,369	3,312	3,204	3,262	3,330
Class C2/C3	2,818	3,139	3,062	2,904	2,895	2,933	3,050
Medium Light weaners	1,754	1,986	1,884	1,895	1,892	1,874	1,812
Monthly prices (c/kg)	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17
Class A2/A3	3,809	3,784	3,745	3,690	3,866	3,940	4,330
Class AB2/AB3	3,654	3,671	3,643	3,635	3,837	3,796	4,175
Class B2/B3	3,367	3,429	3,354	3,395	3,679	3,639	3,790
Class C2/C3	3,146	3,265	3,321	3,333	3,538	3,489	3,610
Medium Light weaners	1,949	1,956	1,998	2,082	2,183	2,340	2,600
Monthly prices (c/kg)	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
Class A2/A3	4,441	4,694	4,594	4,621	4,648	4,647	4,617
Class AB2/AB3	4,278	4,464	4,360	4,513	4,513	4,577	4,576
Class B2/B3	3,838	3,980	3,994	4,216	4,222	4,321	4,314
Class C2/C3	3,685	3,746	3,861	3,981	4,082	4,105	4,108
Medium Light weaners	2,679	2,882	2,883	3,014	3,320	3,213	3,238

TABLE 20 - MONTHLY AVERAGE ABATTOIR SELLING PRICES OF BEEF CARCASSES EXCLUDING V.A.T
Source: AMT beef and mutton monthly report.

South African meat actors seem to adopt an offensive strategy to provide meat at affordable prices***. South Africa's meat is 20% less expensive than the world average but South Africans often must work more hours than their counterparts in other countries to afford it.*** South Africa's unskilled Labourers had to work 5.9 hours to afford a kilogram of beef, with a beef leg round priced at an average R88.03 ($6.54), offering some of the cheapest beef on the planet. Between January 2016 to September 2017, the average increase of monthly abattoir net-selling prices of beef carcasses were one percent for the class A2/A3 and two percent for the other classes. This trend is likely to keep pace as slaughtering is expected to continue to increase over the next few years, placing downward pressure on producer prices as demand is expected to remain flat.

The feedmaster conducted a detailed study on four big retailers and analysed their commercial transactions with their suppliers.

Store Chain	Tons per annum	Formal Suppliers	# of Stores Nation wide	Cuts	Average Price/Kg	Average retail price	Weight earned in stores	Annual Weight IN	Amount Purchased (SZL)	Annual Projections (SZL)
Retailer 1	202	SMI, SMW, RAM Burg SA	4	53%	48.15	51.4	9,142	109,709	469,921	22,556,228
Retailer 2	163	100% Imports, RAM Burg SA	2	157	41.39	47.6	8,326	99,917	396,326	9,511,833
Retailer 3	662	SMI, SMW, Local Abattoirs	8	157	48.15	51.4	41,114	493,364	1,979,622	23,755,467
Retailer 4	122		6	53%	48.15	51.4	9,745	116,940	500,893	6,010,716

TABLE 21 - THE BIG FOUR RETAILER OUTPUTS – THREE MONTHS AGGREGATED DATA
Source: Feedmaster study, 2015.

Retailer N°1 has four super stores and buys meat formally from RAM Burg, SMI, and SMW. It purchases approximately E450,000 worth of beef, E120,000 of lamb, and E240,000 of pork per month. Sometimes, retailer one purchases from individual suppliers in an opportunistic way and looks to diversify in rabbit and goat meat as the demand is particularly high. The biggest challenge for meat producers right now is overcoming financial and cash flow hurdles as they aim to maintain and rebuild their herds to normal levels with little or no income coming in, due to the drought woes they currently face.

Retailer N°2 has two stores and imports 100% of their meats from South Africa, due to preference, price transparency, and the claimed ease of systems. They also have their own butcheries and make their own processed meats such as sausages, mincemeat, and also package many of their own products. The perception of local meats is that the leading supplier, SMI, imports cattle from SA to meet local demand and acts as a retailer instead of a wholesaler. It is believed that SMI orders live cattle from South Africa (SA) and places them into their Swazi Feedlot program for 30-90 days. By doing this, these animals are said to qualify as Swazi cattle.

Retailer N°3 has eight stores nationwide and purchases all their meat produce locally. They also have their own butcheries and make their own processed meats such as sausages, mincemeat, and also package many of their own products. With an annual weight of 662 tons, this makes retailer three the largest red meat supplier cornering 32% of the market.

Retailer N°4 has six stores nationwide and purchases all meat produce locally. They bring in a total of 122 tons annually and calculations reveal that they manage 13% of the red meat market share.

In terms of cost structure, a study conducted in Tanzania (Kamugisha et. al, 2017) shows that beef cost structure in retailing is constituted by beef purchases at 91%, utility costs at six percent and packing materials at three percent.

From these examples, we elaborated operating accounts of three typical retail business that can be found in eSwatini given their strategy of animal and meat sourcing for sell.

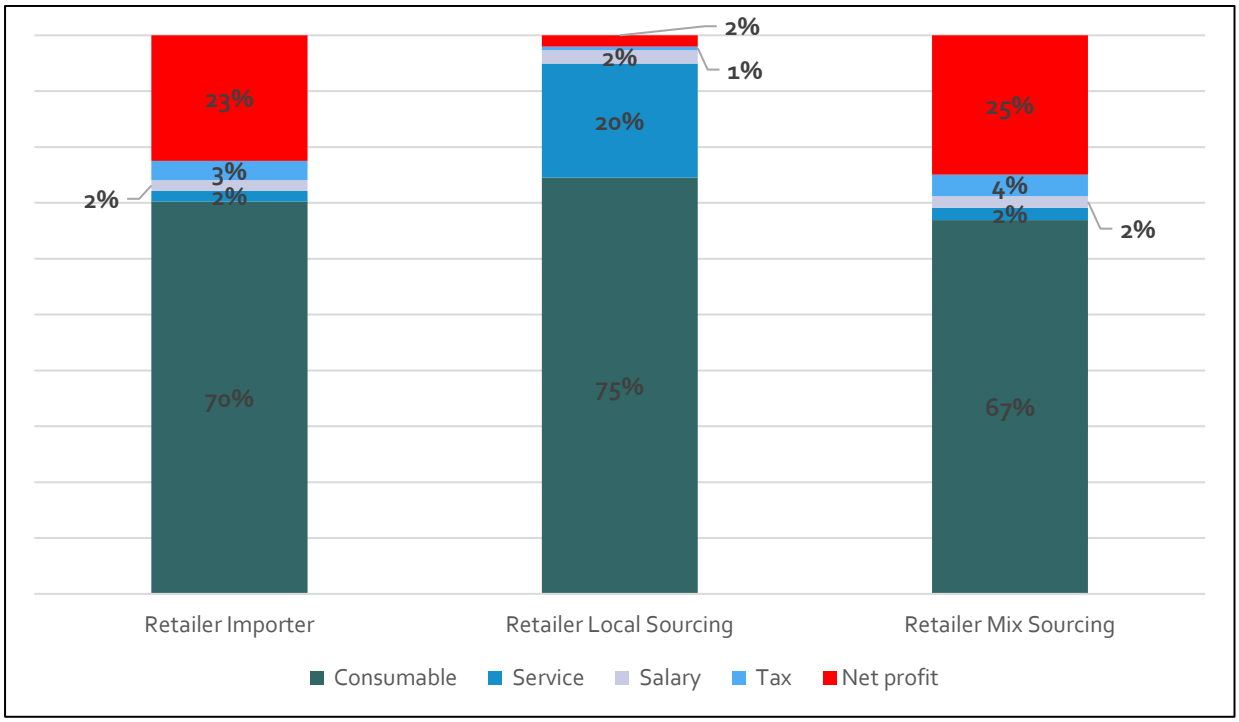


FIGURE 3.7: COSTS AND NET PROFITS OF THE TYPICAL BEEF RETAIL BUSINESS IN ESWATINI
Source: Authors' calculations on ranch financial statements.

3.5 At the integrated business stage

The beef value chain in eSwatini is also characterized by the presence of integrated business incorporating various processing aspects from the farm to the butchering.

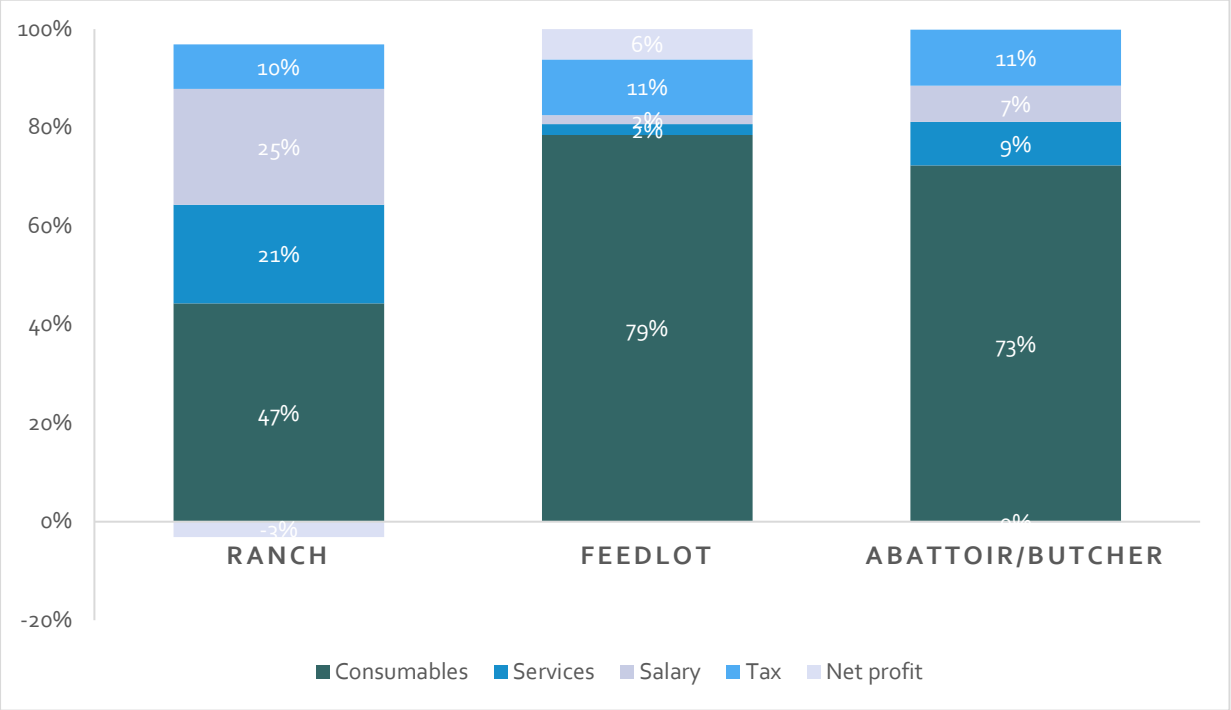


FIGURE 3.8: COSTS AND NET PROFITS OF A TYPICAL INTEGRATED BEEF BUSINESS IN ESWATINI
Source: Authors' calculations on ranch financial statements.

3.6 Issues with Buying and Selling Prices and Attempts

Cattle are the traditional store of wealth in eSwatini. Cattle have important cultural functions, for example their use in paying *lobola* (the bride price). Smallholders would often rather accumulate cattle as a store of wealth and prestige rather than sell to generate income. Sales of cattle are typically made, as the household needs income, rather than based on a cycle of animal production. While a commercial farm aims to fatten cattle to sell at a higher price, Swazi smallholders often prefer to retain fattened cattle, as they are a more stable store of wealth and more likely to reproduce.

One of the main challenges is in obtaining suitable 'feeder' cattle for the feedlots. In the first cycle, older cattle were purchased, which have lower feed conversion efficiency, and achieve lower per kilogram prices based on quality. SWADE has been involved in training farmers on suitable feeder cattle and helping with sourcing cattle. Into the second cycle, the quality of the feeder cattle has improved. This is expected to improve returns.

Farmers consistently cite sourcing cattle as one of the biggest challenges to the feedlots' success. The feedlots can source feeder cattle from the herds of members of the farmer company, or from other smallholder farmers. However, due to farmers' unwillingness to sell, securing a supply of good quality feeder cattle can be a challenge.

There are no formal markets for purchasing cattle off SNL. This creates inefficiencies and imposes high transaction costs. Animals are often bought and sold at dip tanks, where animals are required by law to be bought regularly to be dipped. It is a natural gathering place where buyers can see all the local cattle and discuss with their owners if they are willing to sell. However, sourcing feeder cattle from dip tank transactions is a time-consuming process. Few owners would be willing to sell at any one time, and negotiations may involve cattle owners going away to discuss and consider offers before coming back next week. To buy cattle, typically the farmers must travel around several dip tanks and purchase the full 20 animals for the feedlots,

which takes most feedlots several weeks. Animals are often purchased individually or in groups of twos or threes. Farmers also do not trust weight as measured by scales to determine sale price, so the price must be negotiated based on visual estimates of the animal.

This process incurs high search costs, consuming farmers' time as they must travel around dip tanks and negotiate. It results in high transport costs for the buyers to travel around looking for cattle, and then to transport cattle from distant dip tanks to the feedlots. Attempts were made to quantify these transaction costs, but a lot of the cost is associated with people's time, which is difficult to estimate. Importantly, while most of these search costs are not captured in the budgets presented below, they will be considered by the farmers when deciding if feedlotting is worthwhile.

Many market opportunities exist for sale of finished cattle. Butchers are a major market for finished cattle. Many of the local butcheries operate as braai restaurants, where you buy your meat, and then it is cooked for you on the premises. As a result, butcheries that have good quality meat quickly get a reputation for it, and so some are interested in buying good quality finished animals. eSwatini Meat Industries (SMI), is a major abattoir, but the farmers had a poor experience dealing with them in the first cycle. SMI's pricing schedule is not publicly available, they have made payments many weeks after receiving the animals, and there is a lot of distrust towards the abattoir from farmers. Bushlands is a local abattoir that entered into a verbal agreement to purchase finished stock from the feedlots. However there have been disputes between the farmers and Bushlands over the terms, which Bushlands is offering. Bushlands offers a price of SZL22.50/kg live weight for 'Supers', SZL38/kg carcass weight for 'C grades', and SZL28/kg carcass weight for 'Bulls'. The Super price is very competitive, but losses would be made on the other stock classes at those prices. Modelling suggests that on a 'generic' feedlot, selling cattle at an average price of SZL35/kg carcass weight would result in a loss of SZL13,467.22 per cycle, and an average price of SZL40/kg carcass weight would result in a profit of just SZL993.76. The farmers refuse to sell C grades and Bulls at this price, and Bushlands is refusing to buy only the Supers; they want to buy all the cattle or none.

As a result, the current marketing strategy proposed by SWADE officers is to sell to butcheries and restaurants. Leading up to Christmas, it is projected that all the cattle will be sold to butcheries at an average price of E45/kg carcass weight due to strong seasonal demand. These buyers however usually only buy animals in small numbers, increasing transaction costs for the feedlots.

The total value of the beef sector in eSwatini must reflect all the valued added at each node of the value chain that could be analyzed through pricing and profitability analysis. A marketing margin is the difference between the buying and selling price at each stage and consists of the costs and profits incurred.

Production costs for cattle smallholders are significantly subsidized in eSwatini by the Government of eSwatini (GoS) that, until 2010, helped them to keep their cattle on communal land for grazing and paid only SZL6.00 per animal per month for fattening. To encourage off-take and reduce grazing pressure on SNL rangelands, the subsidy was raised to SZL30 in 2011 as an incentive to motivate farmers to commercialize their practices in accordance with the monthly management fee, which is levied when animals are sold (World Bank, 2011). To run well, this mechanism should be based on comprehensive knowledge of small-scale farming in eSwatini, which remained missing.

Bearing in mind that total profits depend on the scale of operations, some indicators should help to halve and compare beef returns and profits in equivalent terms across value chain stages. Gross profit reflect what a company earns from its sales. Both are determined with information from a company's income statement.

Under strong assumptions, we pictured the different prices on tons of live, carcass, and meat weight exchanged by the main stakeholders of the beef value chain.

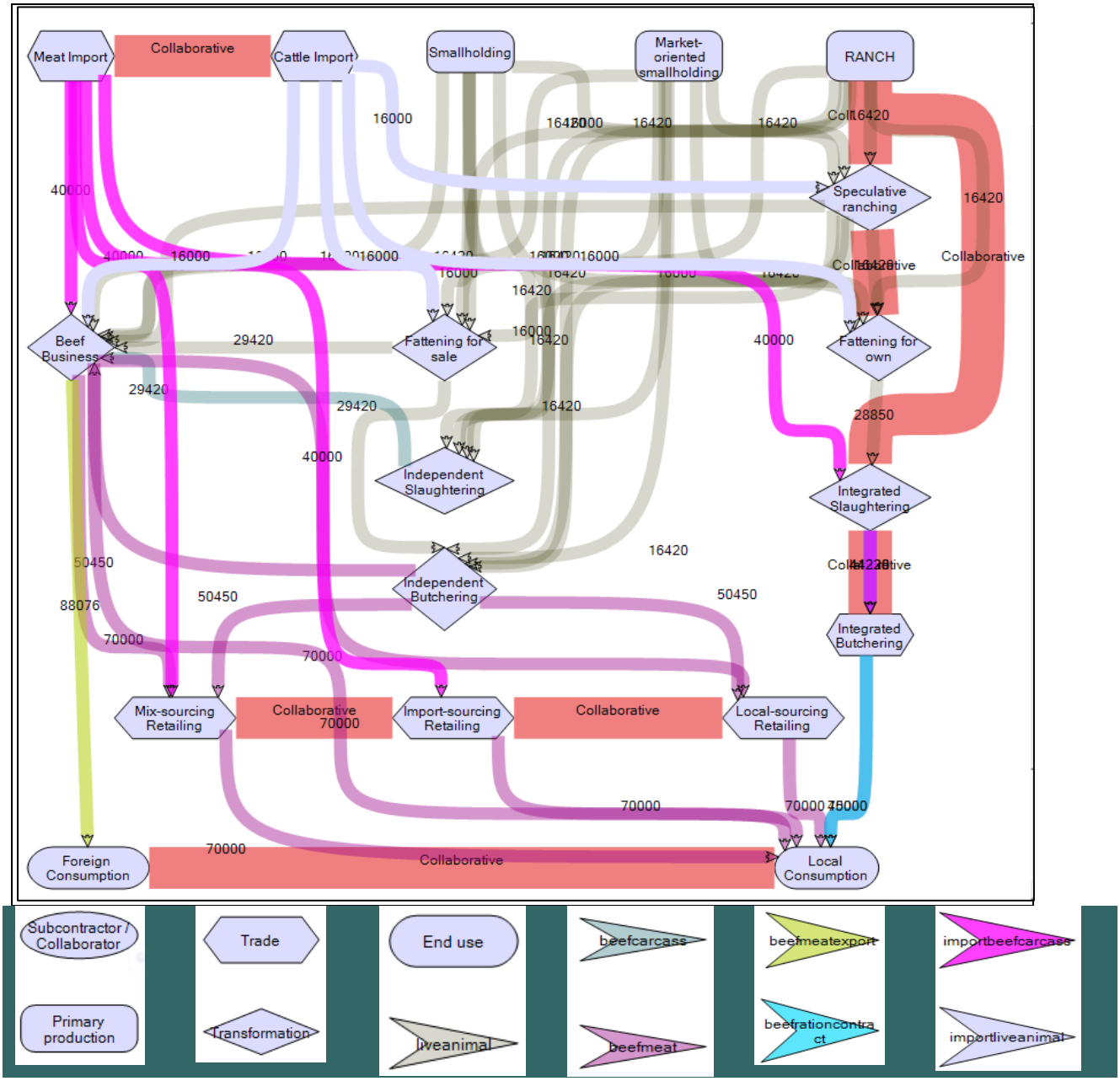


FIGURE 3.9: PRICES PER TON OF PRODUCTS SHARED BY BEEF VALUE CHAIN ACTORS IN 2017
Source: authors' calculations based on available information.

3.7 Main Assumptions Used to Calculate the Main Economic and Financial Indicators

The quantitative analysis was prepared using a set of Excel spreadsheet templates developed specially for the **Agri-Foodchain Analysis through the AFA Software.** Great care was taken to ensure that the templates are as transparent and user-friendly as possible so that anyone with a detailed interest in the eSwatini beef sector can easily model other management and price conditions. The analysis will depend on data availability and robustness. Methods and tools applied to measure criteria will be selected according to those data and the time allocated to data collection.

Thus, specific assumptions applied at the farm, feedlot, butchery, and retailing stages of the value chain are provided along with discussion of the main results for those activities and in the spreadsheet models.

3.7.1 Current Prices

Analyses are based on prices observed or estimated in/for 2017 through the literature review. It would be obviously more relevant to base analyses on a so-called normal season with adequate rainfall. However, eSwatini has faced many successive drought episodes, so we chose to apply the real prices incorporating these different shocks.

3.7.2 Labour

All financial models include a cost for hired labour as appropriate (herdsmen at the farm level, general workers and a supervisor at the feedlot level, and sales staff /meat cutters at the butchery level). However, no cost was included for the owner's time or for other senior management. The estimates of gross and net profits can therefore be reinterpreted as returns to the owner's labour.

3.7.3 Dressing-out Percentages

Conversion rates from live weight to cold dressed mass have an important bearing on value-chain profits for all participants. As in many Southern African countries, these were said to vary from 49% to 56% depending on the animal's breed, grazing patterns, diet and general health, and whether feedlotting was performed. The assumed dressing-out age is 52 %. Again, further spreadsheet variations could be prepared using different dressing-out percentages. This variable has an important bearing on the total profit from beef and would be a good area for further analysis to test the impact of policies aimed at improving dressing-out ratios.

3.7.4 Government Subsidies

The Government of eSwatini provides a range of subsidies to beef producers, including free vaccinations for "critical" diseases. During drought years, the government sometimes also subsidizes to encourage use of these inputs.

3.7.5 Other assumptions for the Impact Analysis

Electricity: eSwatini imports 86% of its electricity from South Africa and generates only ten percent locally, adding to the ten percent that was exported from Mozambique even if this later was suspended in 2016. For 206-2017, the Central Bank of eSwatini, citing the *eSwatini Electricity Company,* reported that despite the fall in local generation to 173.1 GWh (14%), electricity imports were slightly lower at 1,063.7 GWh in 2016/17 (86%) from 1,077.1 GWh in 2015/16.
Water: eSwatini is well endowed with water resources, though the Lowvelt region is subject to periodic droughts. the river systems doing the watering the country, three rising within eSwatini, two in South Africa, and all flowing into South Africa or Mozambique. eSwatini has nine major dams, seven used for irrigation, one for hydroelectricity, and one for water supply. The Ministry of Natural Resources and Energy is responsible for water supply and sanitation in rural areas, while the parastatal eSwatini Water Service Corporation manages the water supply in urban areas.

3.8 CQ1.2 - What is the Contribution of the VC to Economic Growth?

The software allows calculating several useful indicators (see in annexes) to better understand how the Swazi beef value chain is quantitatively articulated at different stages.

	Direct effect	Indirect effect	Totals
	in E' billion	in E' billion	in E' billion
Imports	411,468,408	0	411,468,408
Labour	534,183,846	274,866,503	809,050,349
Tax	49,317,691	67,936,223	117,253,915
Finance	1,909,371	98,870	2,008,241
Depreciation	0	31,078,017	31,078,017
Net incomes	133,345,755	51,501,467	184,847,222
AV Not Ventilated		59,777,651	59,777,651
IC Not Ventilated			0
Value added	**718,756,664**	**485,258,731**	**1,204,015,394**

TABLE 22 – SUMMARY TABLE OF EFFECTS
Source: authors' calculations using AFA Software.

The total contribution of the beef value chain is E' **1.204 billion.**

Total tax perceived from the beef value chain is **relatively high at E' 177 million** even though it should be noted that government subsidies to support the value chain are also substantial (**E' 57 million**). This reflects discourses both from officials and the population on the socioeconomic importance of cattle rearing and business in eSwatini.

The total value added of the beef value chain being **E' 1.204 billion**, its **direct (E' 719 million)** and **indirect (E' 485 million)** contribution to eSwatini's GDP is **two percent** both at constant 2011 prices and in current value.

	2017(f) in E' billion	Direct contribution	Indirect contribution	Total contribution
GDP at constant 2011 prices	58.800	1.2%	0.8%	2.0%
GDP at current prices	58.140	1.2%	0.8%	2.1%

TABLE 23 – DIRECT AND INDIRECT CONTRIBUTION OF THE BEEF VALUE CHAIN TO GDP SOURCE: CENTRAL BANK OF ESWATINI (FOR THE GDPS) AND AUTHORS' CALCULATIONS USING AFA SOFTWARE.

3.9 CQ1.2 - What is the Contribution of the VC to the Agricultural Sector GDP?

According to the Index Mundi, a data portal that gathers facts and statistics from multiple sources, the overall GDP of eSwatini is expected to result at 6.5% from agriculture, which broadly includes farming, fishing, and forestry. Thus, the beef value chain estimated **E' 1.204 billion**, contributes **32% of the country's overall Ag GDP**.

	2017(f) in E' billions	Direct contribution	Indirect contribution	Total contribution
Agriculture GDP at constant 2011 prices	3.822	18.8%	12.7%	31.5%
Agriculture GDP at current prices	3.779	19.0%	12.8%	31.9%

TABLE 24 – DIRECT AND INDIRECT CONTRIBUTIONS OF THE BEEF VALUE CHAIN TO AG. GDP SOURCE: AUTHORS' CALCULATIONS USING AFA SOFTWARE.

3.10 CQ1.3 - What is the Contribution to Public Funds?

The amount of **direct and indirect taxes** generated by the beef value chain in eSwatini is **117.3 million**. However, the government of the eSwatini distributes subsidies that are considered in this study through the drugs provided mainly to smallholders in the SNL. These **subsidies** amount to **E' 57.7 million** for 2017, therefore the **contribution of the beef value chain to public finance** remains positive to **E' 59.6 million**.

3.11 CQ1.4 - What is the Contribution of the VC to the Balance of Trade and Balance of Payments?

In eSwatini, SMI holds the sole license to export mainly in Norway. At the same time, the country imports cattle and meat mainly from South Africa and Mozambique to meet local demand.

Although great efforts have been made by SMI to increase commercial slaughters, notably in 2016, exports were characterized by the poor quality of the cattle provided by farmers influenced by their beliefs about the persistent drought's negative impacts on animal feeding. Consequently, beef exports were bumpy during the five past years and remained dependent both on trade volumes as well as exchange rate variations. In 2016, although the trade volumes decreased, the export receipts increased, driven by monetary depreciation.

	2012	2013	2014	2015	2016	Annual average
Exports (Mt)	1,402	1,280	1,038	1,126	983	**1,166**
Value of Exports (E'000)	85,888	84,142	73,917	77,804	86,578	**81,666**

TABLE 25 – BEEF EXPORTS FROM 2012 TO 2016SOURCE: ESWATINI MEAT INDUSTRIES.

For the beef value chain, we assume that in 2017, the **export receipts** would be at the average level of **E' 81,7 million** while the **direct imports** of cattle and meat mainly from South Africa and Mozambique were **E' 411.5 million**. Finally, the beef value chain contributes negatively to the balance of trade with a **deficit of E' 329.8 million**.

3.12 CQ1.5 - Is the VC Economically Sustainable at the International Level?

To analyse the sustainability of the beef value chain in eSwatini, we first adopted some assumptions:

- There is no distortion in the labour market,
- The average Nominal and Real Effective Exchange Rates are those observed by the Central Bank in 2016 (respectively 450 and 225).
- The average Nominal and Real Interest Rates are the Lending interest rate of 10.25% and the real interest rate of 4.74% provided by Index Mundi for 2016.

Then, we examine the three following indicators selected among others:

- The **Domestic Resource Cost ratio (DRC)** of a project or VC is defined as the ratio of the international prices of its **domestic** net inputs to the international price of its traded net outputs. A DRC value less (greater) than one is taken to imply that net benefits are positive (negative).
- The **Nominal Protection Coefficient (NPC**) measuring the ratio between the average price received by producers (at farm gate), including payments per ton of current output, and the border price (measured at farm gate level).
- The **Effective Protection Coefficient** (**EPR**) is a measure of the total effect of the entire tariff structure on the value added per unit of output in a given economic sector, when both intermediate and final goods are imported. It enables measuring the real amount of protection afforded by import duties, tariffs, or other trade restrictions, and comparing the costs of domestic resources (primary factors such as labour, capital, and land) committed to the production of final goods with prices at which these goods can be exported or imported, the latter prices considered as the ensuing benefits from production. In this case study, we are not using opportunity costs. We use the approach developed by the EU-DEVCO that consists of tabulating some indicators aiming to make transfers neutral by applying international prices to tradable goods and real market prices to domestic goods.

Consequently, when the DRC is inferior to one, the cost of domestic factors surpasses the value created for the economy. When the NPC and the EPC are superior to one, the value chain is protected (mainly at the output level).

For the Swazi beef value chain, the DRC is 1.660 (superior to one) meaning that the value chain doesn't use efficiently local resources. The NPC of 1.171 (superior to one) illustrates that the beef value chain is fully protected while the EPC of 0.629 (inferior to one) shows that the net impact on output and input of government policy is to constrain the beef value chain to have a value added in market prices 37% lower than the value added without policy transfers (as measured in world prices).

Thus, this situation mostly proves that the transfers (tabulated as the difference between market prices and international prices) are more important to the inputs than to the outputs.

	Tradable Output	Tradable input	Labour	Capital	Net income	Selected sustainability indicators	
Market price (E' million)	2,194	1,374	1,895	277	-1,353	Domestic Resource Cost	1.660
Reference price (E' million)	1,874	570	1,895	277	-868	Nominal Protection Coefficient	1.171
Transfer (E' million)	320	804	0	0	-484	Effective Protection Coefficient	0.629

TABLE 26 – SUSTAINABILITY INDICATORS AT THE INTERNATIONAL LEVEL SOURCE: AUTHORS' CALCULATIONS USING AFA SOFTWARE.

3.13 CQ1.6 - What Are the Risks for Growth Sustainability at the VC's Different Levels?

A comprehensive assessment of the risks in the Swazi beef value chain requires research to continue on a longer time-frame (at least three decades), definitely into the foreseeable future. It will inform about the likelihood and economic and agricultural impacts of these risks, as well as their impact on the livelihoods of livestock producers. Such a risk assessment study will have to inform on the main risk factors and their likelihood; to analyze their economic and agricultural impacts; to identify and assess the existing risk management tools and policy instruments; to identify the main risk management gaps and needs; and to

provide guidance for a prioritization of risks and tools to be implemented. The format of our study in eSwatini and the current framework of DEVCO do not allow to provide in-depth analysis of risk in the beef sector.

In addition, livestock rearing in eSwatini is undertaken in an environment with strong socio-ecosystemic constraints, along with a lack of tangible and intangible dedicated infrastructures and economic services and, lastly, in a sub-optimal and unfavourable environment (weak involvement of financial services for example) as well as in a context of strong land use competition of commercial crop systems. Furthermore, the livestock farming sub-sector in eSwatini is facing effects caused mainly by climate change, which is both the direct cause of losses and an aggravating factor in other economic, health, political and social threats. Risk assessment does not consist ***to analyse those constraints***, but rather to ***identify and assess the risks***, even if there are obvious links between the two.

An in-depth literature review and observations made during our 25-days fieldwork could allow us to provide a picture of main risks that can constraint the growth sustainability of the beef value chain.

Risk related with	Inputs	Production	Aggregation and processing	Marketing
Climate change (drought, floods)	SIGNIFICANT	SIGNIFICANT	MEDIUM	LOW
Animal diseases	SIGNIFICANT	SIGNIFICANT	LOW	LOW
Bushfires	LOW	SIGNIFICANT	LOW	LOW
Market prices	SIGNIFICANT	MEDIUM	MEDIUM	SIGNIFICANT
Conflicts	LOW	SIGNIFICANT	MEDIUM	MEDIUM
Enabling environment	MEDIUM	MEDIUM	SIGNIFICANT	SIGNIFICANT

Risk management options

Strengthening early warning and early response

Increase awareness and training in weather forecasts (media, institutions, rural communities).
Broaden the current dissemination of seasonal and short-term weather forecast, and warnings.
Refine and downscale seasonal and short-term weather forecasts, and seasonal monitoring.
Improve ground data-based validation for seasonal monitoring.
Customize a eSwatini risk View and launch a broad reflection on drought insurance instrument.
Broaden and formalize the involvement of rural communities in early warning/early response.

Strengthening the climate resilience of smallholder systems

Promote broader adoption of Conservation Agriculture
Promote adoption of Farmer-Managed Natural regeneration
Promote farmer adoption of effective water harvesting practices.
Scale up Community-based resource Management
Promote integration of small animal husbandry into cropping systems.
Promote household gardening.

Strengthening management of rangeland and livestock resources

Promote the development of local fodder production.
Build-out of underground rainwater storage & water harvesting infrastructure.
Launch a broad reflection on the reform of dipping systems in the context of climate change as well as on possible mobility of livestock in view to avoid potential conflicts.

TABLE 27 – RAPID ASSESSMENT OF RISKS FOR GROWTH SUSTAINABILITY OF THE BEEF VALUE CHAIN SOURCE: AUTHORS' ESTIMATES

3.14 CQ2.1 How is Income Distributed Through the VC Levels and Actors?

In common with many other pastoral regions, inequality in income and livestock wealth is pronounced in eSwatini where approximately 40.6% of the population were living on less than USD 1.25/day in 2010, while

60% of the population survived on less than USD 2/day (World Bank 2014b). This situation is leading to major differences in the adaptive strategies of different economic actors. The country has a long-standing income inequality even if the Gini index declined at a moderating rate to shrink from 60.5 index in 1994 to 51.5 in 2009 (World Bank, 2017). In a recent document provided by the Ministry of Agriculture, it was stated that the richest 19% of the population controls 56% of total income, while the poorest 19% controls only 4.3% (MOA, 2016). **The beef value chain does not escape to this overall situation as shown by the Gini index largely higher than 50% and reaching 80% during our investigation period**. Thus, poor households in livestock usually must seek alternative income sources and have low per capita incomes. One aspect of diversification, the presence of salaried income, has an especially dramatic effect on total income, but is an advantage enjoyed by relatively few households.

The output of the livestock sector was strongly impacted by the unexpected effects of the drought such as low birth rates, high mortality and mostly high feeding costs. In this context, the value-added of the beef sector was mainly used to wage payment.

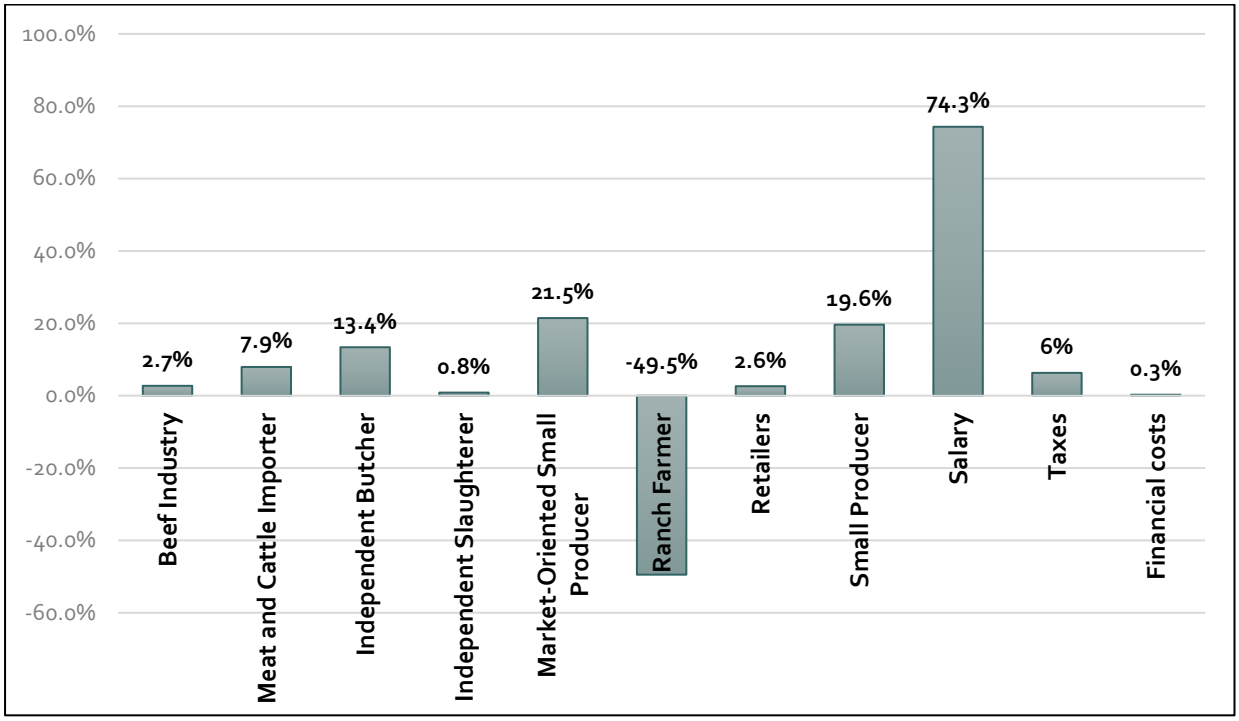


FIGURE 3.10: DIRECT VALUE-ADDED DISTRIBUTION
Source: authors' calculations using AFA Software.

This situation would potentially affect the performance of the Ranch farmers that experimented real sourcing issues with good animals as well as high inputs costs and thus, negative value added. With their structural salary costs, they had been not able to positively contribute to the overall net operating surplus generated by the beef value chain. Reversely, smallholders that have barely monetary production costs as it is assumed that they mostly used "free" natural resources despite the effects of the drought, created value from their activities. Given also their small other costs, they contributed to the net operating surplus.

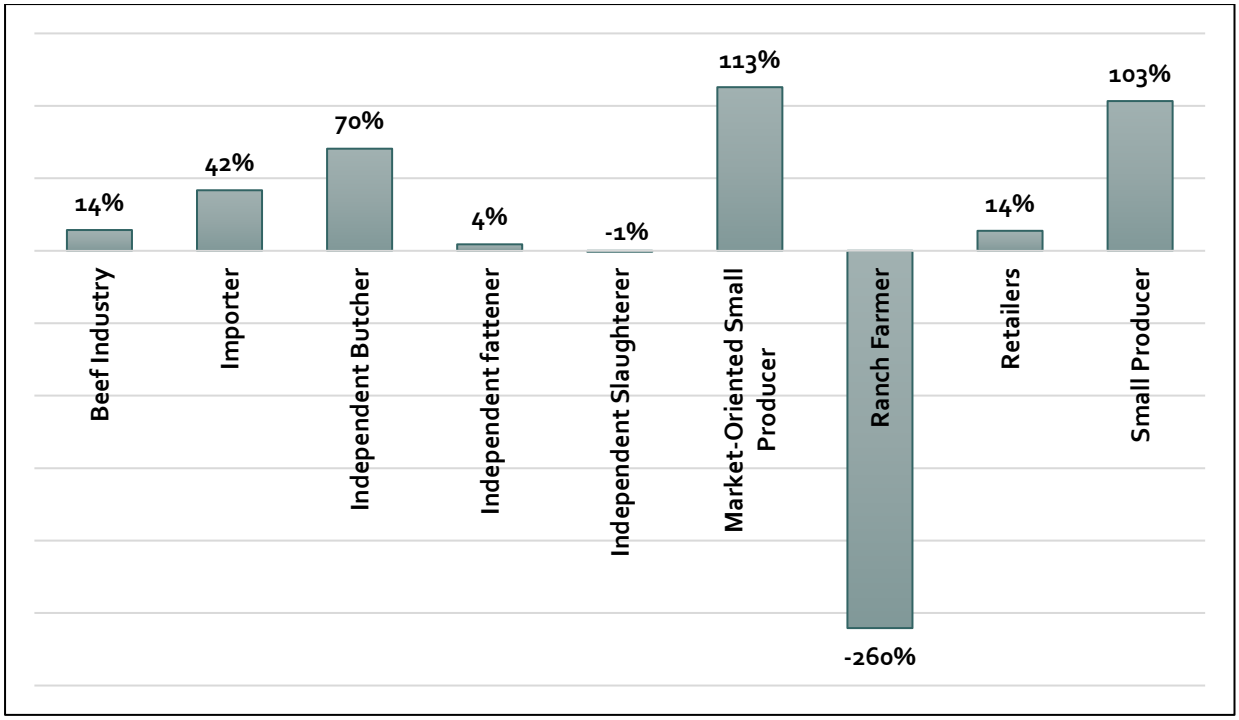


FIGURE 3.11: BREAKDOWN BY AGENT OF THE NET OPERATING SURPLUS
Source: authors' calculations using AFA Software.

3.15 - CQ2.2 - What is the Impact of Governance Systems on Income Distribution at Various Levels of the VC?

The complexity of the Beef value chain in eSwatini is also reflected by the variety and diversity of the tacit and implicit arrangements between the main actors. These could be **hierarchical** as observed at the level of integrated business (ranch farming), **contractual** notably when formal actors are involved (ranch farming, beef export business) as well as **market-driven** when actors bargain to buy or sell animal products.

The organization of the beef value chain has an obvious effect on the diversity of prices along the value chain and so on income distribution. Indeed, the smallholders are conducted to be linked by contractual arrangements to be committed on more formal transactions with a certain delay on payments. In common to many livestock keepers in Sub-Saharan Africa, smallholders in eSwatini have an objective function that is a composite utility function that balances their short-term consumption needs and long-term herd building strategy to meet future consumption (Fadiga, 2013). For these reasons, they participate in a market(s) in an opportunistic way. Their motivations for sales become a key element to fully understand (Wane et al, 2017). Consequently, this opportunistic approach of smallholders vis-à-vis the market has a serious impact on income generation and inequality as the other stakeholders of the beef value chain will be not able to better plan their business due to uncertainty on supply side. This could lead them to import animals from South Africa and we guess the importance of these imports on internal circuits is underestimated. Here we touch deeply the problems that can be posed by the profound dualism inside the beef value chain in eSwatini.

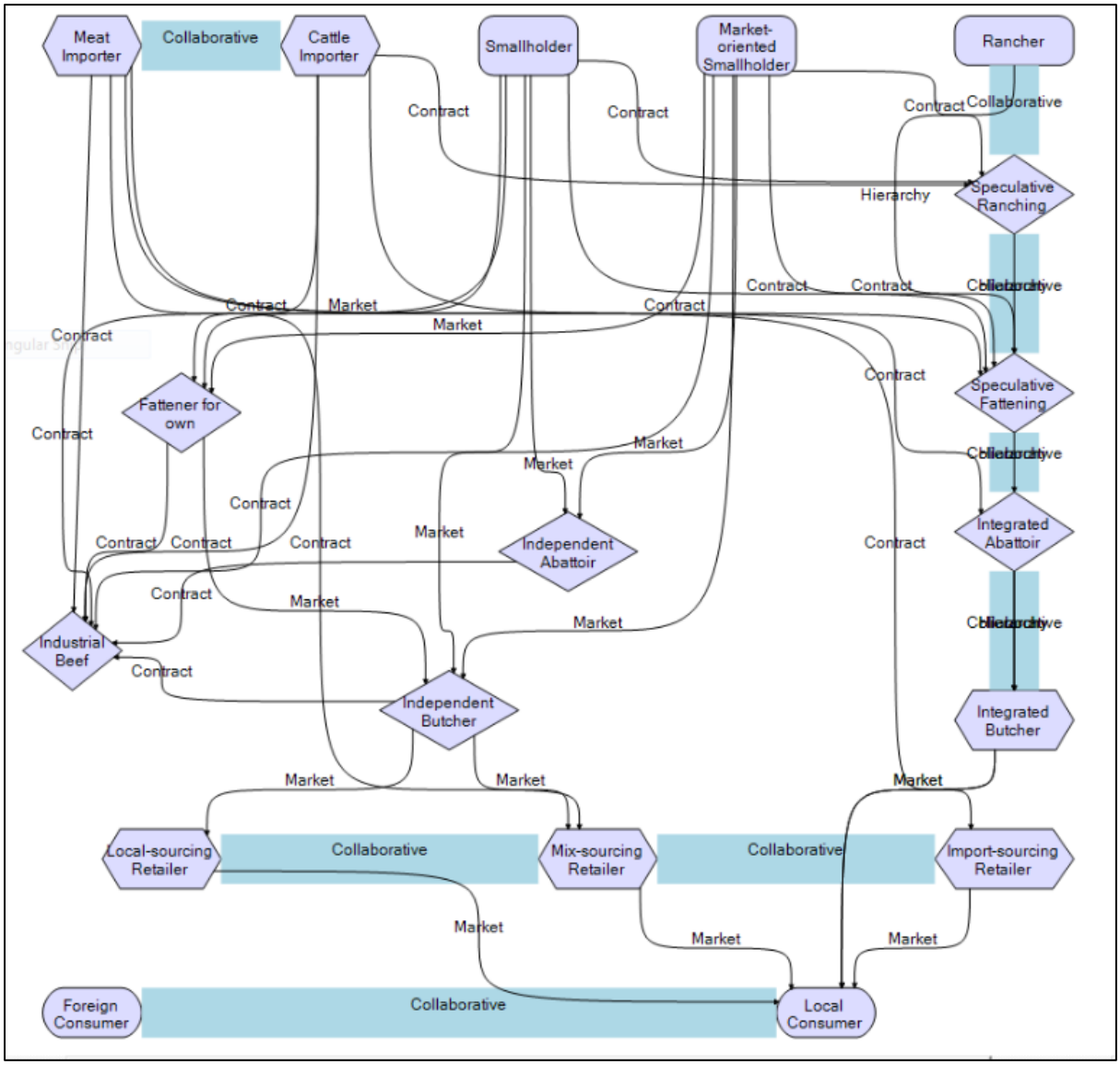


FIGURE 3.12: ORGANIZATION CHART OF THE BEEF BUSINESS IN ESWATINI
Source: authors' calculations using AFA Software.

3.15.1- How is Employment Distributed in the Value Chains?

The total employment in the beef value chain is estimated to 62,067 remunerated or waged employees, almost 13.5% of the total Labour force[8] in eSwatini. Among them, 58.7% are part-time waged jobs while 41.3% have full-time remunerated jobs.

However, it is also very important to note that in livestock sector and more specifically in small-scale households, the non-remunerated workforce is very common as for many countries in Sub-Saharan Africa and constitutes the reality of the work in the primary sector.

8 Total Labour force comprises people ages 15 and older who meet the International Labour Organization definition of the economically active population: all people who supply Labour to produce goods and services during a specified period. It includes both the employed and the unemployed. While national practices vary in the treatment of such groups as the armed forces and seasonal or part-time workers, in general the Labour force includes the armed forces, the unemployed, and first-time job-seekers, but excludes homemakers and other unpaid caregivers and workers in the informal sector. For eSwatini, the total Labour force was estimated to 457,900 individuals in 2012 (see http://www.nationmaster.com/country-info/profiles/eSwatini/Labour))

Variable	Estimates	Number Provided by the MOA	Employment estimates	Full or part time	Explanations
Beef value chain at the national level	Number of farmers	49,489	24,745	Partial	50% of cattle owners recruit a waged employee that usually not work full-time.
Scale communal farmers (<150 animals)	Number of farmers	46,503	11,626	Partial	
Very large-scale Ranch	Number of Ranch	8	1,168	Full	Our field visit in a very large-scale ranch allows to note 150 employees among which 4 are dedicated to hostel facilities that hosted tourists for gaming.
Ranch farmers	Number of farmers	978	22,494	Full	23 employees identified during our felicity in a commercial ranch.
Medium to large scale communal farmers <150 animals)	Number of farmers	2,986	747	Full	
Feedlot operations	Number of feedlots	55	55	partial	Each feedlot requires only one worker, who performs on average less than six hours of work per day in running the feedlot (ILRI, 2017)
Abattoirs	Number of registered municipal abattoirs	4	16	Full	
	Number of private rural slaughter houses of slab facilities	6	24	Full	
Butchers	Number of registered butcheries	251	1,004	Full	
Modern retail (supermarkets and cash-and-carry stores)	Number of supermarket chains	47	188	Full	
Total			**62,067**		

TABLE 28 - EMPLOYMENT ESTIMATES FOR THE BEEF SUBSECTOR IN ESWATINI

4. Social Analysis

This analysis of the six major social issues and their sub-components, which in turn address the framing questions on the inclusivity and social sustainability of the value chain, is based on several sources:

- Four focus group discussions (plus one informal discussion) held with cattle-producers on the SNL (see table 29 below), covering the major agro-ecological zones of the country.
- Meetings with a range of stakeholders in government, the private sector, international agencies and other bodies. Some of these meetings were attended by more than one of the authors of the report, in others only the social sector specialist was involved. Particularly important meetings for the social analysis included those with UNDP, WFP, FAO, two commercial ranches, the Swazi Meteorological Office, the Ministry of Labour and the eSwatini Agricultural, Plantation and Allied Workers Union.
- Document review of many official reports and data made available by stakeholders.

Date	Location	Notes
27.09.17	Cota Diptank (Middleveld)	Informal meeting with Veterinary Assistant and local cattle-owners, post-dipping
02.10.17	Maphoko Diptank (Highveld, close to Mbabane)	Full Focus Group Discussion with male and female cattle-owners and Veterinary Assistant, post-dipping
20.11.17	Lwandle Diptank (Middleveld)	Full Focus Group Discussion with male and female cattle-owners, and Veterinary Assistant, post-dipping
21.11.17	MoA Office, Siteki	Small Focus Group Discussion with three men from Lowveld areas, and three men and three women from Plateau areas, plus two MoA/SWADE officials
23.11.17	MoA Office, Hlathikhala (Highveld)	Small Focus Group Discussion with six men and one woman[9]

TABLE 29 - DETAILS OF FOCUS GROUP DISCUSSIONS

Providing meaningful answers for the agreed questions and using the agreed VCA4D social analysis methodology is not unproblematic for eSwatini. As discussed above, the rural economy, and cattle production within it, are highly dualistic, and some questions must be interpreted very differently for SNL and TDL production. In addition, cattle production which at least intermittently sells into the beef value chain is practiced by 40-50% of the rural Swazi population, dispersed over the entire SNL, and has a social and cultural importance that reaches further still. It is not therefore always possible to distinguish between social aspects of the value chain and social aspects of the rural economy in general.

4.1 Are Working Conditions throughout the VC Socially Acceptable and Sustainable?

eSwatini has a well-developed Labour law, with gazetted minimum wages for different sectors, and legislation on trade union membership, contracting, health and safety and employment of children and young people. The Department of Labour within the Ministry of Labour and Social Security conducts inspections throughout the country in accordance with ILO Convention 81 (the Labour Inspection Convention of 1947) – not one of the Fundamental Conventions but a means to ensure their implementation. There are around 25 Labour Inspectors nationally, in seven branch offices. Inspection covers smaller and less formal enterprises like local-level butcheries, as well as larger enterprises, including commercial ranches.

[9] Other women who had planned to attend were instead engaged in drawing their monthly pensions

4.1.1 Respect of labour rights

eSwatini ratified the eight Fundamental Labour Conventions of the ILO between 1978 and 2004,[10] and has been a signatory of the ICESCR and the ICCPR since 2004. It is not clear whether all the Fundamental Conventions have been passed into national law. Government sources admit that while corporations adhere to the standards of the fundamental conventions, and to the national Labour laws, the situation with family-owned businesses (in general, not specifically in the beef value chain), is more mixed. An example given was failure to participate in the Workmen's Compensation Scheme.

Freedom of association is recognised under ILO Convention 87 and Section 52 of the Industrial Relations Act, and legally every employee is free to join a trade union. In enterprises of 25 or more employees there is an obligation on the employer to encourage employers to join a union or form a staff association. If union membership within the enterprise reaches 51%, the union can apply for recognition. The largest abattoir, the largest feed mill and the parastatal ranch interviewed all have, and regularly renegotiate, collective agreements with the relevant unions. At a medium-sized private abattoir the authors were informed by management that there was no union membership or staff association "by the workers' choice". At a smaller ranch with a workforce under the threshold of 25 employees, three elders are used as informal workers' representatives.

In practice, there may be restrictions on freedom of association. Officials of the eSwatini Agricultural, Plantation and Allied Workers Union (SAPAWU) mentioned cases of harassment of union members and officials, though this was not linked to enterprises in the beef value chain, and a political climate that is anti-union, including official sponsorship of a rival to the main established and politically active union federation TUCOSWA.

Union membership is clearly not relevant to smallholder cattle-producers on the SNL, or their employees. The eSwatini National Agricultural Union is an apex body for regional farmers' associations, but the authors were informed it is inactive in the livestock sector, and it was not mentioned in any of our FGDs.

The law requires that employees be given either a written contract or a document known as Written Particulars of Employment (provided as an appendix to each of the sectoral Wages Orders). At least in more formal enterprises, and particularly where there is trade union recognition, contracts appear to be enforced. In SNL production systems, herding contracts are informal, and certainly in some cases at lower than gazetted minimum wages, but in the light of understanding of such contracts in African traditional livestock systems, we do not believe there are clear implications for inequality or poverty. To some extent working as a paid herder is a way for young men to accumulate savings, and in most cases meals, shelter and bedding are provided above the financial payment. In other cases, herding contracts can be made between social equals to allow economies of scale in herding labour.

The authors found no evidence of anything resembling forced labour, which is contrary to the eSwatini Constitution. Outside the question of gender equality, eSwatini is a fairly homogeneous society, ethnically and culturally. In several SNL areas we were informed that Mozambican migrants are employed as paid herders, but it was not clear they were paid any less than young local men for the same work.

4.1.2 Child Labour

Under the Employment Act children are defined as those under 15 and may not be employed except in the context of a training programme. For young people between 15 and 18 the law is complex, and there are circumstances in which young people can be formally employed in agricultural apprenticeships, though these are highly circumscribed. In practice, formal sector employers (commercial ranches, feed mills and abattoirs) in the value chain do not employ people under 18.

[10] ILO website
http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:10011:0::NO::P10011_DISPLAY_BY,P10011_CONVENTION_TYPE_CODE:1,F

Children, especially older children, work in cattle production in the SNL, but, as the authors were assured in all the FGDs, in lighter tasks such as taking the cattle to and from grazing, and not at times or in ways that conflict with school attendance - which is universal up to 16 and very high in the SNL between 16 and 18 - but up to two hours per day after school, and for longer periods at weekends, especially in areas where cattle graze further afield during the week, and are only brought back to the kraal on Sundays.

In the formal sector the law on hazardous tasks for young people is enforced by the Ministry of Labour; in the agriculture sector this notably includes work with chemicals. In the SNL we were not informed of, and did not observe, any involvement of children in dipping, which would be the principal relevant hazard.

4.1.3 Job safety

eSwatini has a developed system of Occupational Safety and Health (OSH) regulation, based on the Factories and Machineries Act and the Occupational Safety and Health Act. There are around four separate OSH Inspectors regulating this system across the country. Employers' responsibilities are to make sure that employees are not exposed to potential harm, under Section 9 of the OSH Act. Employers must have a written health and safety policy and a designated health and safety committee (this is not expected of sole traders and small companies, but such enterprises are inspected for unsafe practice). There is a system for employers to report injuries at work; injuries involving hospital visits or three or more days' absence from work are notifiable, but employers are also encouraged to report more minor incidents to study for possible patterns. Employers are required to provide protective clothing and equipment. Employers are required to pay into an insurance-based Workmen's Compensation Scheme – several different schemes operated by different companies are available, regulated by a Regulator under Section 23 of Workmen's Compensation Act of 1983.

The large formal sector companies in the beef value chain appear to take their responsibilities under this system seriously and mention that responsibility is shared by all line managers. Union officials interviewed expressed the view that companies evade their responsibilities and push employees into dangerous practices, but these concerns were raised primarily in connection with the forestry sector, not the livestock sector. At the parastatal ranch visited by the authors, employees have access to a doctor employed by the adjoining sister company, and the company contracts NOSA, a well-established South African OSH company (https://www.nosa.co.za/) to manage its OSH system. The large abattoir visited employs a nurse on site and a doctor visiting twice a week. Its OSH systems are audited yearly by the British Retail Consortium.

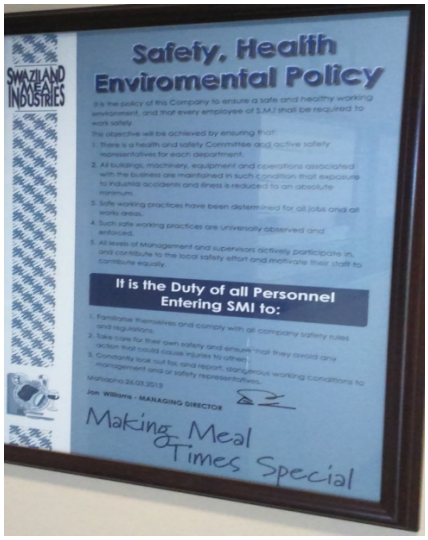


FIGURE 4.1: HEALTH AND SAFETY POSTER IN THE RECEPTION AREA OF ESWATINI'S LARGEST ABATTOIR

The national OSH system does not function within SNL cattle production, but the authors were not aware of any unusual hazards or instances of negligence. Dip operators appear to be well-trained and no cattle-owners raised the issue of dip safety or correct use of chemicals. The authors were not able to ascertain the standard of OSH in smaller processing enterprises such as abattoirs or butcheries.

4.1.4 Job attractiveness

eSwatini has a well-developed system of minimum wages (referred to as "gazetted" wages) for different sectors and grades of employee. Under the Wages Act of 1964, Regulation of Wages Orders are issued at two-year intervals for several sectors. Under the Agricultural Industry Order of 2015 (the latest one made available to the authors) the basic minimum daily wage for general workers including “stockmen” is E38.55 to be supplemented by specified minimum rations. In larger formal sector companies, gazetted wages are comfortably exceeded, with additional benefits. On the commercial ranch visited, the rate is E50 with rations. On the parastatal ranch visited the rate under the collective agreement with SAPAWU (seen by the authors) is E8.42 per hour for stockmen and E9.24 per hour for abattoir hands, with a variety of additional benefits including bottled gas, electricity, housing loans and education grants for children. The parastatal ranch and the large abattoir visited both use versions of the Paterson Job Grading System to define levels of seniority and thus pay scales above the basic.[11]

The situation in smaller-scale processing enterprises, such as local butcheries, is less clear. In the SNL production system, figures given in FGDs for herding wages varied widely between E400 and E1200/month, clustering around E700-800, but with most herding arrangements involving the herder living as a household member with food, shelter and bedding supplied. In some areas, arrangements may depend on the number of cattle herded: E400/month for one to ten head of cattle, 800/month for more than ten. Herders are also able to work jointly for more than one cattle-owner. As in some cases working as a paid herder is a way for young men to accumulate savings, and in other cases herding contracts can be made between social equals to allow economies of scale in herding Labour, the full implications of paid herding for inequality and poverty are unclear and may not be great.

Despite the existence of such herding arrangements, cattle production on the SNL (like SNL agriculture in general) is not particularly attractive for youth, and there is a trend for rural youth to migrate to urbanized areas. Cattle-owners complained of the difficulties in getting older children to carry out even light herding tasks (“they prefer football”). Employment in the more formal parts of the value chain (e.g. in abattoirs or feed mills) is seen as self-evidently attractive because it consists of salaried employment which is in high demand, not because of any specific aspects of cattle-related work.

4.2 Are Land and Water Rights Socially Acceptable and Sustainable?

The dualistic nature of land tenure in eSwatini, and the communal nature of grazing access (with remaining uncertainties over how it works in practice, are presented in Section 2.1 above. Given that analysis, this section will essentially deal with two distinct questions: a) is future development of the beef value chain likely to involve negative consequences for ordinary farmers’ access to land? and b) is the current management of grazing on the SNL equitable and sustainable?

4.2.1 Adherence to VGGT

It was striking to the authors that no government officials, or other stakeholders, had heard, still less used, either FAO’s *Voluntary Guidelines on the Responsible Governance of Tenure* or the multi-donor *Guide to Due Diligence of Agribusiness Projects that Affect Land and Property Rights*. This lack of knowledge extended to senior national staff in the FAO eSwatini Office. It points to a deeper problem of a lack of appreciation of the contentious land issues that can appear in the development of commercial agriculture.

4.2.2 Transparency, participation and consultation

Acquisition of land within the TDL is a relatively straightforward commercial transaction for eSwatini nationals or companies with majority Swazi shareholding. Other individuals or companies can seek exemption through the Land Control Board if a strong case (e.g. evidence of development benefits) is presented. In practice there is little buying or selling of TDL land, and there is no current trend of land acquisition for the beef sector.

[11] A system developed by the British academic T T Paterson in 1972, categorizing primarily by the degree of autonomous decision-making expected of the worker. Its use in business is found mainly in Southern Africa.

There is no mechanism for wider consultation, for example consultation with SNL neighbours of TDL changing hands.
The authors did not find examples of actual or planned acquisition of areas in the SNL for commercial ranching or related activities, so it is difficult to draw conclusions for this section. SNL cannot be permanently alienated, but chiefs have wide discretion to grant use rights for commercial purposes to wealthier members of their own communities, or to outsiders – this may take the form of formalised 99-year leases. Existing usufruct rights for cropping or communal grazing may be ceded back to the chief to allow this to happen. There was a lack of concrete examples of this process, but the general impression from stakeholders was that these processes were less than transparent.

4.2.3 Equity, compensation and justice

The comments above on transparency, and the lack of concrete examples, mean that it is hard to talk about equity or compensation in transfers of SNL to outsiders. SNL cattle producers did not spontaneously raise any concerns that land might be alienated for commercial projects. There are more positive experiences in the irrigated agriculture sector, notably in LUSIP (Lower Usuthu Smallholder Irrigation Project) where farmers originally holding rights in areas to be irrigated were formed into companies that could collect dividends from the scheme, as well as becoming scheme tenants.

However, the question of equity also arises in connection with rangeland use in the SNL, where it also overlaps with the questions of sustainability and security of access to grazing. One aspect of the communal grazing tenure described in Section 2 above is that the animals of relatively large-scale herdowners (for example the owner of 100 cattle the authors met at Cota borehole) are regarded as having an equal right to use the range as the cattle or the goats of poorer households. The communal aspect of the grazing system is a source of considerable concern to many outside observers, who associate it with overgrazing and land degradation. The views of smallholders tend to more multiple explanations. Stringer (2009) presents a finding from the Middleveld that 56% of her sample of SNL farmers saw excessive grazing as the chief cause of poor rangeland condition, with a further 13% blaming excessive new settlement. Stringer et al. (2007) also note the ability of cattle-owners, largely overlapping with traditional elites, to influence perceptions of what the most important environmental problems are (e.g. rangeland degradation over weed invasion on cropped land) and drive the agendas of supposedly participatory projects. Orchard et al. (2017) underline that increased settlement is seen by SNL dwellers as a driver of degradation, some of which is in turn driven by lower property taxes in rural areas compared to nearby urban areas. This accords with views expressed to the authors by smallholders in all the FGDs and others – that growth in the number of homesteads (family homes and the grants of usufruct for cropping around them), both by natural increase and by in-migration, is causing a shrinking of available grazing land and is the biggest threat to access to grazing. Land degradation is seen in both a general decline in grazing availability and in gullying and point erosion as tracks between homesteads, diptanks and grazing areas become over-used (Orchard et al. 2017).

4.3 Are Gender and Social Inclusion throughout the VC Acknowledged, Accepted and Enhanced?

The government of eSwatini accepts, in its National Gender Policy of 2010, that "Swazi society is characterized by inequality between women and men in different areas". The Policy acknowledges nine thematic areas considered critical for the advancement of women, broadly in accord with the twelve critical concerns in the 1995 Beijing Platform for Action. These include:

- Poverty and economic empowerment
- Education and training
- Legal and human rights
- Politics and decision-making
- Environment and natural resources.

eSwatini ratified the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) in 2004. The constitution of 2005 seeks to promote gender equity. Gender policy is co-ordinated by the Gender and Family Issues Unit of the Deputy Prime Minister's Office through Gender Focal Points in each Ministry (National Gender Policy, 2010).

At the national level, there is evidence that whether a household is male- or female headed is significant for poverty and economic opportunities. The eSwatini Household Income and Expenditure Survey of 2009/2010 shows a significant difference in poverty incidence with 67% of female-headed households being classified as poor, compared to 59% of male-headed households, and a lower drop in poverty for female-headed households since the corresponding survey of 2000/2001.

4.3.1 Economic activities

Women's involvement in cattle production on the SNL is still limited by traditional role expectations, although these play out in complex ways and are changing in equally complex ways. Cattle may be acquired in different ways (inheritance, purchase, as marriage payments/gifts, as rights on calves of cows already owned) by men and women, but traditionally all cattle in the homestead are kept in a single kraal, under the authority of the homestead head. This system has tended to be reinforced by the diptank registration system, which registers cattle under a registered owner required to dip regularly at a tank, who is also required to complete certain formalities when cattle are bought or sold. There is a strong tendency for the homestead head to be the registered owner of all cattle belonging to homestead members.

This system of male registered owners may actually conceal the informal decision-making (or decision-influencing) power of women over cattle and is in any case slowly changing. At various of the FGDs we were told that women are now more likely to be registered as cattle owners, either as independent heads of households such as widows, or alongside their husbands, or even instead of their husbands where husbands are migrants in distant places (Maphoko and Siteki FGDs). In the Lwandle FGD, it was said that 30% of registered cattle-owners are women, but this was not matched elsewhere.

Traditionally, men carry out the heavier tasks associated with cattle production, including building and rebuilding kraals, ploughing, slaughtering and taking cattle for vaccination. Men and children (see 4.1.2 above) are more likely to take cattle to and from grazing. Men, women and children can all milk. Women, especially widows, are increasingly taking on traditionally male tasks, but very rarely slaughtering or ploughing. The authors were told that women find it more difficult to move around in order to sell animals (presumably because of childcare and household duties) and there was some suggestion that women are less confident negotiating good prices for animals, and that some men may resent women in the market place (Hlathikhala FGD).

Women's involvement in the rest of the value chain (intermediary cattle trade, slaughtering and butchery) is very low. Quantitative data from the largest enterprises may obscure the fact that women are in roles not directly related to beef production (e.g. in an eco-tourism facility operating alongside the parastatal ranch). It should however be noted that three of the Veterinary Assistants encountered were women, as was the Beef Procurement Officer/Fattening Manager at the largest abattoir.

The authors saw no evidence of active programmes or policies, specific to the beef value chain, to increase women's involvement.

4.3.2 Access to resources and services

Women are owners of cattle, but the extent of this is not quantified, and is in any case a less important question than their effective control over cattle, which is discussed in 3.3.1 above and 3.3.2 below. In cases where women own and make production decisions over cattle the authors were consistently told that they have equal rights to use communal grazing land and watering points.

Service provision to SNL cattle production (e.g. of extension advice and inputs) is generally low, except for animal health services. It is likely that women suffer some degree of further disadvantage due to their responsibility for household tasks. Lack of credit for beef production activities is a major complaint voiced by

both male and female cattle-owners on the SNL – existing bank loans and formal credit schemes have high collateral requirements which are not satisfied by cattle ownership.[12]

4.3.3 Decision-making

Most informants in the FGDs said that decisions to sell animals are taken jointly by husband and wife (assuming both are present in the household) as are decisions on how to use the proceeds. It was also stated that women are less likely to sell cattle unless there is a specific need for cash in the household, whereas men might sell because they felt they could get a good price. The issue of intra-household decision-making is complex and not easily investigated by rapid methods such as FGDs. The authors consider that in the context of traditional values, and the lower access of women to information and to physical venues for selling cattle, the pattern of decision-making in cattle sales is unlikely to be as egalitarian as the FGD data suggests.

4.3.4 Leadership and empowerment

Questions of women's leadership and empowerment are hard to address given the relative lack of farmer groups or similar associations at village level. There were therefore few opportunities for the authors to discuss or observe female leadership. In formal sector employment, women are active members of trade unions. As noted above, women are employed as Veterinary Assistants, which is a key support role in cattle production and rural development more generally. Both male and female informants in FGDs expressed satisfaction with the official local development planning structures at chiefdom level. In the FGDs women spoke up independently and confidently, and when women informants were asked subsequently and separately if they agreed with views expressed by men in the FGDs were generally satisfied.

4.3.5 Hardship, gender roles and division of Labour

The gender division of Labour in cattle production has been discussed in 4.3.1 above. Comparing workloads of men and women is difficult. Women undoubtedly bear a heavy burden of domestic work and child care, but in an agricultural system that has been plough-based for generations, men carry out ploughing, as well as the weekly dipping and the more strenuous aspects of herding.[13] The authors saw no evidence of Labour-saving technologies specifically promoted for traditionally female tasks.

4.4 Are Food and Nutrition Conditions Acceptable and Secure?

Using national-level indicators disaggregated for the rural population (Government of eSwatini 2016 citing the Multiple Indicator Cluster Survey of 2014) shows that eSwatini has good indicators for food security measured by consumption and for acute malnutrition, but more concerning indicators for chronic malnutrition. Prevalence of Undernourishment, an agreed international measure of probability of consuming few calories than required for an active and healthy life is 5.8% nationally and 6.2% in rural areas. Prevalence of wasting among children under five (weight for height more than 2 standard deviations below the international reference medium) in 2014 was 2% nationally and 2.1% in rural areas. However, prevalence of stunting in children under 5 (height for age more than 2 standard deviations below the international reference medium) was 25.5% nationally and 27.3% in rural areas.

The eSwatini Annual Vulnerability Assessment and Analysis Report of 2016 gives data for further indicators and with disaggregation by regions:

[12] The authors understand the reasons why formal sector credit schemes would not accept cattle as collateral, but the point remains that no feasible alternative, such as group liability schemes, have been developed.
[13] Including herding in more distant areas where there are snakes! (Hlathikhala FGD).

	National	Hhohho	Manzini	Shiselweni	Lubombo
Food Consumption Score (%)					
Poor	5	2	6	5	6
Borderline	22	21	24	19	24
Acceptable	73	77	70	76	70
Household Dietary Diversity (%)					
Low	31	20	33	34	35
Medium	54	57	52	57	48
High	15	22	15	9	18
Household Food Expenditure Share (%)					
>75%	20	8	26	25	19
65-75%	14	9	13	12	22
50-65%	24	20	17	29	29
<50%	43	64	44	35	30

TABLE 30 - FOOD CONSUMPTION, HOUSEHOLD DIETARY DIVERSITY AND HOUSEHOLD FOOD EXPENDITURE SHARE, NATIONALLY AND BY REGION, 2016.

Source: eSwatini Annual Vulnerability Assessment & Analysis Report 2016

The Food Consumption Score is a composite index of dietary diversity, food frequency and nutritional importance of food consumed. Dietary diversity is linked to sufficient intake of necessary nutrients including micro-nutrients. The share of household expenditure accounted for by food shows vulnerability to rapid inflation and other economic shocks. The data shows concerning levels of poor and borderline Food Consumption Scores, low dietary diversity, and high proportions of expenditure on food. There is significant regional variation, but as the districts do not align well with agroecological zones it is hard to draw conclusions. Lubombo, which includes both Lowveld and remote plateau areas, generally has the lowest scores.

The Vulnerability Assessment and Analysis Report also gives an inter-year comparison of Food Consumption Scores, with the proportion of acceptable scores rising from 84% in 2012 to 97% in 2014, then falling sharply to 73% in 2016.

Indicators from the two reports taken together suggest a lower than acceptable level of food security. Figures for childhood stunting (chronic malnutrition) are high. The relatively low 2014 figure for childhood wasting in the SDG report (Government of eSwatini 2016) is likely to be sensitive to weather conditions and rise in drought years – the overall decline in Food Consumption Scores between 2014 and 2016 supports this interpretation.

These figures are not disaggregated between cattle owning and non-cattle owning households.
The FGDs enabled the authors to explore the question of whether the food security of cattle-owning households within the SNL is better than that of non-cattle-owning households within their communities – which is related to the more general question of whether cattle-owners are *wealthier* than non-cattle-owners. Summary responses are set out below:

Maphoko (Highveld peri-urban)	Cattle-owning households are not wealthier per se, some people happen to be interested in cattle. Generally, the standard of living is the same if you have a cow or not, everyone tries to eat better (informants appeared to be referring to the importance of good nutrition for those on ARV therapy for HIV/AIDS). Those with cattle have milk, others can buy it, provided they organise their household budgets. But responses on reasons for keeping cattle suggested that women place high value on milk and manure which is used for vegetable growing. People with cattle can weather shocks.
Lwandle (Middleveld)	Some people who don't have cattle are wealthier than some who do, these are people employed in non-agricultural jobs. In general cattle-owners eat better food, they get milk and meat. During droughts, supply of milk and meat decreases, and cattle-owners and non-cattle owners are almost at the same level, except for those who have jobs. They are struggling to eat well because of the recent drought. In their fathers' times there was plenty of food, they could slaughter an animal simply to have a celebration.
Siteki (Plateau and Lowveld)	Families who own cattle are wealthier by definition, it is not a matter of cause and effect. Some invest money from other sources in cattle. Cattle-owners are said to be living a better life, they have milk for consumption, but some others with money can also afford to eat better. "We could debate for a day": maybe in the old days it was the rule that cattle-owners ate better. When there is a drought, it is bad for those with cattle.
Hlathikhala (Highveld)	Cattle-owners are wealthier in the sense of being more secure. They are no more likely to eat better. They do have it easier in a drought, even if they have to buy hay, which can become very expensive.

TABLE 31 - SUMMARY OF FGD RESPONSES OF RELATIVE WEALTH AND FOOD SECURITY OF CATTLE-OWNING AND NON-CATTLE-OWNING HOUSEHOLDS

The above responses give moderate support to the hypothesis that cattle-owning households are more food secure, through a) direct consumption of livestock products, particularly milk b) use of manure as a fertilizer on vegetable gardens, and c) the buffering effect of livestock sales during droughts. However, employment of a family member outside agriculture may be as or more important.

Recurrent drought is a major risk to food security in the SNL, exacerbated by climate change, and by increased pressure on resources for demographic reasons. While there is some subsidized distribution of livestock feed during drought, other drought management policies for the livestock sector that might improve food security are under-developed, and there is no mechanism to reduce food price variation during droughts.

Outside the variability in food availability caused by drought, and the apparent decline from what seems to have been a highpoint in food security in 2014, the authors have seen no long-term trends in food security (availability, accessibility, utilization or nutritional adequacy). Separate sub-sections for these aspects have therefore not been included in this report.

4.5 Is Social Capital Enhanced and Equitably Distributed throughout the VC?

4.5.1 Strength of producer organizations

Focus Group Discussions were unanimous in stating that farmers have not organized themselves into groups for cattle production or marketing: in the Maphoko and Lwandle FGDs the answer to this question was "it is every man for himself", and in Siteki the proverb "each frog jumps for himself". Service of some farmers on diptank committees could be seen as an example of producer organization or voluntarism within the livestock sector, but it takes place within a government mandated and managed institution. Outside the livestock sector there are more important successful examples of self-organization, notably collective action to raise local contributions to infrastructure development. On questioning about the lack of farmer groups in cattle production or marketing, one FGD replied it was something they had not previously thought about, and they

would require training, but it would appear that the lack of collective action for production and marketing are largely collected to the social role of cattle and their association with homesteads and their kraals.

4.5.2 Information and confidence

SNL cattle-owners receive information on livestock health and production, through Veterinary Assistants and informally, from neighbors. We were given examples of SNL producers requesting advice from neighbors in the TDL (as well as buying breeding bulls from them). SNL farmers receive information on timing and location of cattle markets and other selling opportunities, from various sources including the radio and Ministry of Agriculture communication initiatives. However, there is no channel other than word of mouth by which farmers receive market information in the sense of information on current cattle prices.

It was clear from FGDs and from other stakeholders that there is very little trust between farmers and potential buyers of cattle, or between other value chain actors (though there seem to be higher levels of trust between fatteners and SMI – see Section 2). While abattoirs make payment several days after sale based on the dressed weight of a carcass, farmers distrust this system and the potential for cheating within it, and only enter it for lack of alternatives. The practice of the abattoir keeping the sale proceeds of the "fifth quarter" (offal and skins) to cover overheads, is misunderstood and resented by SNL cattle-owners. There is also a lack of trust between commercial ranchers and abattoirs. This pervasive lack of trust within the value chain is treated as a normal state of affairs, and the system works around it in various ways, by attempts at vertical integration, or at smallholder level, by a preference for spot transactions for cash.

4.5.3 Social involvement

General development issues for SNL communities are discussed in official fora organised by local Chiefs (and at a higher level of local government known as Tindkhundla), and there is general satisfaction with this system, though in the case of our FGDs, little enthusiasm. Stringer et al. (2007) note the tendency for official "participatory" processes in rural eSwatini, in this case a bilateral project to address land degradation, to be captured by local elites. The question of whether these development planning processes respected local knowledge did not strongly arise. The processes are embedded in the very complex evolution of the Swazi state, its legitimation through tradition, and its attempts to balance centralized authority with some degree of localization. As stated above, there is a strong strand of local co-operation, in officially-sponsored development activities like community water supply and rural electrification, but also in more personal ways like women's joint action in buying food commodities in bulk to save money. But these tendencies have not to date been harnessed in the livestock sector.

4.6 What are the Standards of Health, Education and Training Infrastructure and Services and do the VC Operations Contribute to Improving them?

This section will highlight national-level data on important indicators of living standards, where they are available – Swaziland's Transition Report from the MDGs to the SDGs (Government of Swaziland 2016) reports there are many data gaps. Additional commentary is derived from FGD findings on whether such indicators might be more favorable for cattle-owning households.

4.6.1 Health services

Health indicators associated with SDG 3 "Ensure healthy lives and promote well-being for all ages" are reported in eSwatini's Transition Report from the MDGs to the SDGs (Government of Swaziland 2016). They include a maternal mortality ratio of 593 per 100,000 live births against a target of 70 by 2030, although a relatively high 88% of births are attended by skilled personnel. On this indicator eSwatini demonstrates a better situation than most of its neighbors except South Africa. The under-5 mortality rate is 67 per 1000 live births against a target of 12 by 2030; on this indicator eSwatini is worse placed than its neighbors.

eSwatini is taking steps to control the HIV/AIDS epidemic, by which it had previously been one of the worst affected countries in the world. The rate of new infections is now 2.38 per 1000 person-years among the uninfected population. The incidence of malaria in the population is now 36.5 per 1000 and the malaria mortality rate has been greatly reduced. 85% of women of reproductive age have their family planning needs satisfied with modern methods.

The eSwatini Household Income and Expenditure Survey, 2009/10 reports on the %age of individuals who consulted a medical worker during the year. The total rural figure was 12.6%, with small variations between men and women (12.4% and 12.8% respectively), districts (ranging from 10.3% in Manzini to 14.4% in Hhohho) and most significantly by income quintile (ranging from 8.3% in the lowest quintile to 18.5% in the highest).

Responses from FGDs on whether cattle-owners are more likely to have better health are summarized as follows:

Maphoko (Highveld peri-urban)	The health of cattle-owners and non-cattle-owners is the same – non-owners can buy milk if they organise their household budgets, and in any case cows are dry during winter
Lwandle (Middleveld)	The health of cattle-owners and non-cattle-owners is generally the same. Cattle-owners may have to sell at a low price to meet health needs (which implies that at least they have this option. It is those who are employed who have fewer problems
Siteki (Plateau and Lowveld)	Generally, cattle-owners are better off in terms of health

TABLE 32 - SUMMARY OF FGD RESPONSES OF RELATIVE HEALTH OF CATTLE-OWNING AND NON-CATTLE-OWNING HOUSEHOLDS

The overall picture is that serious problems of access to health services and facilities persist in eSwatini, although the picture is improving. There is little or no systemic difference in health between cattle-owners and non-cattle owners.

4.6.2 4Housing

No statistical data is easily available on type of housing in eSwatini, but the authors' observations were that block-built houses, of a decent size and with permanent roofs, were virtually universal in the rural areas visited. Three of the FGDs saw no close connection between ownership of cattle and better housing - people might have cattle but not enough to sell animals to finance building or might have animals but be unwilling to part with them. In Siteki the FGD stated that cattle-owners do have better housing.

eSwatini is making significant progress on provision of safe water and sanitation in rural areas. The following table summarizes results from the eSwatini Household Income and Expenditure Survey of 2009/2010:

	2009/10			2000/01
	Rural Lowest Income Quintile	Rural Highest Income Quintile	Rural Total	Rural Total
Piped into housing	0.2	23.1	6.2	5.2
Piped outside housing	29.9	44.5	39.0	16.8
Borehole	11.1	5.4	7.5	5.5
Protected well	2.4	2.6	2.9	4.6
Protected spring	6.6	3.2	4.2	3.2
(Sub-total Safe water supply)	*50.2*	*78.8*	*59.8*	*35.3*
Unprotected well	16.5	1.4	10.3	8.9
Unprotected spring	6.6	2.0	4.9	6.7
Surface water	26.7	17.7	25.0	49.1

TABLE 33 - SOURCE OF HOUSEHOLD WATER SUPPLY IN RURAL AREAS, 2009/10 AND 2000/01. SOURCE: ESWATINI HOUSEHOLD INCOME AND EXPENDITURE SURVEY OF 2009/2010

Water sources vary also by region but more importantly by income quintile, as shown above. But on average important gains are being made.

The same report gives data on sanitation for rural areas:

	2009/10			2000/01
	Rural Lowest Income Quintile	Rural Highest Income Quintile	Rural Total	Rural Total
Flush toilet	0.2	31.6	8.7	5.9
Ventilated Improved Pit	11.4	22.1	18.4	21.1
(Sub-total Acceptable Sanitation)	*11.6*	*53.7*	*27.1*	*27.0*
Ordinary Pit Toilet	51.8	42.6	54.7	41.8
Bush/Field	36.7	3.7	18.3	31.2

TABLE 34 - HOUSEHOLD ACCESS TO SANITATION IN RURAL AREAS, 2009/10 AND 2000/01 SOURCE: ESWATINI HOUSEHOLD INCOME AND EXPENDITURE SURVEY OF 2009/2010

These figures show a stagnation in improvement of rural sanitation between 2000 and 2010. More recent figures in eSwatini's Transition Report from the MDGs to the SDGs (Government of eSwatini 2016) give a national figure of 53% using "safely managed sanitation services, including handwashing with soap and water", but this is not disaggregated between rural and urban. The authors' observations in rural areas would suggest quite a lot of progress has been achieved in sanitation since 2010. Observations from FGDs on whether cattle-owners are likely to have better access to water and sanitation than non-cattle-owners are summarised below:

Lwandle (Middleveld)	Water is scarce, people use the river, but cattle-owners who also work can buy from tankers. All families have pit latrines, through government efforts
Siteki (plateau and Lowveld)	Generally, cattle-owners are better off in terms of water

TABLE 35 - SUMMARY OF FGD RESPONSES ON RELATIVE ACCESS TO WATER AND SANITATION OF CATTLE-OWNING AND NON-CATTLE-OWNING HOUSEHOLDS

4.6.3 Education and training

eSwatini is making significant progress on provision of both primary and secondary education in rural areas. The following tables summarize results from the eSwatini Household Income and Expenditure Survey of 2009/2010[14]:

	2009/10		
	Rural Lowest Income Quintile	Rural Highest Income Quintile	Rural Total
Primary Net Enrolment Rural Male	79.0	91.4	86.6
Primary Net Enrolment Rural Female	84.8	94.7	87.6
Primary Net Enrolment Rural Total	81.8	92.9	87.1

TABLE 36 - PRIMARY NET ENROLMENT IN RURAL AREAS, 2009/10. SOURCE: ESWATINI HOUSEHOLD INCOME AND EXPENDITURE SURVEY OF 2009/2010

	2009/10			2000/01
	Rural Lowest Income Quintile	Rural Highest Income Quintile	Rural Total	Rural Total
Secondary Net Enrolment Rural Male	23.0	58.9	34.0	22.8
Secondary Net Enrolment Rural Female	28.7	53.1	39.1	26.6
Secondary Net Enrolment Rural Total	25.8	56.0	36.4	24.6

TABLE 37 - SECONDARY NET ENROLMENT IN RURAL AREAS, 2009/10 AND 2000/01SOURCE: ESWATINI HOUSEHOLD INCOME AND EXPENDITURE SURVEY OF 2009/2010

These figures show very high primary enrolment, with secondary enrolment varying strongly with household income, but making significant progress between 2000 and 2010. At both levels there is higher enrolment of girls than of boys. However, education is now compulsory until 16 and the authors were assured in the various rural areas that it is near universal through secondary school.

Views in FGDs were more unanimous that cattle-owning households were more likely to have children in education than they were for parallel questions on health, housing, water and sanitation.

[14] Net primary enrolment is the proportion of children of the nationally designated primary school age enrolled in primary school and thus cannot exceed 100% (whereas gross primary enrolment can include children attending primary school even though they are above the nominal age, and can thus exceed 100%)

Maphoko (Highveld peri-urban)	Having cows makes it easier to keep children in school
Lwandle (Middleveld)	Most of the adults here have no education, their fathers were not convinced it was worth it. It is something for their children, the adults will sell cattle to fund their education, even at tertiary level
Siteki (plateau and Lowveld)	Cattle-owners are definitely getting better education for their children including private schools. Government secondary schools can charge up to E6000 a year, plus E1700 for uniform. Private School expenses can go up to E20,000. They sell cattle at the beginning of the year (the calendar year, also the start of the school year), or when there is need such as school fees
Hlathikhala (Highveld)	Cattle-owners get better education for their children. They sell their animals towards January to pay school fees. Primary education is free, secondary education costs E5000/year, private school costs E7-8000/year or even up to E90,000 (sic)

TABLE 38 - SUMMARY OF FGD RESPONSES ON RELATIVE ACCESS TO EDUCATION OF CATTLE-OWNING HOUSEHOLDS AND NON-CATTLE-OWNING HOUSEHOLDS

The seasonal peak in sales in December and January in connection with the new school year was also mentioned to the authors by the managers of the largest commercial abattoir. Not only is cattle-ownership positively associated with expenditure on education for children, but it appears it is strongly influencing marketing behaviour by SNL cattle-owners and the seasonality of the value chain as a whole.

4.6.4 Mobility

eSwatini was at one time well-known as one of the countries that sent migrant Labourers to South Africa. Simelane and Crush (2004) show the number of Swazi workers in South African mines peaked at nearly 18,000 in 1990 and had declined to 9,000 in the year they were writing, 2004. It is likely the number has further decreased since. Swazi rural society is still characterized by migration, but of multiple types and multiple geographical and temporal scales, from weekly commuting for urban jobs to long-term migration to the UK. Migration patterns seem similar for cattle-owners and non-cattle owners – in Siteki it was explained that cattle wealth belonging to their fathers does not prevent young men migrating to start a life of their own. Migration interacts with the cattle economy in three other ways. Firstly, male out-migration requires women to take on some traditionally male roles in cattle production, though they may find some roles, particularly in taking cattle to market and negotiating prices, difficult and require help from sons or others. It is also one factor in the increase in women becoming registered cattle-owners. Secondly, as already mentioned, in-migration of Mozambicans, Mozambique being a generally poorer country, may be adding to the pool of Labour for paid herding. Thirdly, the move of urban people to rural SNL areas from where they can continue to commute to urban jobs, is associated with encroachment on grazing lands by homesteads and crops. There is some suggestion this migration is exacerbated by lower property taxes in rural areas.

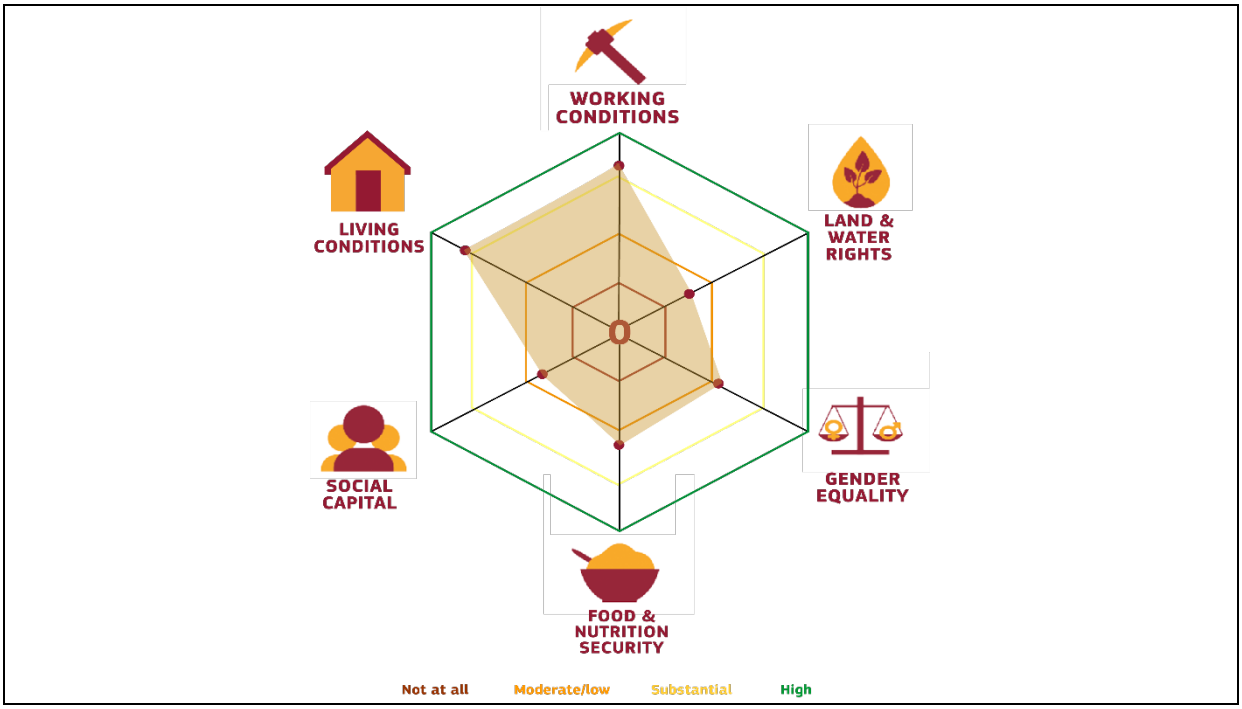
4.7 Conclusions of the Social Analysis

This section summarizes the main findings above.

4.7.1 Assessment of the social domains

Scores for each of the six domains were calculated from the average scores of the component questions in each sub-domain. A high score indicates positive social conditions, while a low score indicates potential risks.

Domain	Profile
1. WORKING CONDITIONS	Substantial
2. LAND & WATER RIGHTS	Moderate/Low
3. GENDER EQUALITY	Moderate/Low
4. FOOD AND NUTRITION SECURITY	Moderate/Low
5. SOCIAL CAPITAL	Moderate/Low
6. LIVING CONDITIONS	Substantial



Working conditions in the value chain are generally positive. This is due to the relatively strong legislative framework which applies to formal sector enterprises. Detailed discussion with managers suggests that regulations on matters such as minimum wages and occupational safety and health are respected or exceeded. Representatives of the trade union movement were more critical, but examples given of poor practice in Labour relations were not from the beef value chain. No major risks were identified. In the SNL traditional role expectations govern the Labour of cattle production (for example paid herders live as quasi-family members). The chief risk is that rural youth may increasingly drift away from cattle production.

Mitigating measures would include:

- continued efforts to observe the spirit and letter of international norms on Labour rights including free association,
- continued enforcement of current policies on child Labour,
- more monitoring of and/or research on working conditions and occupational safety and health in small-scale abattoirs and small and/or informal butcheries,
- continued investment in services to SNL cattle production (animal health, production inputs, market information and value chain integration) and training targeted to youth.

On *land and water rights*, while a large-scale shift in use of SNL areas to commercial ranching is unlikely under current economic conditions, there is a current lack of transparency on acquisition of use rights for commercial investment on the SNL (and compensation for it), of which the complete lack of awareness of the VGGT and related international guidelines is a symptom. This presents some risk of effective expropriation, damage to livelihoods and knock-on increases in grazing pressure elsewhere in the system. The risk is

exacerbated by the long-running failure to approve a national policy on land. For the SNL, many observers assert that the communal nature of grazing access *per se* presents a risk, but the bigger risk highlighted by our study is that of encroachment on communal grazing lands by homesteads and cropping.

Mitigating measures would include broader and deeper policy discussion on:
- bringing international norms on land acquisition into eSwatini policy
- a land policy that can serve growth objectives while protecting SNL livelihoods
- measures to slow down urban-rural migration and consequent additional pressure on grazing lands.

On *gender equality*, the situation is moderately unfavorable. There are significant risks of:
- continued exclusion of women from value chain roles other than cattle production on the SNL
- continued exclusion of women from opportunities for efficient and improved cattle production
- missed opportunities for female participation and for use of income on household priorities
- missed opportunities for female participation in public decision-making
- missed opportunities for reduction of female drudgery.

These risks are rooted in traditional structures of rural Swazi society, and the lack of empowerment of women, and will have to be addressed by long term policies. One such policy, the encouragement of girls' primary and secondary education, is already being implemented with effect. More immediate mitigating measures would notably include:
- Skills training for women in butchery and abattoir work and management
- Improved service provision, and provision of credit, to both women and men cattle producers on the SNL.

While national indicators of *food and nutrition security* are low, there is evidence that cattle-ownership is associated through various mechanisms with better food and nutrition. *Well-managed* initiatives to increase offtake from the SNL through improved calf survival and faster growth of male animals to a marketable weight might increase the food security of cattle-owning households, and under some scenarios increase the proportion of such households in the rural population. On the other hand, if not well designed, such initiatives might concentrate SNL cattle into fewer hands, and decrease human milk consumption and the availability of draught oxen for loans and exchange of ploughing services.
Mitigating measures would include:
- Measures for improved efficiency in the beef value chain (technical interventions on breed, calf survival, age at offtake)
- Measures for improved equity in the beef value chain (market and price information)
- More recognition at policy level of nutritional benefits of SNL cattle production (milk consumption, draught power, manure)
- Better drought management policies (micro-insurance, targeted feed distribution, market intervention).

On *social capital and information*, the authors found very low levels of farmer organization in either cattle production or primary marketing (despite successful examples of collective action in other spheres), and very low levels of trust in the value chain as a whole. The associated risks are those of missed opportunities for improved cattle productivity, and improved efficiency and equity of the beef value chain.

Mitigating measures would include:
- Research on reasons for absence of producer associations, followed by development of pilots
- Accelerated development of market information systems accessible to SNL farmers
- Establishment of industry fora with representation from along the value chain, including SNL farmers.

In the longer term it would also be important to continue to develop local planning institutions, at chiefdom level and higher.

On *living conditions*, including health services, housing, water supply, sanitation and education, eSwatini is making general progress. Participation in the beef value chain for rural people is either neutral or positive

(especially in the case of education) for these aspects of well-being, and the authors see no major risks for development of the value chain.

4.7.2 Social sustainability of the beef value chain

As already emphasized, cattle production is a fundamental part, not only of rural livelihoods in eSwatini, but also of Swazi culture. Further development of the beef value chain has the potential to reach a very substantial proportion of the rural population, although it is unlikely ever to reach the poorest in the rural areas and will have to be supplemented with many other forms of development, including social safety-nets but also more targeted supported such as small ruminant development. Development of the beef value chain can also build on knowledge and skills in an activity already well-known to the population, skills that have been passed down through generations. But in such development, certain policy principles must be respected:
Recognition of the multi-functional nature of cattle in Swazi livelihoods, including the importance of draught power, manure as fertilizer, family consumption of milk, and cash income to meet urgent household needs.

- Recognition of the strong seasonality of SNL cattle supply, in large part an effect of the use of cattle to pay education fees. Ways should be found to work with, rather than against, seasonal peaks in supply from the SNL, for example increasing canning capacity, or encouraging sales to feedlots for gradual release on the market.
- Recognition of both the potential of communal management of grazing (in other words that "the tragedy of the commons" is not unavoidable) and the current threats to it, including encroachments by homesteads and cropping.

These last three points are all examples of an even more fundamental need: to respect farmers' knowledge and existing objectives, listen to and learn from them, a need often lost in the development imperative to train farmers and mould their behaviour.

In addition, the following will be needed:

- Recognition of the structural nature of drought, which will only increase with projected climate change, and the need for specific policies to manage the effects of drought on the livestock. This report is not the place to lay out such policies in detail, but international experience on emergency market intervention, fed supply and negotiated access to private grazing should be consulted.
- Recognition of the current low levels of information and trust within the value chain, requiring both well-designed market information and longer-term measures such as fora for discussion between different value chain actors.

5. Environmental Analysis of the Beef Value Chain

5.1 Goal and Scope Definition

5.1.1 Objectives and Intended Application

The general objectives of this study are as follows:

- To calculate and compare environmental impacts of the two main beef production systems in eSwatini
- To identify the main environmental challenges but also the opportunities of the beef value chain in eSwatini
- Identify the life cycle stages with the highest environmental impacts and the main drivers of these impacts
- Assess the overall environmental sustainability of the beef value chain
- Identify improvement opportunities allowing to enhance the sustainability of the value chain

In addition to the technical identification of the environmental challenges and opportunities, the results of this study will be used by EU DEVCO to improve its knowledge of the Swazi beef value chain and for a better policy dialogue with the national stakeholders.

5.1.2 Description of Studied System

The scope of this study includes the inputs (feed, energy, water, land), the farming operations (including the cow-calf stage and the stocker/background stage), the finishing, the processing (slaughtering, the cleaning and the cut) and the distribution in local butcheries (Figure 1.1Figure 5.3). For the export component of the value chain, the transport of the carcass from the SMI slaughterhouse (only slaughterhouse with export license) to the port of Durban in South Africa is considered.

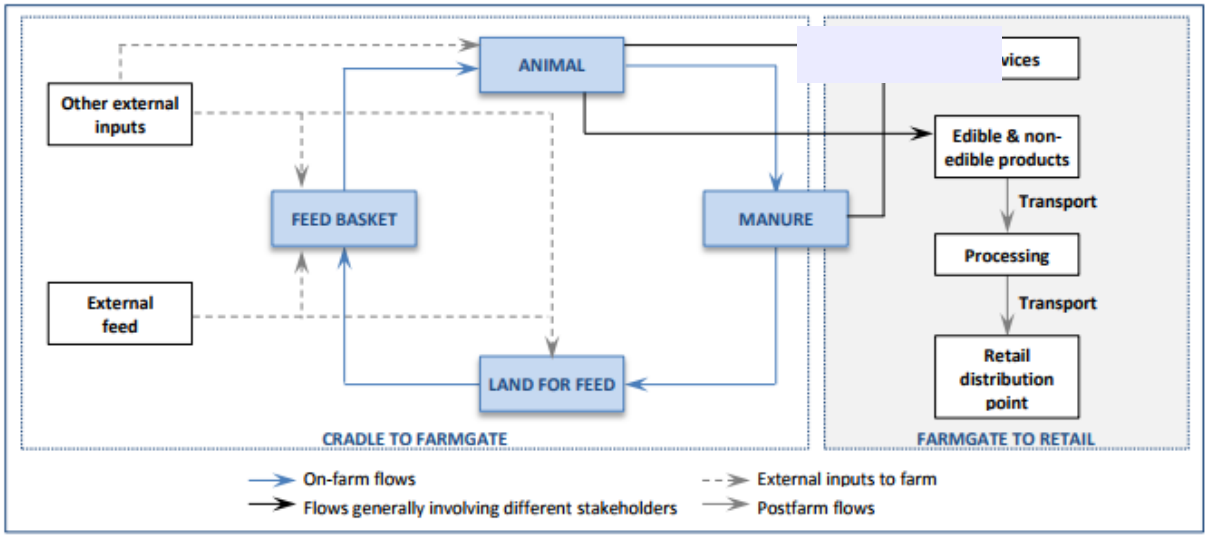


FIGURE 5.1: SYSTEM BOUNDARY (ADAPTED FROM GLEAM[15])

The present study considers two production systems for two markets (Table 39).

- The first scenario is a full grazing system in communal pasture combined with a three-month fattening. The finished cattle are slaughtered in a small commercial slaughterhouse.
- The second scenario is a full grazing system in a Title Dee Land with more grassland area available combined with feedlotting. The finished animal is slaughtered and processed in an export-oriented slaughterhouse.

[15] Food and Agriculture Organisation of the United Nations, Global Livestock Environmental Assessment Model, Version 2.0, 2010.

The reality is more complex than these two scenarios. The animals are almost never in a single feeding (full grazing system) system during the whole year. The grazing is most of time combine with crop residues, hay and other supplements. Unfortunately, the breakdowns of feeds taken per animal category, per day and according to the season are not available.

	Swazi Nation Land (SNL)	Title Deed Land (TDL)
Farming operations	Communal pasture grazing	Private pasture grazing with lower livestock density
Finishing	Fattening	Feedlotting
Slaughtering	Small commercial slaughterhouse	Export oriented slaughterhouse
Distribution	Local butcheries	Distribution in local butcheries
Transport to the boarder	-	Transport by refrigerated truck for the exported share of the production

TABLE 39: CONSIDERED SCENARIOS

5.1.3 Herd Structure

The environmental analysis takes the herd structure of the two production systems (Table 40) into account. This allows to research results to better reflect the ratio between mature females, mature males, and young cattle in the modelling of the farm. Thanks to the detailed herd composition, it is also possible to calculate (and/or adapt) the direct emissions per animal category with respect to the weight and the sex.

	National average		SNL		TDL	
	Proportion	Average weight (kg)	Proportion	Average weight (kg)		Average weight (kg)
Bulls	3.60%	350 to 450	3.54%	350 to 400	4.22%	400 to 450
Cows	36.92%		36.95%		37.78%	
Oxen	12.58%		12.89%		7.36%	
2-3 yrs Male	10.12%	350 to 400	10.05%	350	10.99%	400
2-3 yrs Female	11.94%		12.02%		11.65%	
1-2 yrs Male	6.56%	150 to 220	6.46%	150 to 180	7.56%	200 to 220
1-2 yrs Female	5.41%		5.16%		7.70%	
<1 yr Male	6.50%	120 to 180	6.58%	120 to 150	5.97%	150 to 180
< 1 yr Female	6.37%		6.35%		6.78%	

TABLE 40: HERD STRUCTURE ON SNL, TDL AND NATIONAL LEVELS (SWAZI MINISTRY OF AGRICULTURE, 2017)

5.1.4 Functional Unit

The **functional unit** is the quantified performance of a product system. It quantifies the performance of a product system and is used as a reference unit for which the LCA study is performed. It is therefore critical that this parameter is clearly defined and measurable. In several beef LCA studies, the weight of the final product destined for human consumption is taken as the functional unit. In this study the functional unit will be:

- One kg of carcass at the butchery for local consumption
- One kg of carcass at the Durban port for the export market

5.1.5 Allocation

When a production system has more than one output, partitioning the environmental impacts induced by this production system between its different co-products is one the technical possibilities. Different rules (bio-

physical rules, energy content, mass balance…) could be used as a basis for allocation and the allocation method could have an important influence on the results of an LCA.

In this study the mass balance and the unit prices of the edible components of cattle are used to allocate the impacts of the beef value chain between the carcass and the remaining edible parts. In fact, it is common in the LCA community to use economic allocation when performing an environmental analysis of beef value chain. The Cattle Model Working Group has also recommended this allocation method in the framework of the European Product Environmental Footprint (PEF) project.[16]

Outputs	Component weight kg?	Weight percentage	Unit price (E/kg)	Value	Allocation factor
Carcass	220	55%	43.00	9'460.00	89%
Hide	27	7%	7.41	200.00	2%
Head	20	5%	7.50	150.00	1%
Hooves	4	1%	1.75	7.00	0%
Rumen, intestines, spleen, lungs	41	10%	11.71	480.00	5%
Liver, heart, kidneys, tongue	8	2%	40.00	320.00	3%
Udder, testes, bladder…etc.	5	1%	4.00	20.00	0%
Rumen contents + blood	75	19%	-	-	0%
Total	400	100%	26.59	10'637.00	100%

TABLE 41: BEEF BALANCE AND CORRESPONDING ECONOMIC ALLOCATION FACTORS (IYSIS COMMERCIAL RANCH, 2017)

5.1.6 System Boundaries

- **Spatial boundaries:** The environmental analysis of the beef value chain uses a cradle to retailer point (butchery) for the local market and a cradle to gate approach for the export market. The geographical scope of the study is limited to the Kingdom of eSwatini. However, when imported feed from the region (Mozambique and South Africa) are used, their production and their transport are also considered in the analysis.
- **Temporal boundaries:** The environmental assessment considers the situation of the period from 2011 to now. This approach is motivated by the fact that the Kingdom of eSwatini has faced severe droughts in 2014-2015 and the consequences are still being felt today. For parameters like the number of births and the number of deaths, different scenarios will be made to differentiate normal periods with shock periods. The actual state of farming practices, feedlotting, dip tanking, slaughtering, animal transport is considered in the study. Since South Africa is the main electricity supplier of the kingdom of eSwatini (about 90% of the national supply), the South African electricity has been considered as representative of the national production.
- **Technological boundaries:** The analysis covers the two main production systems which are the SNL systems and the TDL systems (see paragraph 5.1.2).

5.1.7 Cut-off Rule

The cut-off rule allows excluding form the scope of the study activities, materials or energy flows with very low environmental significance. Sometimes, the cut-off could be motivated by both the low environmental significance and the lack of data and/or the difficulty to model a given activity or product.

In general, infrastructures, capital goods, small equipment, vaccines, medicines are not considered in beef LCA studies. These mentioned elements are also excluded from the scope of this study.

[16] European Commission, DG ENV A1, Cattle Model Working Group, Baseline Approaches for the Cross-Cutting Issues of the Cattle Related Product Environmental Footprint Pilots in the Context of the Pilot Phase 2013-2016.

5.2 Life Cycle Inventory

The Life Cycle Inventory (LCI) is a gathering of input/output data that relates to the functional unit of the system being studied[17].

In the framework of this study, a dedicated data collection template has been developed. It covers all the stages of the beef value chain and includes all the inputs from the nature (water, land, grass…) and the techno sphere (energy, materials, chemicals…), and all the outputs (main products, co-products, wastes…).

For the foreground processes, the data collection template is used to gather secondary data and primary data from the literature and Swazi stakeholders. These data are related to the farming operations, the fattening, the slaughtering and meat processing, the distribution in local butcheries and/or the export.

The SimaPro software (version 8.4.0.0) has been used to assist the LCA system modelling and to link the reference flows with the environmental databases and compute the complete life cycle inventory of the systems. The SimaPro software is a widely used and regularly updated LCA software with large background databases and LCIA methods.

The LCI datasets describing background processes (e.g. electricity generation, feed production) are in large part from the ecoinvent (v3.3), the Agrifootprint and the Agribalyse (v1.3) databases. Most of the environmental datasets (or life cycle inventory datasets) which are contained in these databases (e.g. pesticide production, transportation processes) are initially modelled for western countries (mainly Switzerland, France and other European countries). During the modelling, the datasets (background data) of technologies which are available in or comparable to the ones of developing countries are chosen.

In the specific case of the exported oriented abattoir, no physico-chemical data were found during the field missions and our interview/plant visit with SMI. Detailed input-output data were not found neither in the neighbouring countries. Finally, detailed input-output data of an Ethiopian export-oriented abattoir are used as proxy.

The quality of LCA results is dependent on the quality of data used in the study. Every effort has been made to implement the most credible, representative, and up-to-date information available. Gathering reliable country specific data was challenging in the Swazi context. Sometimes, expert judgments have to be made on the basis of experience from other comparable situations.

5.2.1 Data Gaps

From published beef LCA studies, the production phase is the most important life cycle stage. This stage is input intensive and could be relatively longer than the other life cycle stages. Modelling the production phase of cattle could be a complex process requiring an important number of parameters and assumptions (when specific data are not available). Once the herd composition and the average weight per animal category are known, the estimation of the annual feeding requirements (measured in energy unit) and the corresponding dry matter intakes (Figure 5.4) are of key importance for the calculation of greenhouse gas emissions (CH4, N2O, CO2…) and the other environmental burdens, which occur during the production phase. Additional parameters such as the feed quality (e.g. dry matter digestibility), the nutrition value (crude protein concentration per unit of dry matter, nitrogen content…) of the different types of feed and the animal productivity data are also required.

[17] ISO 14040:2006

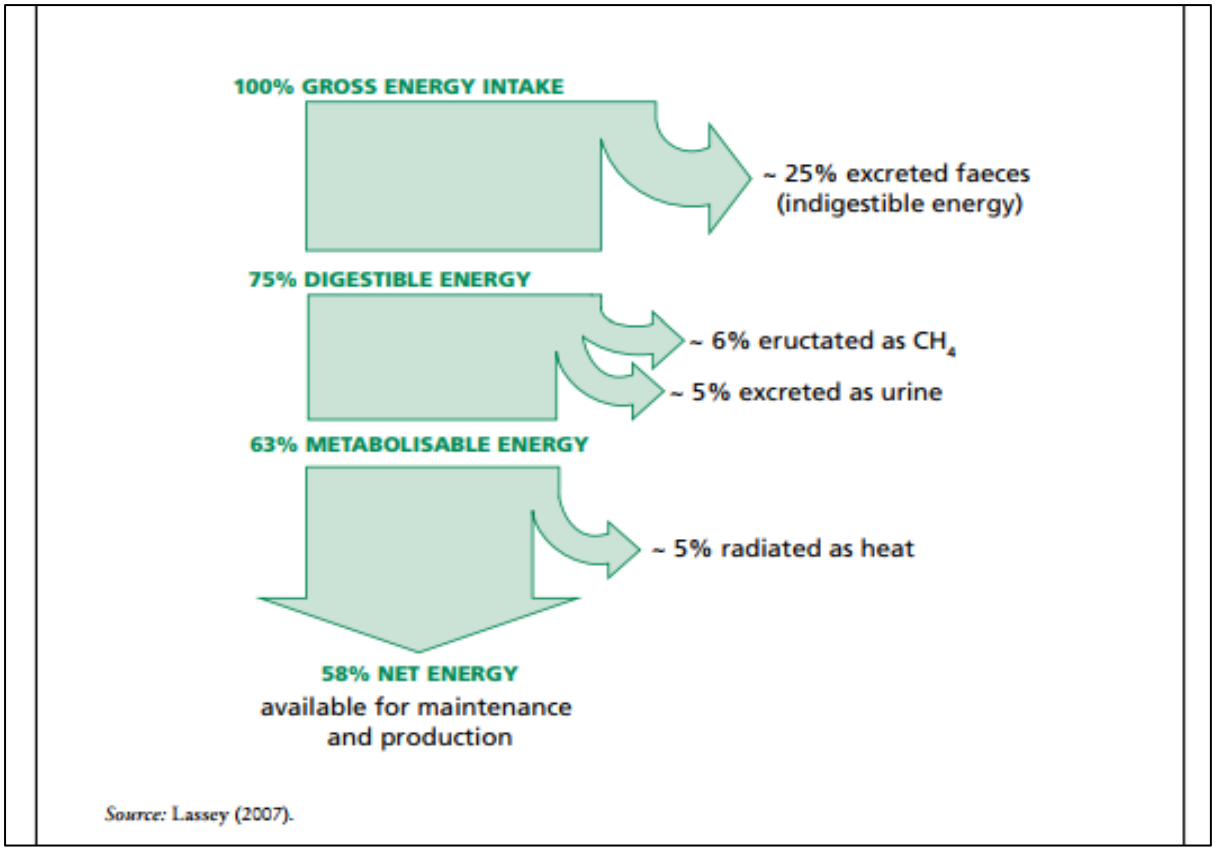


FIGURE 5.2: FLOW OF THE DIFFERENT SOURCES OF ENERGY FOR RUMINANTS, BASED ON A HIGH-QUALITY FEED WITH A DIGESTIBILITY OF 75% (FAO, LEAP, 2016)

Specific guidelines (Figure 5.7), on how to use these parameters to calculate the direct emissions of the cattle production phase, have been developed and are available in the literature (FAO, LEAP, 2016)

Unfortunately, the detailed needed inputs to use these guidelines and calculation models are not found in the literature for the kingdom of eSwatini. Different interviews with national animal nutrition scientist (University of eSwatini and eSwatini Water and Agricultural Development Enterprise) have not allowed to find this information. The livestock chapter of the eSwatini's national communication to the United Nations Framework Convention on Climate Change does not neither includes these parameters. According to the eSwatini meteorological service, the lack of a convenient data management system, the inadequate expertise and the reliance on external consultants are the main reasons of the lack of county specific data[18].

In this study, IPCC 2006 Tier1 default emission factors are used because of the lack of country specific data. However, some of these emissions have been adapted to the national herd composition (percentage of cattle categories) and the average weight per category to better match with the local context. It is also important to keep in mind that this same approach is used for the two production systems (communal grazing and private TDL grazing) and will therefore not favour one system over the other.
Another challenge encountered during the data collection process is the lack of bio-chemical-physical data on the SMI export-licensed abattoir. Moreover, no detailed input-output data on an EU export-licensed abattoir were found in the literature for the neighbouring countries.

18 http://www.swazimet.gov.sz/climatech/ghg_inventory.php, accessed on February 21, 2018

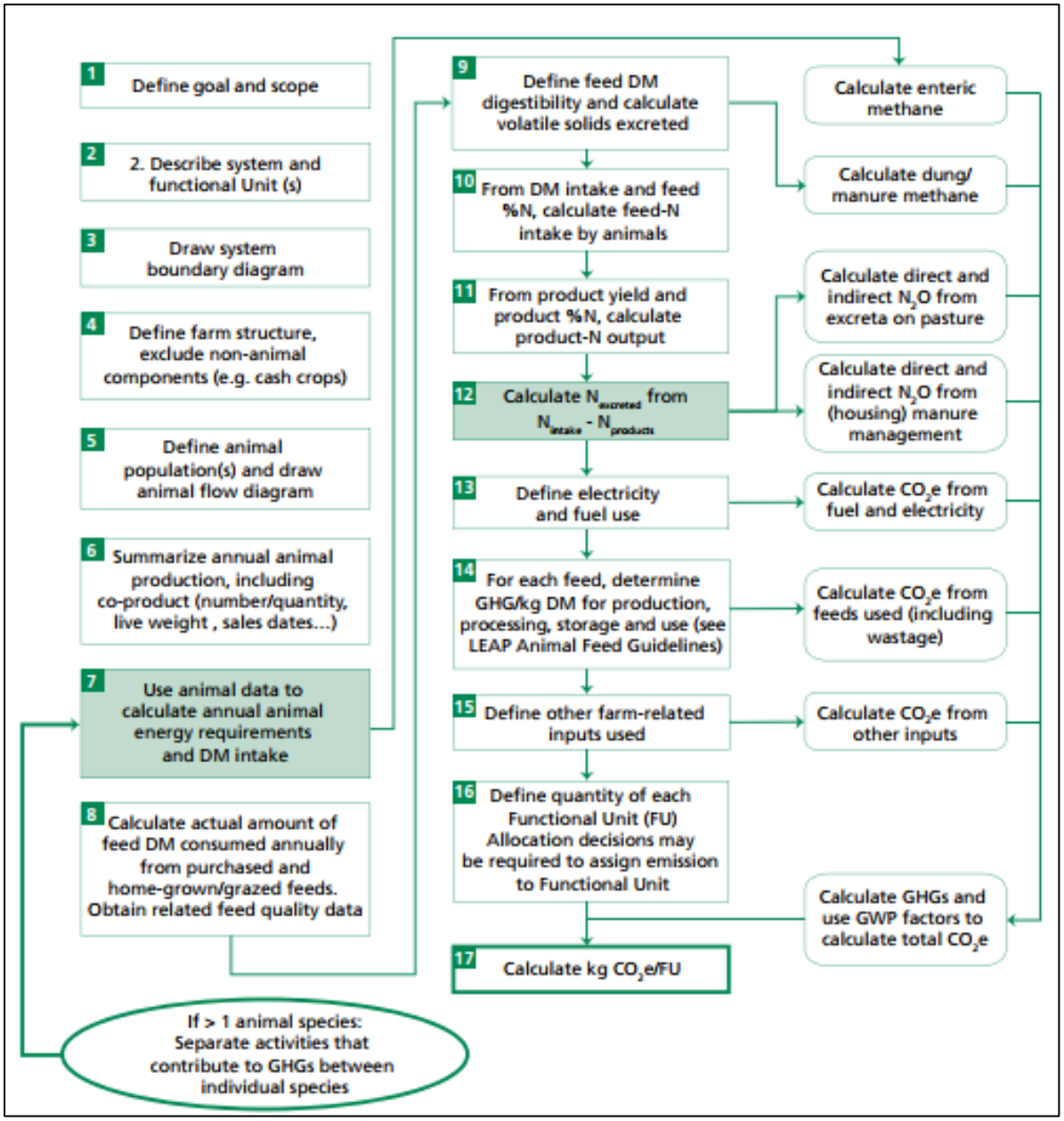


FIGURE 5.3: METHODOLOGICAL APPROACH FOR DETERMINING THE CARBON FOOTPRINT OF LARGE RUMINANT PRODUCTS FOR THE CRADLE-TO-FARM-GATE STAGE[19] (FAO, LEAP, 2016)

5.2.2 Farming Operations

The whole farm modelling approach has been used to estimate the inputs and output data of the farming operations. The idea is to assess all the consumptions of feed, water, land occupation, energy, chemicals on one hand and the corresponding produced outputs (newly born calves, gained live weight, sold animals), on the other hand during a one-year period while taking into the herd performance parameters (birth rate, mortality rate, replacement rate of culled cows, etc.). Unfortunately, some of the herd performance parameters are sometimes not available or are not sufficiently detailed. Most of the performance parameters obtained from national authorities and/or in the literature are national averages without a clear differentiation between small producers and commercial ranches. In this study, an average small farm with 17.5 animals and an off-take rate of 6.3% have been considered for the SNL scenario. This average herd size is based on a study performed by ILRI in 2014 (Mtimet N. et al, 2014). For the commercial ranches, the Inyoni

19 Food and Agriculture Organisation of the United Nations, Environmental performance of large ruminant supply chains, Guidelines for assessment, 2016.

Yami eSwatini Irrigation Scheme (IYSIS) ranch has been chosen as representative of commercially oriented ranches. This ranch has the advantage to be one of the biggest beef production farms in the Kingdom. It has a surface of 21 000[20] ha and 2379 cattle in 2017 (**Table 42**). The off-take rate in this ranch is 19%. Moreover, the IYSIS ranch has the advantage to be an integrated production system because they have a ranch, a feedlot, a slaughterhouse and a butchery. An average water consumption of 60 L per animal and per day (for drinking and cleaning) has been considered for both small farms and commercial ranches. This is the standard water consumption rate per cattle as defined by the national water resource branch. The first findings of the whole farm modelling are the relatively low off-take rates (6.3% for SNL, 19% for IYSIS), the lower number of births per year, the higher mortality rates and the lower average weight of mature animals. These low herd performance parameters will have an important influence on the LCA results because the live-weight gain of cattle will be lower while the animals keep on emitting. The low productivity of the Swazi beef value chains (low fertility rate and low off-take rate) will increase the environmental impacts per mass unit of beef.

	SNL			TDL		
	Unit	**Amount**	**Comments/sources**	**Unit**	**Amount**	**Comments/sources**
Average herd size	animals	17.5	ILRI, 2014	animals	2379	IYSIS, 2017
Land occupation	ha/animal	1.6	(Vilakati, 1994)	ha/animal	5.93	IYSIS, 2017
Birth rate (normal years)	%	44%	SNL beef production model, MOA	%	44%	Considered to be as SNL
Calving rate (Drought period 2014-2015)	%	37%	SNL beef production model, MOA	%	37%	Considered to be as SNL
Cattle mortality	%	9.80%	SNL beef production model, MOA	%	7.55%	IYSIS, 2017
Acaricide	L of solutions/head/year	97.5	Dip tank managers	L of solutions/head/year	97.5	Dip tank managers,
Water consumption	L/head/year	21900	SZL water resource branch	L/head/year	21900	Swazi water resource branch
Forage Yield	t fresh forage/ha/year	4	Agroecosystems, 2014	t fresh forage/ha/year	5	Agroecosystems, 2014
Average number of cattle sold per year	%	6.30%	FAO, 1998	%	19%	IYSIS, 2017
Average sold liveweight	kg live-weight	205.8	ILRI, 2014	kg live-weight	311	IYSIS, 2017

TABLE 42: WHOLE FARM MODEL FOR PASTURE-BASED BEEF PRODUCTION IN SNL AND TDL MOA: MINISTRY OF AGRICULTURE.

20 The calculation of the land occupation per animal does not consider the fact that a very small share of the ranch surface is occupied by the commercial infrastructures.

5.2.3 Fattening

Two fattening scenarios have been considered in the environmental analysis. The Swazi MOA performed a cost benefit analysis for a three-month feedlotting operation. This fattening operation is supposed to increase the weight of the finished animal from 200 kg to 400 kg. The data of this cost benefit analysis are used for the fattening (finishing) scenario of SNL cattle (Table 43). However, these data should be interpreted with caution. A weight gain of 200 kg (from 200 kg to 400 kg) in 3 months (2.2 kg/day) is not realistic in the Swazi context. The average daily weight gain per supplemented cattle could rarely reach more 2kg in African countries.

Detailed feedlotting information from IYSIS with detailed feed composition and feed efficiency have been used to model the fattening scenario for animals raised in commercial ranches. These data are primary information which have been monitored by the IYSIS team.

Additionally, alternative feeding information have been collected from the University of eSwatini (UNISWA). The UNISWA has developed a new feeding recipe initially made with sugarcane tops, chicken litter, molasses, minerals and salt. The chicken litter has been progressively replaced by leaves of Melia Azedarach (Table 43). The introduction of 15% and 30% in the cattles' diet allowed increasing the feed conversion efficiency from 9.60% (0% M. Azedarach) to respectively to 27.90% and 33.20%. This information will be used to perform a sensitivity analysis to assess the influence of the feed composition on the final LCA results.

A default transport distance of 50 km has been considered for the different feeding ingredients apart from the coconut for which 200 km is considered because it is imported from Mozambique. By experience, the contribution of the transport of these ingredients to the overall impact is expected to be very low.

	Feedlot for SNL cattle (3 months)			IYSIS Feedlot		
	Unit	**Amount**	**Comments/ sources**	**Unit**	**Amount**	**Comments/sources**
Weight before feedlotting	kg	200	MOA, 2007	kg	200.00	IYSIS, 20117
Weight after feedlotting	kg	400	MOA, 2007	kg	400	IYSIS, 20117
Feed consumption	kg beefpro/3 months	250	MOA, 2007	kg IYSIS feed/kg gained liveweight	12	IYSIS, 20117
Acaricide	L of solutions/ head/3 months	24.375	Dip tank managers	L of solutions/head/ year	24.375	Dip tank managers
Water	l/head/3 months	5475	Swazi water resource branch	l/head/ 3 months	5475	Swazi water resource branch

TABLE 43: FATTENING OPERATION MODEL

	Mix feed prepared by the farmer				Concentrate form industry	
Ingredients	0% M. azedarach	15% M. azedarach	30% M. azedarach	IYSIS	Beefpro (g/kg)	
Wheaten bran				22.00 %	Moisture	120
				-	Proteins	140
Sugarcane tops	39.30%	39.30%	39.30%	-	Fat	25-85
Hominy chops (maize)	20.00%	20.00%	20.00%	35.00 %	Calcium	12-17
Chicken litter	30.00%	15.00%	-	17.00 %	Phosphorus	5
M. azedarach (Umsilunga)	-	15.00%	30.00%	-	Lysine	9
Molasses	10.00%	10.00%	10.00%	17.00 %	Methionine	3
Urea + lime + minerals and vitamins	0.20%	0.20%	0.20%	3.00%	Salt	3
Coconut	-	-	-	6.00%	Fibre	60-100
Salt	0.50%	0.50%	0.50%	-	Urea	20
Feed conversion efficiency	9.60%	27.90%	33.20%	8.33%	Recommendation	1.5 to 2 kg/day/ head

TABLE 44: DIFFERENT FEED OPTIONS FOR FEEDLOTS

Direct on Field Emissions

In the FAO guidelines for the assessment of the environmental performance of large ruminant supply chains (FAO, LEAP, 2016), an order of preference of data sources to be used has been defined:

- Country specific data should always be preferred.
- Peer-reviewed and published models that are relevant for the country should be considered as a second option
- And finally, regional default values (generic values at group of countries or continental level) should be used as last resort.

- In the specific case of greenhouse gas emissions of the livestock sector, the following order of preference is defined in the Chapter 10 of the IPCC 2006 guidelines for National Greenhouse Gas Inventories on the emissions from livestock and manure management[21]:
- In countries for which livestock emissions are very important, the IPCC Tier 3 method should be used. This method uses complex models with detailed information on animals' diet with respect to the seasonal variations in animal population and in feed quality/and or availability.
- The IPCC Tier 2 method, which is less complex but still requires detailed country specific data on animals' gross energy intake and methane conversion factors for specific animal categories, is advised as a second option if Tier 3 is not feasible
- The Tier 1 simplified method which is based on continent or region default emission factors should be used as the last alternative.

In this study, the IPCC 2006 Tier 1 default emission factors and equations have been used to estimate/calculate the enteric fermentation methane, the methane emissions from manure management, the nitrous oxide emissions from manure management, the indirect volatile nitrous emission and the total nitrogen excretion. The total Nitrogen excretion is used to calculate the ammonia emissions and the nitrogen oxides according to the requirements of the EMEP/EEA emission inventory guidebook[22].

		Value	Unit	Comment/sources
Methane from enteric fermentation	Mature female-grazing	41	kg/head/year	IPCC 2006, Tier 1
	Bull-grazing	49	kg/head/year	IPCC 2006, Tier 1
	Young	16	kg/head/year	IPCC 2006, Tier 1
Methane from manure management	-	1	kg/head/year	IPCC 2006, Tier 1
Total N excretion	-	0.63	kg N/100 kg animal mass/day	IPCC 2006, Tier 1
N20 from grazing	-	0.01*Total N excretion*44/28	Kg N20/head/year	IPCC 2006, Tier 1
Indirect N20_Volatilisation		0.01*NH3*44/17	Kg N20/head/year	IPCC 2006, Tier 1
Indirect N20_leaching		Negligible (not irrigated pasture)	Kg N20/head/year	IPCC 2006, Tier 1
NH3		0.2*Total N excretion*17/14	Kg NH3/head/year	EEA 2013, 3B, Tab. 3.7
Total Ammoniacal Nitrogen (TAN)		0.6* Total N excretion	Kg N/head/year	Hao and Benke, 2008
NOx as NO		0.01*TAN*30/14	Kg NO/head/year	EEA, 2013, Tab. 3.8

TABLE 45: DIRECT ON FIELD EMISSIONS

5.2.4 Slaughtering

Slaughtering operations in eSwatini could be classified into 4 categories which are:
- Industrial slaughtering in the export-licensed abattoir of SMI
- Slaughtering in municipal abattoir
- Slaughtering in small and medium commercial abattoir
- and home slaughtering.
-

21 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
22 European Environment Agency, EMEP/EEA air pollution inventory guidebook, 2016.

In this study two slaughtering scenarios are considered: industrial slaughtering for animal raised in commercial ranches and slaughtering in commercial abattoirs for SNL cattle. Municipal abattoirs which work as service providers for both private individuals and professional butchers would have been an interesting case to assess. Unfortunately, the visited municipal abattoir was not working because of high energy cost and low exploitation rate.

The operation data of the small commercial slaughterhouse are collected from the **Mashayinkonjame** abattoir in Manzini (eSwatini). The energy consumption, the water consumption, the detergent consumption, the number of slaughtered animals and their corresponding weights are primary data collected directly from the management records of the abattoir.

For the specific case of the SMI export-licensed slaughterhouse, a detailed cost benefit analysis of an Ethiopian export-oriented abattoir has been used as a proxy. This Ethiopian proxy has a capacity of 200 cattle's per day. The energy and water consumption, the detergent consumption and the generated volume of wastewater are provided in **Table 46**.
An average distance of 60 km has been considered for the transport of animals by truck from the farm to the slaughterhouse.

		Proxy for an export-oriented abattoir (Jenkins & Miklyaev, 2014)	Mashayinkonjame-commercial abattoir
	Unit	Amount	Amount
Slaughtering capacity	cattle/day	200	20
Storing capacity of the cold room	animals		6
Average carcass weight per animal	kg	137.5	174
Average number of slaughtered animal	animals/month	5000	37
Carcass	kg/month	687500	6438
by-products for human consumption	kg/month	250000	1287.6
Rumen contents + blood	kg/month	1125000	1223.22
Hides	kg/month	87500	450.66
Electricity	kWh/month	47366.66667	2349.97
Tap water	m3/month	8500 (Meissner et al, 2013)	27.3
Fuel	L/month	252	-
Detergent	kg/month	206.27 (Jungbluth, 2011)	6.5
Wastewater	m3/month	9350	30.03

TABLE 46: SMALL COMMERCIAL AND EXPORT-ORIENTED ABATTOIR'S MODELS

5.2.5 Distribution in Butcheries

The distribution phase in local butcheries has been modelled with site specific primary data and estimations collected from IYSIS which has its own butchery. The annual energy and water consumptions and the correspond masses of beef and other type of meats are provided. The weight ratio of the beef to the total volume of distributed meat has been used to allocate a certain share of the total energy and water consumptions to the beef. These data have been used to calculate average energy and water consumption per unit of distributed beef (**Table 47**). An average distance of 5 km is considered for the trip from the consumer's place to the butchery.

Distribution		Unit	Amount
Distribution in butcheries	Distance from the slaughterhouse to butchery	km	0 to 10
	Means of transport	Type of vehicle	Refrigerated truck
	Electricity	kWh/kg meat	1.11
	Tap water	m3/t meat	0.30

TABLE 47: BEEF DISTRIBUTION IN LOCAL BUTCHERIES

5.2.6 Export

The Swazi beef has two important markets: the local market and the export to EU countries including the Mayotte Island and Mozambique. For the exported beef, a transport by refrigerated truck from the SMI plant to the South African boarder over 220 km is considered.

5.3 Life Cycle Impact assessment

The Life cycle impact assessment stage aims at translating the resource consumptions and the emissions of the life cycle inventory into relevant environmental impacts which are understandable for decision makers. Each environmental flow will be connected to a corresponding environmental impact. Once classified in the relevant impact category, a characterization factor will be used to express the relative contribution of the environmental flow to this impact category. The environmental impact could be at midpoint level or at endpoint level. The midpoint is located at the early stages of the cause-effect chain and explains the physico-chemical changes in the environment. The endpoint goes further on the cause-effect chain and explains the damages on the environment and the society.

In this study, the RECIPE 2016 (H) method has been used. This calculation method has the advantage to combine both midpoint and endpoint impacts (Figure 5.6). It also includes the latest IPCC emission factors for climate change and used relatively complete impact pathways. It is also recognised by important number of LCA experts and stakeholders. For the specific context of the Swazi beef value chain, the endpoint level has been preferred. In fact, the endpoints allow to directly address the three most important environmental safeguard zones which are ecosystem quality, human health and resource depletion. Endpoints are also more relevant for policy dialogue because they give the environmental implications of a product system at a macro level (damages on the society and the environment). However, the midpoint level impact on climate has been assessed because of the importance of this topic in both the national and international sustainability agenda.

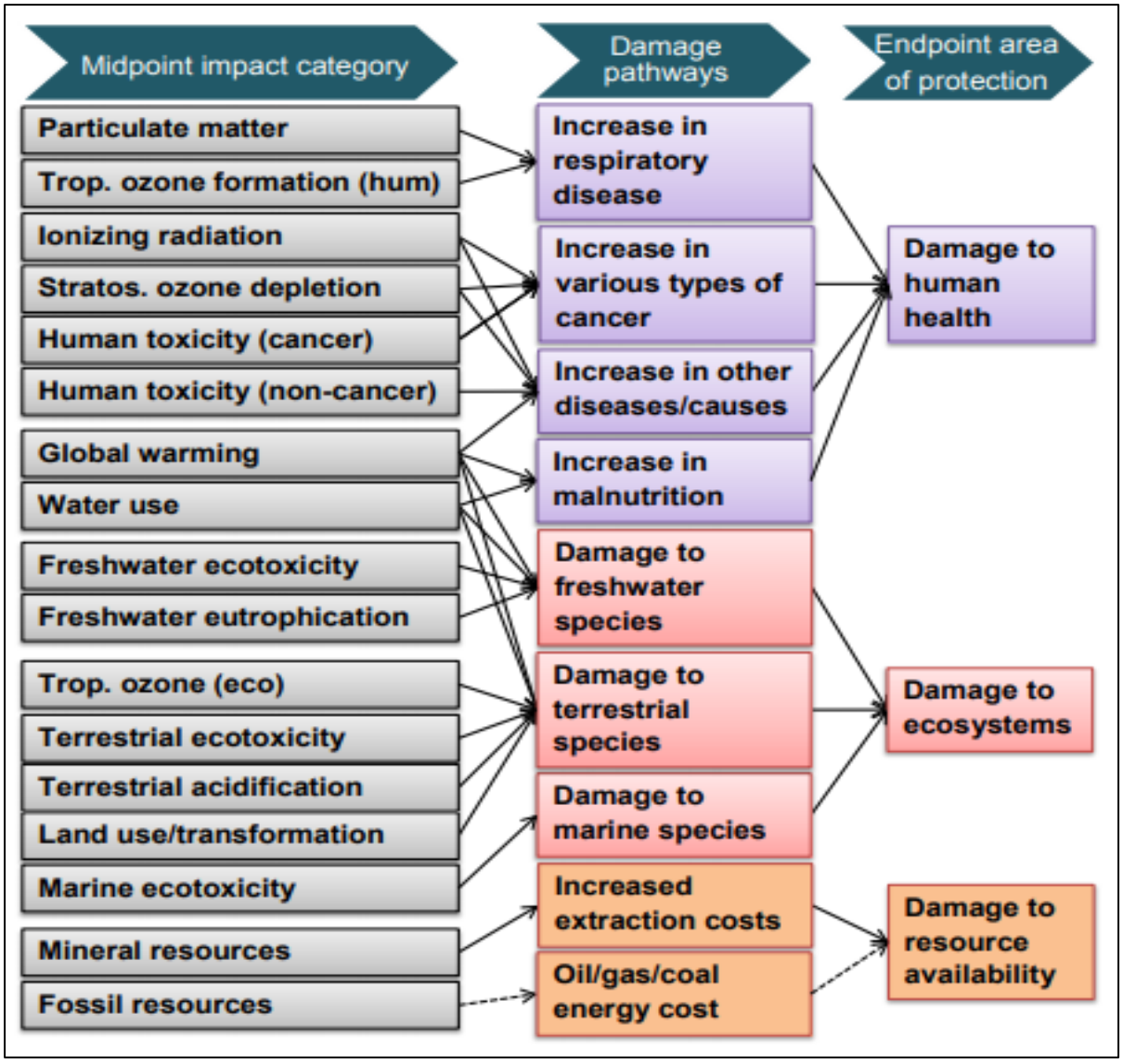


FIGURE 5.4: GENERAL CONCEPT OF THE RECIPE 2016 METHOD (HUIJBREGTS M.A.J. ET AL, 2016)

5.4 Results

It is important to understand the modelling approach which has been used to generate the following results when interpreting them. In fact, a whole farm modelling approach has been used to estimate all the input consumptions and the corresponding produced live-weight beef with respect to the productivity performances (birth rate, mortality rate, off-take rate…) of the two production systems for a one-year period. In other words, all the impacts generated by the herd during a one-year period are allocated to the outputs (the calves which are born during the year and the adult animals which are sold during the year with respect to their weight) of the farm, which means the lower the off-take rate, the higher the environmental impact per kg of beef.

5.4.1 Climate Change

As it could be expected, the farming operations (cow-calf operations) are the main contributors to the climate change (Figure 5.5). This life cycle phase represents more than 90% and 75% respectively for the SNL beef and the TDL beef. This is due mainly to the enteric fermentation methane, the methane from manure, and the direct and

indirect nitrous oxide emissions from the nitrogen excretion (feaces and urine) of animals. The difference between the contributions of the fattening phase in the two systems is mainly due to the data quality. In the case of the commercial ranch (TDL), the information on the feedlotting operations are well detailed primary data with clear information on feed efficiency while a very optimistic scenario (cost benefit analysis on feedlotting operations by the MOA) is used for the SNL system. Moreover, the fact that default emission factors are used for the farming operations creates a certain disparity between the contributions of the feedlotting (higher in the case of TDL) and the cow-calf operations (lower). However, the observed trends are comparable to what is found in the literature. The difference between the two systems is mainly due to the lower off-take rate of the SNL system (6.30%) in comparison to the TDL system (19%).

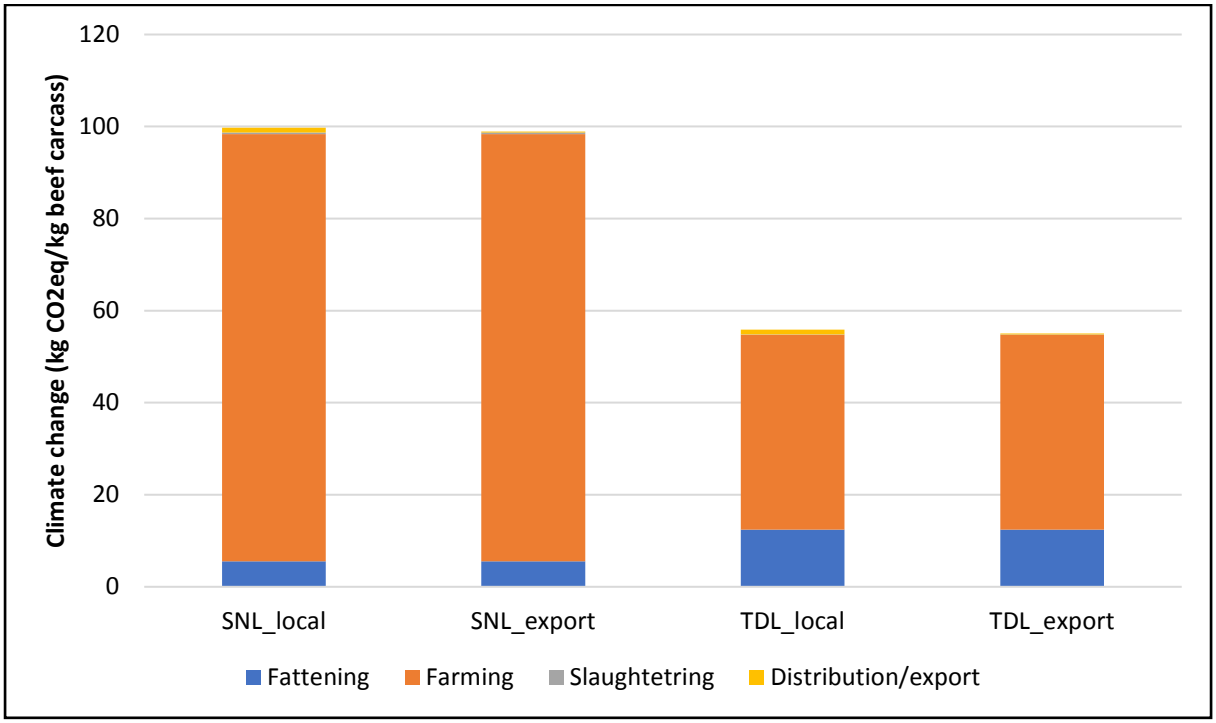


FIGURE 5.5: IMPACT OF THE BEEF VALUE CHAIN ON THE CLIMATE

5.4.2 Human Health

The human health includes the negative impacts of different midpoint impacts (climate change, human toxicity, water use, ionising radiation…) to human health (Figure 5.6). In comparison to other agricultural sectors which are highly agrochemical intensive, the contribution of the Swazi beef value chain to human health issues is negligible. However, when the different life cycle phases are compared to each other, the farming operations contributes more than all the other life cycle phases. This is due mainly to the ammonia and the nitrogen oxides emissions during the outdoor grazing and the dung decomposition. The higher contribution of the feedlotting operations in the TDL system is mainly due to the use of the hominy chops, vitamins and imported coconut in the feed ration (Figure 5.8). The relatively higher contribution of the local distribution in comparison to the export scenario is due to the use of electricity in the butcheries. In fact, the electricity from the grid is mainly imported from South Africa where coal is the main feedstock used by the power industry.

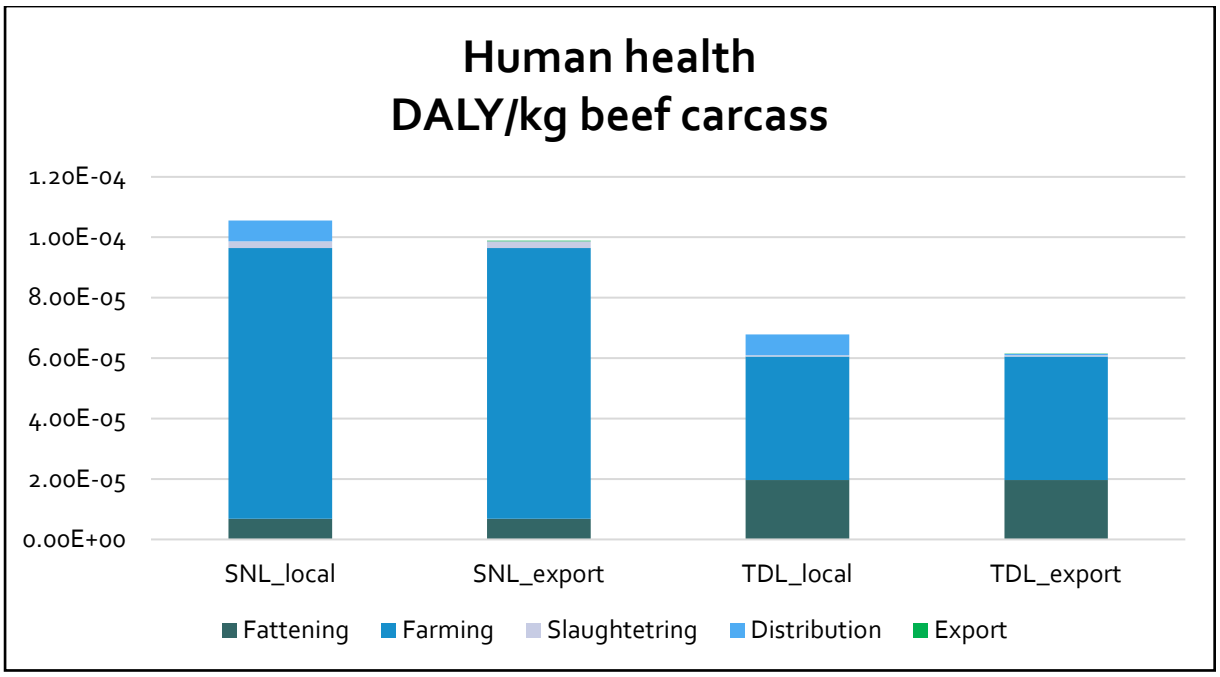


FIGURE 5.6: CONTRIBUTION OF THE BEEF VALUE CHAIN TO THE IMPACT ON HUMAN HEALTH

5.4.3 Resources

The fattening operations are the main contributor to the depletion of resources (Figure 5.9). This is mainly due to the use of maize, coconut, molasses and vitamins for the commercial feedlot and the use of concentrate (including lysine, vegetal fat and feed grade urea) in the SNL scenario. A better estimation on the concentrate consumption in SNL system with more accurate data on feed efficiency would certainly reduce the gap between the two production systems.

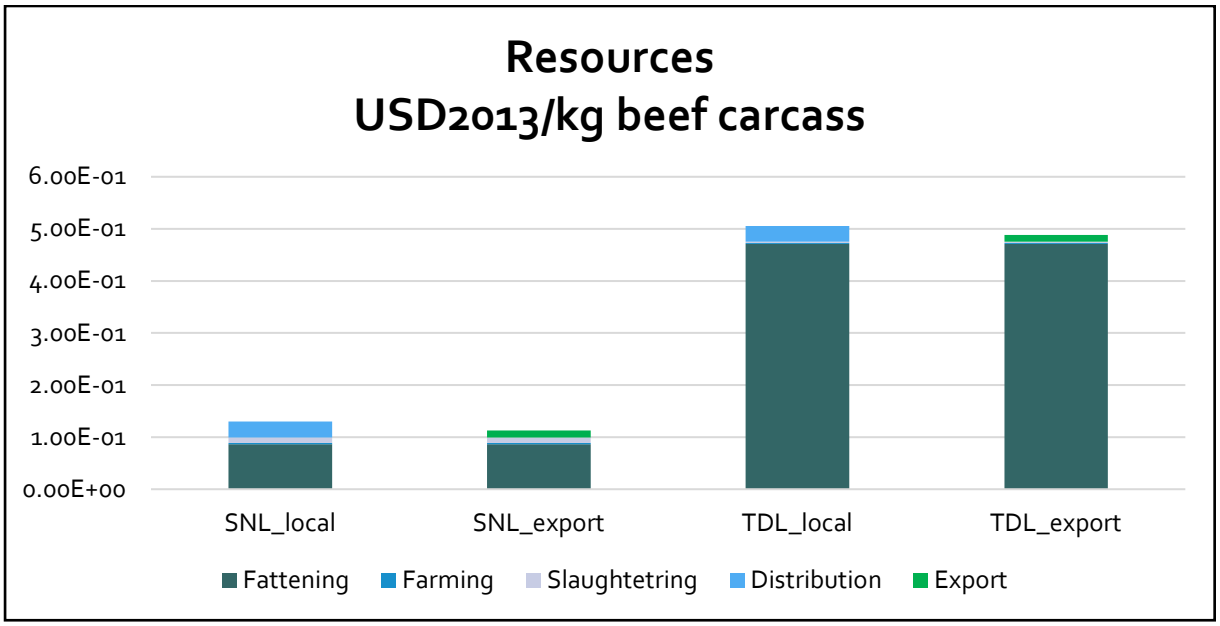


FIGURE 5.7: IMPACT OF THE BEEF VALUE CHAIN ON RESOURCE DEPLETION

5.4.4 Ecosystem Quality

The ecosystem quality calculation method used in this study is mainly influenced by the occupation of grazing land and has thus underestimate the potential contribution of the remaining life cycle phases. The used indicator is the local species loss integrated over time (species, year). (Figure 5.10).

The relatively bigger grazing area per animal in the commercial ranches is the reason of the higher impact per kg of beef carcass in the TDL system in comparison to the SNL system. The difference between a native pasture (SNL) and a managed pasture (Commercial ranch) has been considered in the modelling and this helped counterbalancing the huge difference in terms of soil occupation between the two production systems.

It would be advisable to combine life cycle assessment with additional rangeland assessment methods to better capture all the implications of the beef farming operations on ecosystem quality. These methods include (but are not limited to):

- Weighted palatability composition where the species of a rangeland are rated with a palatability index and a productivity class ranging from one to three with one considered as highly palatable and three unpalatable.
- Benchmark method which identifies productive and stable site which would allow long term animal production while conserving water and soil resources.
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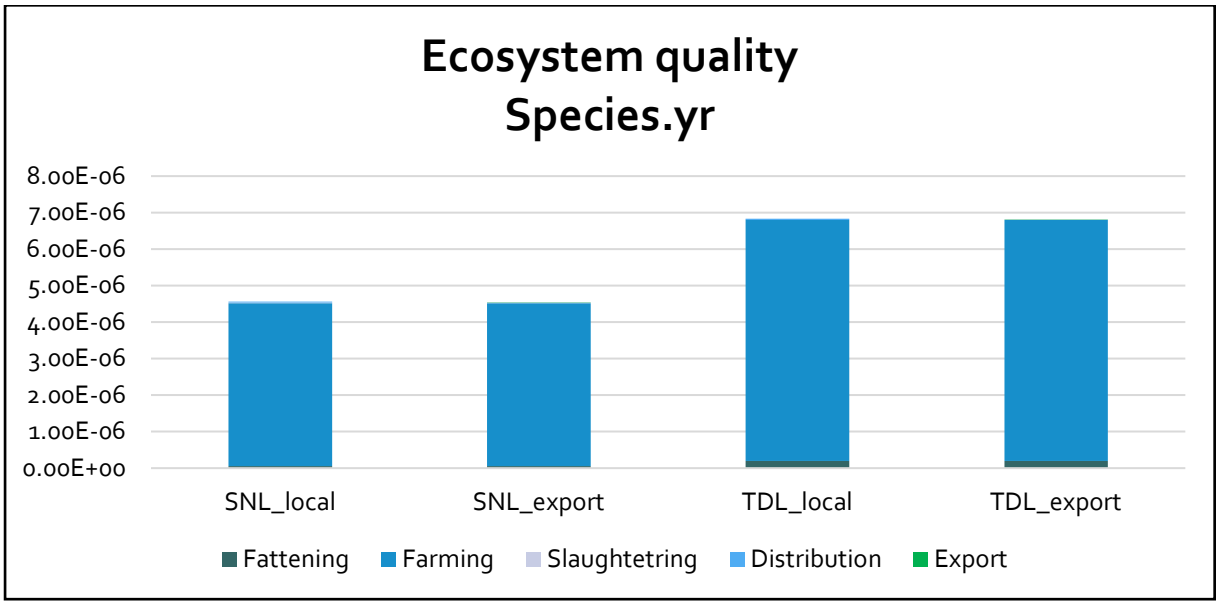

FIGURE 5.8: IMPACTS OF THE BEEF VALUE CHAIN ON THE ECOSYSTEM QUALITY

5.4.5 Sensitivity Analysis

During the field visits and interviews with national stakeholders, the availability and accessibility of alternative feeding options has been identified as a key issue of the beef value chain in eSwatini. The University of eSwatini (UNISWA) has experimented a feedlotting exercise with a dedicated recipe made with sugarcane tops, chicken litter, molasses and hominy chops. In this sensitivity analysis, the feed used in the feedlotting operations of the TDL scenario has been replaced by the UNISWA alternative feed (UNISWA1). The chicken litter in this alternative feed has then been progressively replaced by 15% (UNISWA2) and 30% (UNISWA3) leaves of Melia Azedarach.

The UNISWA1, UNISWA2 and UNISWA3 alternatives has reduced the climate change impact of the beef value chain by respectively 7%, 12%, 13% (Figure 5.11), the human health impact by respectively 6%, 17%, 19% (Figure 5.10), and finally the resource depletion (Figure 5.11) by respectively and 45%, 78%,81%.

In addition of being environmentally friendly, this alternative feeding system is cheaper in comparison to industrial concentrates and uses locally available ingredients. Additional studies of the UNISWA reveals the Melia Azedarach leaves have strong anti-parasitic effect on animals.

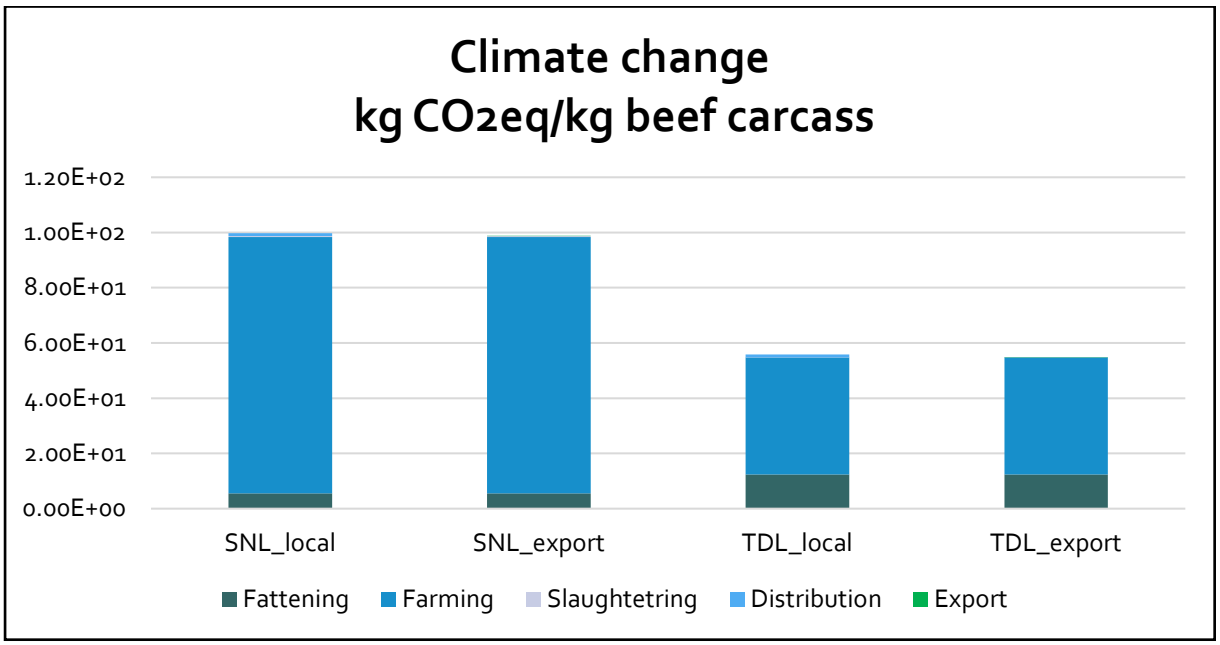

FIGURE 5.9: CONTRIBUTION OF DIFFERENT FEEDING OPTIONS TO CLIMATE CHANGE

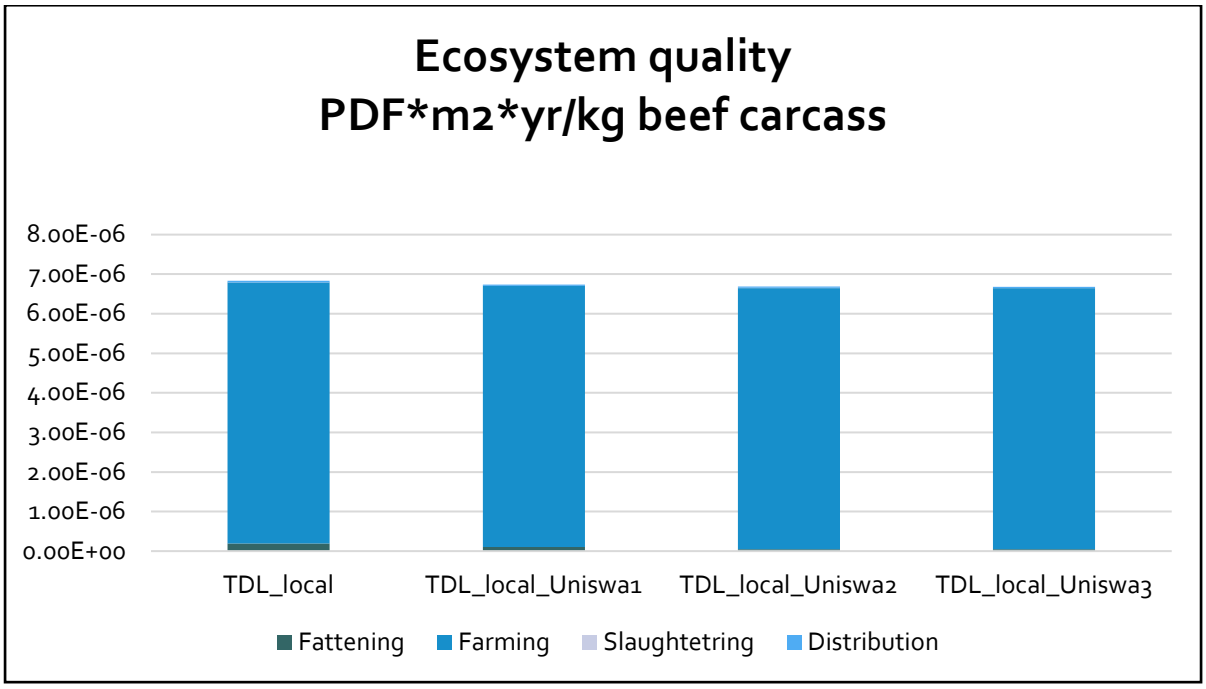

FIGURE 5.10: CONTRIBUTION OF DIFFERENT FEEDING OPTIONS TO HUMAN HEALTH IMPACT

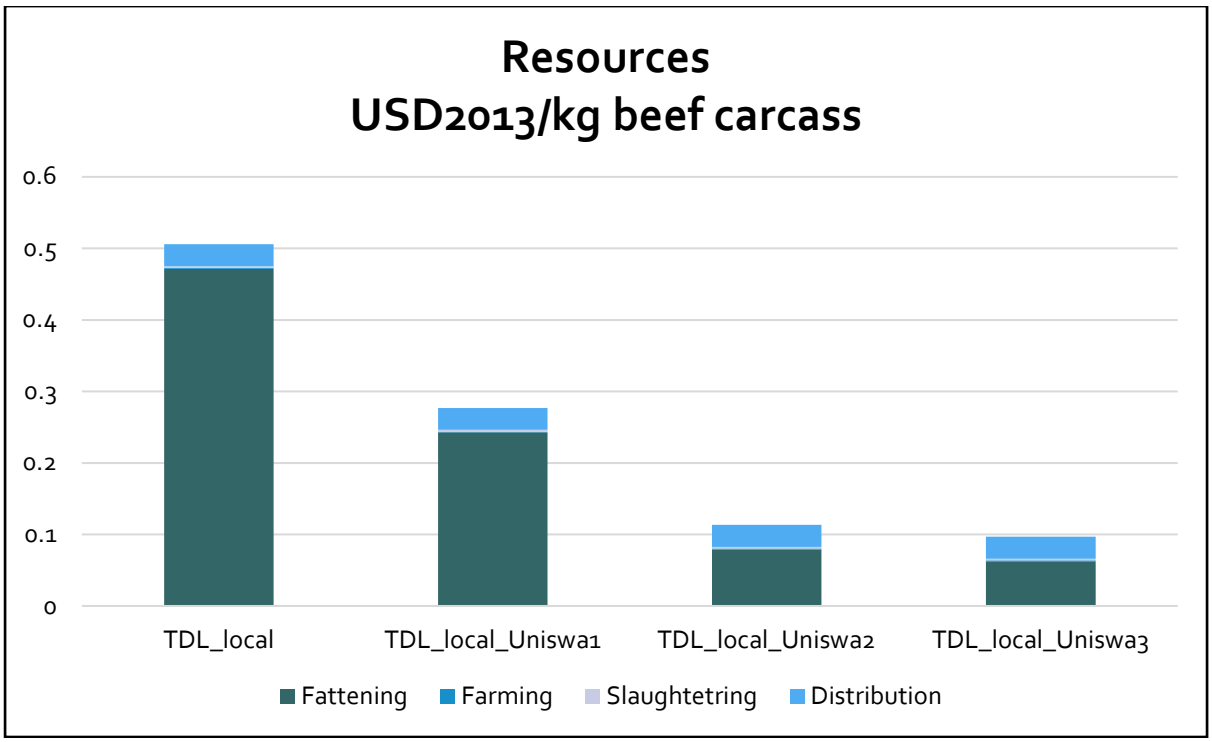

FIGURE 5.11: CONTRIBUTION OF DIFFERENT FEEDING OPTIONS TO THE DEPLETION OF RESOURCES

5.5 Limitations of the Study

The above results of the environmental analysis should be interpreted with caution. Different data quality levels (primary data, secondary data, default regional emission factors and proxy(ies)) have been used. The main reason of this combination is the lack a national specific data for some key components of the beef value chain. Greenhouse gas emission from the farming operations are not country specific. IPCC 2006 Tier1 default emission factors have been used. The fattening operations in the commercial ranches are well detailed primary data while the data on fattening operations for small farms (data from the Swazi Ministry of Agriculture) seem to be particularly optimistic (unrealistic feed efficiency and short feedlotting period).

Moreover, an Ethiopian proxy has been used for the slaughtering operations of the SMI export-licensed slaughterhouse, but this proxy considers a Swazi electricity and tap water. However, the contribution of the slaughtering phase to the overall environmental impact of the value chain is low and does not influence that much the conclusions.

Another important aspect to be noticed is the few number of feedlots and abattoir which were able to provide the expert team with data on material and energy flows. Consequently, these results should be interpreted more as results of a case study instead of the detailed national situation which will require further investigations.

5.6 Environmental Analysis Conclusions

The environmental analysis reveals that the TDL production system has lower impact than the SNL production system on climate change and human health, but it is the opposite trend when it comes to ecosystem quality and resource depletion. The relatively higher impact of the TDL production system on the ecosystem quality is mainly due to the higher land occupation in the commercial ranch (more than three times higher than the national average). The higher impact of the TDL production system on the resource depletion should be interpreted with

caution. It is mainly due to the feedlotting for which detailed primary data have been used for the TDL system while a more optimistic scenario was used for the SNL. The sensitivity analysis has revealed the environmental benefit of alternative feeding systems which seem also to be cheaper (thorough financial analysis needed).

Another important finding of this study is the relatively low technical performance (low birth rate, low off-take rate, higher mortality rate….) of the Swazi beef value chain. The kingdom of eSwatini has limited available rangelands and water (mainly used for irrigation of cash crops) resources. Efforts to reduce the environmental impacts of the sector should focus on how to improve these technical performances to improve the productivity per unit of land since the Kingdom of eSwatini does not have extra carrying capacity.

6. Conclusion and Recommendations

1. Enhanced Baseline Studies

There are several fundamental knowledge gaps on the economic, social and environmental context of cattle production in the SNL. We propose *enhanced baseline studies* that would both serve as research to inform further policy-making *and* inform on ongoing monitoring/impact assessment of the poverty impact of programmes. The enhanced baseline studies should be rigorously sampled to represent the whole SNL population, and cover;

- The proportion of SNL households who own cattle, and those who benefit indirectly from cattle held by other households (loans of draught power, herding employment).
- The importance of draught power for cultivation, and other non-monetized benefits of cattle
- Gender differentials in cattle production and marketing, proportions of men and women among registered cattle owners, proportions of nominally female-owned cattle in kraals
- a detailed study of decision-making and benefits from SNL cattle sales (using in-depth interviews from a sample of selling households identified from VA records. The interviews would cover reasons for sale, timing of sale and choice of purchaser, intra-household decision-making and uses to which sale-price was put.

2. Study on Seasonality in Cattle Marketing

Studies should be carried out at an early stage on the degree of seasonality in current cattle sales from the SNL, its economic impacts, and ways in which development programmes could work with a seasonal glut in sales, rather than trying to ignore or reform it.

3. Coordination of Existing Data Collection on Livestock

The existing situation whereby the Annual Livestock Census Summary collects data only on livestock-owning homesteads and thus has no comparator figures for total households, whereas Agricultural Censuses gather information on all rural households but present major problems of interpretation for livestock-related data, needs to be examined, and opportunities for synergies through modification to protocols identified.

4. Establishment of a Value Chain Forum

To overcome problems of lack of trust within the value chain, it is recommended that a forum is established where representatives of all value chain actors from the formal and informal sectors can meet and hold discussions of mutual interest. Care would have to be taken to include representatives of middling SNL cattle-producers who sell occasionally rather than being “market oriented”. Associated activities, such as study tours of abattoirs by SNAL farmers (and of SNL grazing areas by abattoir managers) care also recommended

5. Implementing an Inclusive Approach to Building Information Production, Knowledge-Sharing, and Investment through Innovation Platforms

The idea would be to promote a national development of information system dedicated to livestock and set up an Observatory of Livestock Systems to produce and share knowledge, data, cross-thematic and comparative surveys, to analyze livestock system transformations, and to contribute to the development of sustainable livestock policies.

- Creation and implementation of innovation platform with the main stakeholders of livestock value chains.
- Identification, quantification/qualification and prioritization of existing livestock risks and dialogue with stakeholders to identify optimal risk management solutions (i.e., mitigation, transfer, and coping) with best potential to address priority risks.
- Elaboration of research protocols to address and tackle research issues on key identified problems.

- Elaboration and dissemination of informational tools then training and capacity building of livestock value chain stakeholders.

For instance, with drought episodes recorded in eSwatini these past years, it would be interesting and useful to better understand how to identify opportunities for economic transformation and diversification in the livestock sector and its integration into national economies. The idea would be to use value chain analysis to test possible pathways for a climate-resilient economic development by describing ways to improve market access and trade relations to protect people but also to stimulate growth by better integrating livestock systems into national economies.

6. Implementing a Livestock Master Plan for eSwatini

- The Livestock Master Plan would help to characterize the current demand and supply situation for livestock products; to develop technical and economic assessment of current production systems and value chains, as well as new emerging systems and value chains; to provide analysis of future livestock trends and impacts on national development objectives without increased investment; and future trends and impacts expected with increased investment.
- Technical staff of ministries in eSwatini should be trained to handle as much as possible the livestock master plan. The backstopping could be ensured by international research organizations such as CIRAD, NRI, ILRI…

7. Measuring Post-production Losses in Livestock Value Chains and Improving Value Chain Performance

Key bottlenecks in the value chain will be identified and main risks assessed
Sustainable solutions will be proposed ``

8. Designing Improved Technologies and Best Practices, Complemented with Endogenous Knowledge to Address Technical and Institutional Constraints that Limit Productivity and Market Access.

Use of various innovative strategies and interventions to ensure that ruminant livestock productivity is improved and market access constraints, with a focus on live animals, are alleviated with the goal to enhance household income, food and nutrition security.

- Promotion of innovative animal health delivery systems and facilitate the implementation of best health interventions that reduce disease burden in livestock.
- Increasing the availability of quality feed biomass both at household, national and regional levels and improving on farm feed utilization and husbandry practices to support ruminant livestock productivity gains and generate livelihood options around feed and fodder value chains
- Increasing livestock market development initiatives
- Implementing a Livestock market information system to capture market incentives. One of the central issues would be to identify the appropriate incentives for livestock producers to invest more in their production activities. A strong incentive base for livestock keepers could be achieved by improving market agents and producers' understanding of how animals' attributes are valued in marketplace, which requires a firmer understanding of the relative importance of each of these attributes
- Increasing the volume and value of ruminant livestock marketed as a result of enhanced competitiveness of family-based cattle and sheep fattening enterprises. Here it is about supporting the competitiveness of family-based animal fattening enterprises to improve their further penetration in domestic and export livestock markets (including South Africa and Mozambique). This is expected to result from their better access to financial institutions and improvement of their technical and managerial skills.

Developing contingent markets that support livestock value chain stakeholders to cover some category of risks related to climate variability that could be direct factor and/or aggravating factor of other risks (conflicts, land competition, economic, social, etc.). The main objective is to reach a short-term recovery effect.

- At the State level, subscription to the mutual fund set up by the African Union to provide parametric insurance covering the impact of climate change.
- At producer level, introducing livestock insurance as a mechanism for compensating livestock owners when livestock mortality or forage loss from weather-related events reduces their income below a pre-defined critical threshold. An index constructed using key climatic variables can provide an objective means of determining when a payout is warranted (innovation developed by ILRI).
- Innovative research activities could be launched in eSwatini to address potential issues already noted during the implementation of these insurance schemes in livestock sector (links between basis risks and uptake, potential exclusion, premium subsidies, scales of implementation, importance of layering risk management solution)

9. **Improving the Environmental Performance Per Mass Unit of Beef by Enhancing Herd Technical Performance Via:**
   - compensating the limited carrying capacity and the limited water availability with a higher carcass weight, a lower slaughter age and shorter calving intervals
   - improving water availability with dedicated water harvesting, water storage and water recycling strategies

10. **Developing alternative feeding systems with cheaper and locally available resources to make fattening accessible for small farmers**

11. **Combining life cycle assessment with additional rangeland assessment methods to better assess the impacts of beef value chain on the ecosystem quality and to better manage the quality and the productivity of rangelands.**

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