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Livestock production system in KSA and strategies for strengthening small ruminant livestock production system in KSA LIV/051/2022/3

*Strengthening MoEWA's Capacity to implement its Sustainable Rural Agricultural Development
Programme (2019-2025) (UTF/SAU/051/SAU)*

**Food and Agriculture Organization of the United Nations
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1. Introduction

Livestock is a major sub-sector of the agriculture in the Kingdom of Saudi Arabia, occupies a distinct economic, social and cultural significance, and contributes 43% to the agriculture GDP. It plays important role in nutrition, food security and livelihoods of millions of small-scale farmers in Saudi Arabia. Around 150,000 – 200,000 small holder farm families depend on livestock as a source of their livelihood in KSA. Further, the growing demand for animal products creates an opportunity for the growth of this sector. The red meat requirements for example are being met through importation to the extent of 70%, during religious occasions.

Present development policies of the KSA such as National Transformation Program (NTP) under vision 2030, and the National Livestock Improvement Program have special focus on the small ruminant sector as engines of sustainable development in the arid and mountainous areas. The Country's Development Plans for the Agricultural sector in the KSA increasingly focuses on the role of agriculture to become the base of the economy. These plans aimed at enhancing the investment capacities of the agricultural sector and greatly emphasizing the importance of the livestock subsector.

SRAD (Sustainable Rural Agriculture Development Program), a flagship program jointly implemented by the Ministry of Environment, Water and Agriculture (MoEWA) and FAO, with an objective to achieve sustainable rural agricultural development and contribute to the sustainable conservation and management of natural resources in the Kingdom of Saudi Arabia, has a considerable focus on working across the livestock value chains with specific activities aimed at capacity development for better production and productivity, value addition, marketing, strengthening rural institutions, and diversification of income generation for better livelihoods. Further, the interventions work to enhance the contribution of livestock to Sustainable Development Goals (SDGs) by supporting the transformation of animal production systems – small and large – in ways that are economically, socially, and environmentally sustainable.

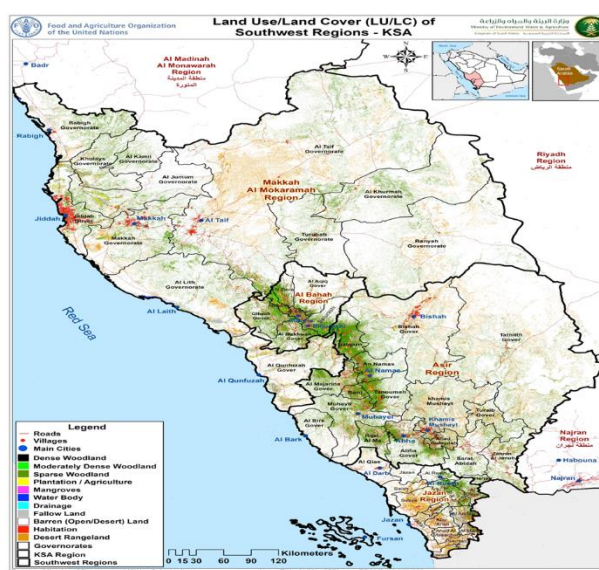
This document is prepared by compiling and comprehending the available information of the earlier studies carried out under the SRAD project, and describes the small ruminant production system of its technical and socioeconomic features, major challenges as experienced by this sector in its current scenario and suggests ways for the sustainable development of small ruminant sector in KSA, that would contribute to enhanced livelihoods and wellbeing of the rural smallholder farmers.

1.1. Agro-ecology of KSA

The Kingdom of Saudi Arabia occupies two-thirds of the Arabian Peninsula, comprising a land area of 2.15 million km². Most regions of the country is classified as arid land ecosystem characterized by unpredictable and low-erratic precipitation and high temperatures. The KSA has average rainfall of less than 100 mm/year and high temperatures that can reach to 50°C in summer. The land pattern of the country i.e., more than 75% of the lands falls under the arid grazing land production system, that favours the rearing of sturdy livestock species like

sheep, goats and camels. The majority land use pattern of rangelands is grazing, mainly by sheep, goats and camels.

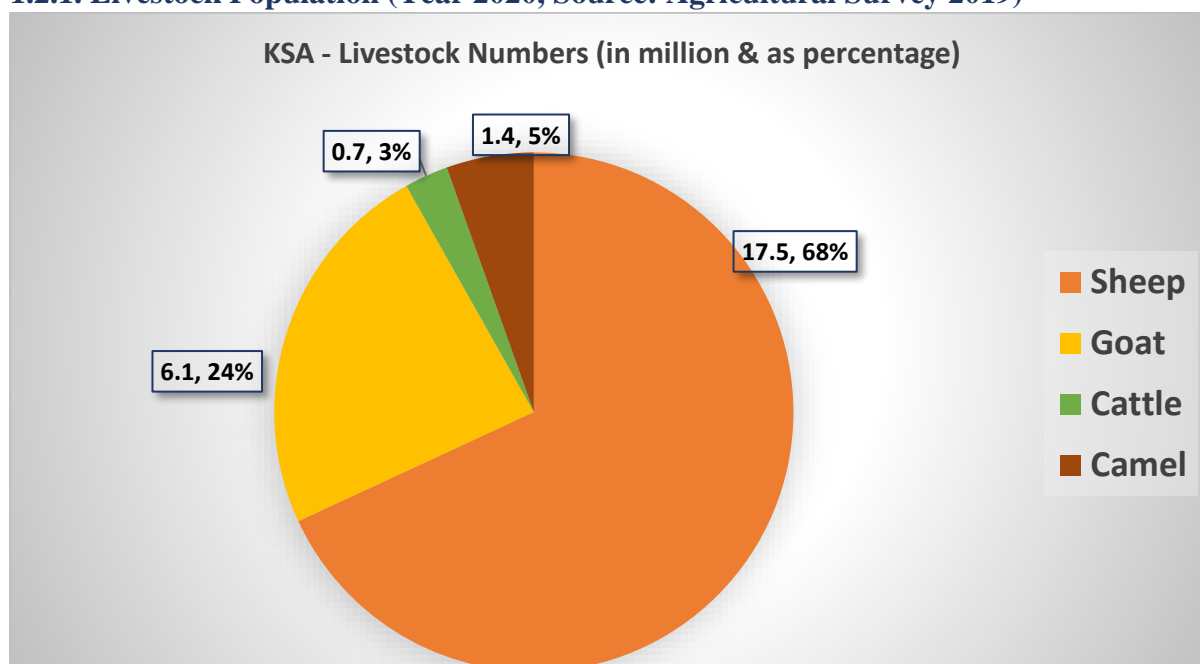
The KSA climate is classified as semi-arid in the highlands and coastal areas, and arid in the inland parts of the country, which is mostly covered with sparse vegetation and receives little rain in winter and spring. Water scarcity is the most important constraint to agricultural activities in the KSA. Despite the overall weather conditions, approximately 10% of the small-ruminant livestock favoured by a moderate climate having a suitable microclimate and vegetation cover. Following figure depicts an example of land cover for one of the targeted SRAD regions. Land cover is directly linked to grazing possibilities, a key factor in determining production systems.



1.2. Livestock in KSA

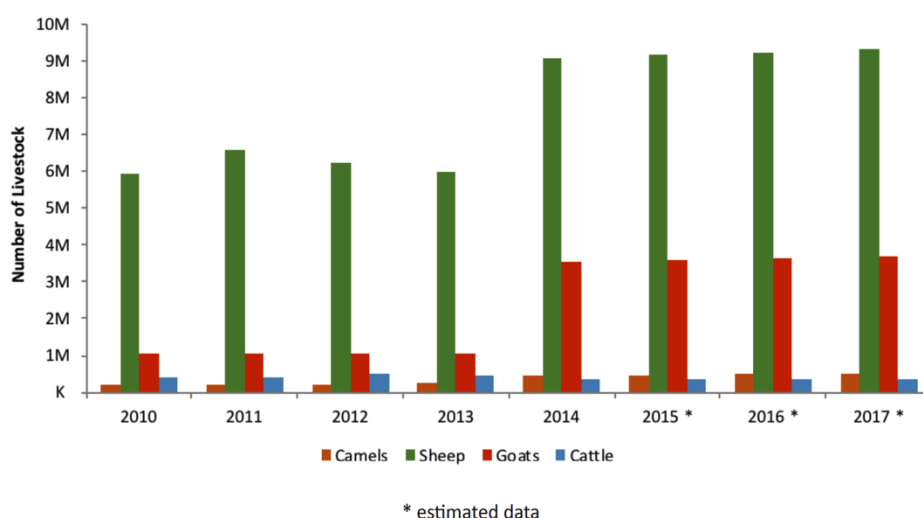
The major livestock species i.e., camel, cattle, sheep and goat population comprise of 25.7 million heads, and out of this animal resources, 92% of them are sheep and goats (17.5 million sheep and 6.1 million goats (MoEWA statistics, 2021)), playing important role in the socio-economic wellbeing of the rural people in the marginal and less favoured areas of KSA. Further, the country adopted intensive, large scale (industrial scale) commercial system of livestock production for dairy and poultry sectors, dominated by few private companies. In contrast, the small-ruminant livestock sector in the KSA subsists mainly in a very traditional way in unfavourable agro-climate conditions. Meat and milk are the primary products of this production system, and contribution from other by-products such as wool and leather is insignificant.

1.2.1. Livestock Population (Year 2020, Source: Agricultural Survey 2019)



1.2.2. Annual growth pattern of livestock in the KSA

Yearly livestock census data trends show a sudden increase in numbers of small ruminants in 2014. The origin of this increase is unknown and may be related to administrative factors rather than to any sudden increase in real numbers. The exact number of small ruminants in KSA is unknown as there is no ID system in place to identify animals.

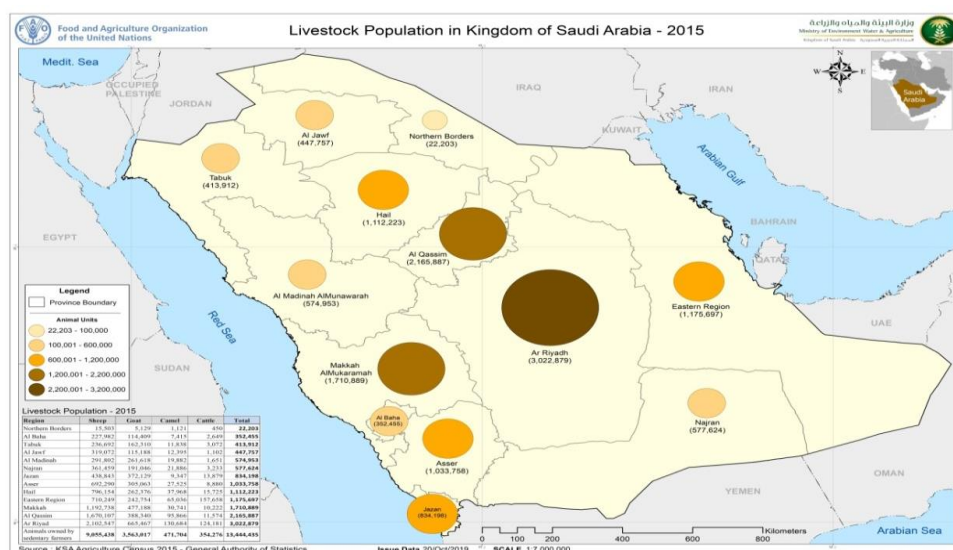


Annual growth of livestock in the KSA. Source: MEWA

1.2.3. Geographical distribution of small-scale livestock holders

Small ruminants account for over 90% of the KSA total livestock population. Estimates are approximately 17.5 million sheep and 6.1 million goats (MoEWA 2021), although only 10 million sheep and 3 million goats were reported in the earlier statistical census, and the sudden

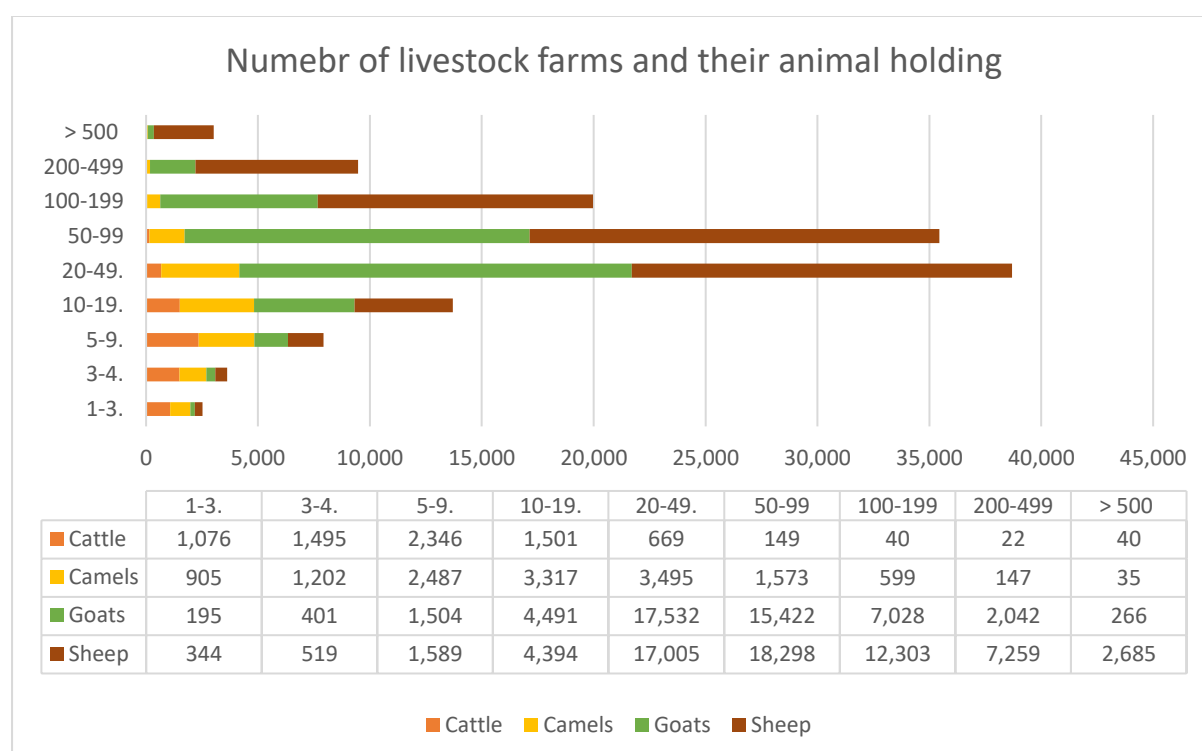
increase seem to be due to some reporting gaps. The spatial distribution of livestock in the KSA (including camels and cows) is shown below.



Geographical distribution of livestock in the KSA. Source: FAOSA
Animals are distributed across the regions. However, densities vary between and within regions and are greater near towns/villages, near feed/water resources, and in climate-favourable areas.

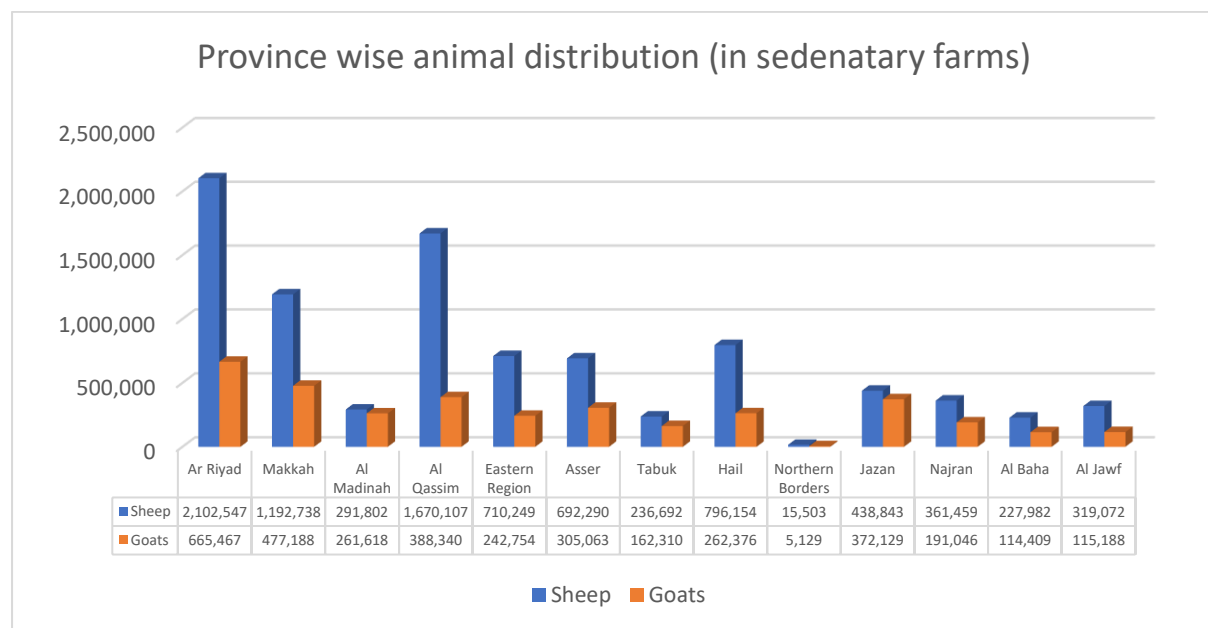
1.2.4. Size and ownership of livestock holdings

The livestock sector consists about 155,318 farm holdings accounting for 38% of all agricultural holdings in KSA (General Authority for Statistics, 2015). Some are mixed holdings (more than a single species), and the largest proportion can be considered small-to-medium size holdings (fewer than 299 small ruminants per holding).



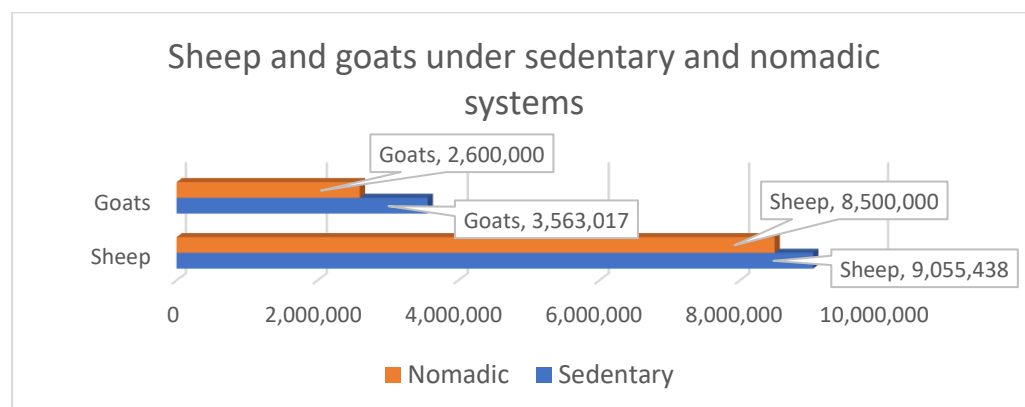
No data is available that links livestock holding size and land ownership. However, it seems likely that smaller holdings tend to own less land than larger holdings. The average size of small-ruminant holdings in the KSA is 299 animals, with 72% of holdings having fewer than 299. Compared to other regions of the world (from the small holder definition point), these many animals per flock is quite high, however for all planning purposes, the existing data could be used to define the smallholder system. For example, less than 300 could be considered as a small holder in KSA. Smallholdings are also predominant in other livestock sectors (cows and camels). Private citizens own 99% of livestock holdings; the remaining 1% are institutional holdings (corporations, companies, and government).

1.2.5. Small ruminant distribution across the provinces



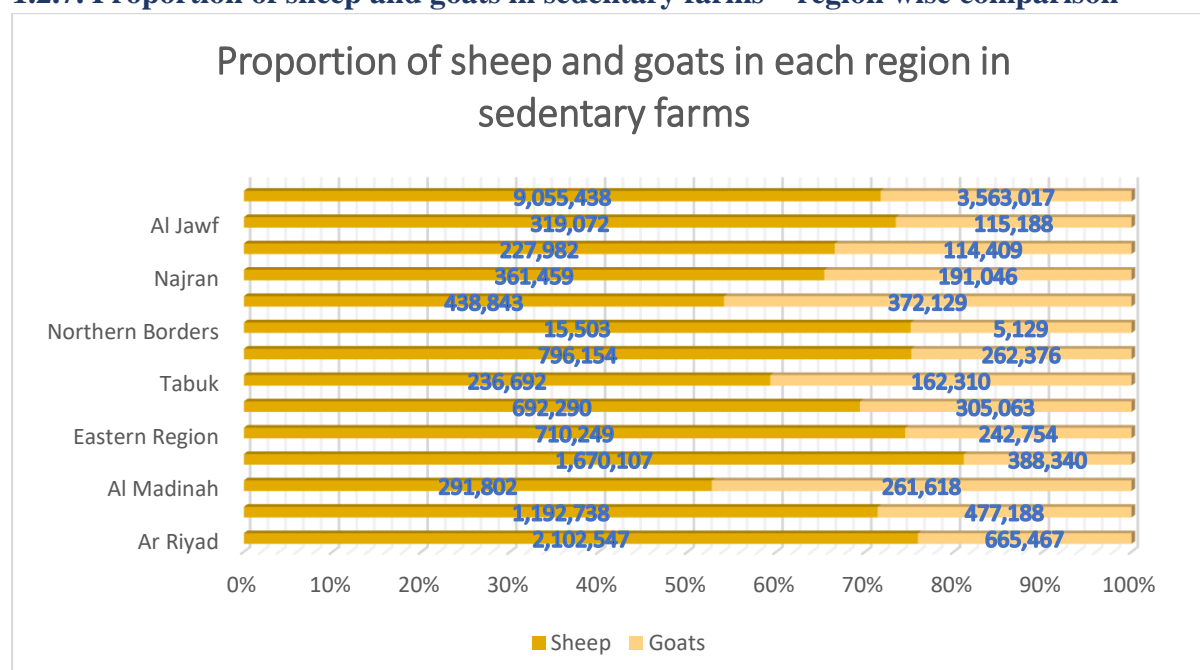
The small ruminant population is concentrated in Riyadh followed by Makkah and Al Qassim. The distribution is uneven, and hence requires region wise specific actions.

1.2.6. Sheep and goat distribution under sedentary and nomadic systems



Half of the population of sheep and goats (48% of sheep & 42% of goats) are still maintained under nomadic and semi-nomadic production system compared to the sedentary livestock keepers, implying need for different development approaches that are appropriate for sedentary and nomadic system. Nomadic system especially poses challenges in terms of organizing breeding programs, sustained genetic improvement, disease control and other animal health care processes, and importantly organizing value chain programs on a collective basis

1.2.7. Proportion of sheep and goats in sedentary farms – region wise comparison



The species composition in sedentary farms is favoured for sheep than goats. 72% are sheep and 28% are goats. This reflects in nomadic system also (77% sheep and 23% goats). Within small ruminant development, more emphasis is needed towards sheep development. (Source: KSA Agriculture Census 2015: General Authority of Statistics)

2. Opportunities for small ruminant sector development in KSA

- Demand for animal products (meat, milk and eggs) are increasing at par with increasing income levels. For example, between 2007 to 2015, the sheep and goat meat consumption volume increased by 1.7% per annum (154 K tons in 2007 to 177 K tons in 2015). At the same time around 35% of the sheep and goat meat requirement was met through imports. This provides a great opportunity to invest in this sector that would lead to increase in self-sufficiency of meat products
- KSA possess unique sheep and goat animal genetic resources that can withstand harsh climate conditions, and use scarce and poor-quality biomass to produce quality food, ensuring food security in these marginal environments. Any interventions to improve these resources will yield resilient agriculture development in these regions, and may provide critical solutions to sustainable animal production under the climate change scenario

- Besides managing goats in extensive production systems and under small holder systems, they also performs well under the intensive farming systems
- Sheep and goat farming are an integral part of the nomadic culture of the KSA. For example, the Naimi sheep are traditionally shepherded by the desert nomads. The meat from this breed fetches a premium price in the market, hence a revived interest among the farmers towards sheep meat production. In addition, there is a good quantity of milk from Naimi sheep, that is being processed and marketed at a premium price by the farmers. The wool is also used to make some hand-crafted products.
- From farm management point of view, sheep and goats are small, prolific and productive ruminants, and are well-suited to grass-based and small-scale agriculture.
- Sheep and goats are relatively inexpensive animals to purchase and feed compared to larger animals, a critical advantage for limited-resource farmers.
- Sheep and goats can be raised with very little grain, which is advantageous at a time when grain prices are on the rise.
- Return on investment (ROI) is quick for sheep and goats because they reproduce at a young age and have a high incidence of twinning, are marketed within 6 to 10 months of birth, and can be raised economically on pasture.
- Due to their smaller size, they are not as intimidating or dangerous animals and are good enterprises for women, youth, and aging farmers.
- Sheep and goats are excellent weed and brush controllers, and improve pastures and often work synergistically with cattle and other livestock and cropping operations.

3. Challenges/ Gaps faced by the small ruminant sector in KSA

1. **Production system and farm management constraints:** Most small-scale livestock holders are nomadic or under transhumance system, adopting traditional livestock farming system in nutrition, farm management, health and breeding, and have no consideration for economic returns.
2. In the KSA, while it is estimated that 1 person can manage 300 sheep, flocks are typically smaller and human work capacities are underused. Some farm owners depend on livestock for a living; other farm owners are hobby farmers with other businesses or jobs, but still may have large numbers of sheep. Out of the 153,000 KSA livestock breeders, 23,000 have a government job, 18,000 have other jobs, 9,000 are investors and the remaining 100,000 have no other job (MoEWA 2020). Labour tends to be underpaid, overworked, uneducated and unmotivated foreign males living in poor facilities. Wages are 1000-1500 riyals per month and days off are rare. This foreign labour is responsible for all aspects of the job (including vaccinations and treatment) and typically lack hygiene, biosecurity, and advanced handling knowledge.
3. **Feeding systems:** Dependency on imported feed sources and lack of research and development efforts in efficient use of available crop residues and food processing industry in the country, non-existence of research support system to introduce alternate forage species or newer forage production systems, unbalanced and improper feeding methods leading to feed wastage, escalating costs of the feed resources due to several external factors, has a great impact on the economics of small holder production system. The country imports around 7 million tons of barley in a year to be used as animal feed

4. While animal feed is costly, natural rangelands suffer low carrying capacity and inferior quality of forages. No well-defined community-based grazing land management system exists.
5. **Breeding systems:** Absence of breeding stock selection practices and KSA does not have a well-structured genetic improvement program for small ruminants. This has resulted in a situation where the breeding males are selected from the own herds and used for a very long period (up to 5 years), and very little efforts have been made to control inbreeding levels in the farm. Due to the absence of any controlled mating plans in the farms, there is hardly any genetic improvement in the population. Further no female herd restocking strategy exists with the farmers to effectively cull the inferior ones and select the best ones for future lamb production.
6. **Lower lamb productivity** - according to the MoEWA (2020), the KSA annual lambs weaned per ewe is as low as 0.52. Low weaned lamb numbers can be attributed to low fertility and low fecundity (high abortion rate), but also to a high rate of pre-weaned lamb mortality. Further the average meta yield in KSA sheep and goat is reported to be around 15-20 Kg per animal.
7. **Animal health and biosecurity constraints:** Animal diseases spread and outbreaks and high mortality rates. There is weak early warning system, and lack of standard herd health protocols limit the monitoring of flock' health status. Dead animal disposals are not carried out in appropriate manner which poses a great risk for disease transmission
8. **Housing systems:** Lack of or limited access to technologies and methods for low-cost animal housing designs for small ruminants leading to poor animal welfare, wastage of feed resources, compromise on biosecurity measures, higher disease incidences and mortality, and loss of manure. In either intensive or extensive systems, and especially in high temperatures areas, shaded facilities are inadequate resulting in increased levels of physical and thermal stress
9. **Research and extension support systems:** Limited research support, extension and disease prevention system prevails in the country. Inadequate access to and poor adoption of appropriate modern technologies and innovative practices including quality genetics, feed resources and other aspects of husbandry leading to low agricultural production and productivity
10. **Post-harvest management and marketing mechanisms:** Livestock farmers pose a challenge of lack of appropriate marketing mechanisms and direct sales channels for their produces. KSA has limited number of functional livestock cooperatives, and very limited efforts were put in collective approaches in strengthening livestock value chain activities
11. **Data sources and Information and Communication Technologies:** KSA does not have a well-defined livestock information management system that results in insufficient data and information on smallholders' farming systems, and lack of mechanisms that develop and disseminate information and knowledge for evidence based sustainable rural agriculture development in the country.
12. **Subsidies:** The subsidy system is generally positive for the sustainability of the small-scale livestock holders that it aims to support. However, it seems that the subsidy system is being misused by the farmers. The proper control of subsidy sometimes may become difficult due to the lack of an animal ID system in the country. Lack of

incentivising the farmers (on variable such as productivity) may help to provide boost to the sector growth.

13. **Production costs:** Compared to the international meat prices (around 4-8 US\$ per kg of carcass weight), the productions costs are higher by 2-5 times, mainly due to purchased feed, and poor management practices.
14. **Religious events and demand for sheep and goats:** The local sheep prices, especially during religious events, are among the highest in the world. Outside religious events, farmers may receive 700-800 riyals per 3/4-month-old lamb, but during high-demand periods, get paid up to 1500 riyals for the better lambs. This demand related cost escalations could be stabilized through appropriate policy and farm planning mechanisms.
15. **Policies and enabling environment:** Limited efforts are put in policy instruments and enabling environment that relies on well-orchestrated policy instruments in respect to breed registry, breed status, animal performance information, breeding program for small ruminants, animal traceability, farm biosecurity, animal health service delivery, introduction of new forage varieties, animal feed standards and monitoring mechanisms, promotion of non-conventional feed sources, livestock information management system, etc.,
16. **Water use in livestock:** It is reported that 87% of available water in KSA is used by the agriculture sector, and livestock share a major part. It is imperative that any water saving measures has to target this sector, especially the feed and forage production. It was estimated that around 31% of water is used to produce alfa-alfa and other fodder varieties. Accordingly, the government has made policies to reduce water use in agriculture as much as by 30% in the year 2030, and promulgated prohibitions related to ban on green forage production especially alfa- alfa in order to minimize the precious water resource in agriculture (without looking at alternate options). This is having a great impact on feed and fodder availability for small ruminants, and increasing the dependency on imported feeds.

4. Approaches to improve the overall performance of the livestock sector

To overcome the challenges of the livestock sector, and move towards a sustainable development of the small ruminant livestock sector, the following strategies are suggested.

1. **Key attention to improve quality feed and fodder availability** with an objective to reduce dependencies on external feed resources. Such interventions could include, balanced, economic and precision animal feeding methods using local feed resources; Development and standardization of technologies in using alternate non-conventional feed resources (e.g., date palm kernel, sesame stalk); introduction of newer forage resources (e.g., legumes adapted for arid regions, spineless cactus)' promotion of agro-forestry
2. **Strengthening community based sustainable grazing management** and range land management. Equally important is the rehabilitation of these rangelands with adapted and high productive range land forages species, shrubs and trees.
3. **Development of community based sustainable and systematic breeding program** for the native breeds of sheep and goats, using appropriate modern technologies such

as genomics based genetic improvement program for the production of elite breeding stock (rams for distribution to farmers or semen production), and application of advanced reproductive technologies such as heat synchronization, artificial insemination for the fast dissemination of top genetics

4. **Access to improved animal health and veterinary service delivery system**, preferably on a public-private partnership mode, that provide timely services at the farm gate at an affordable cost to the farmers. Equally important is implementation of farm biosecurity protocols for efficient disease control.
5. **Well organized and digital based disease surveillance system** for the important contagious and zoonotic diseases, and developing a structured disease early warning system for the veterinary agencies to be timely prepared for planning and executing an appropriate disease control strategy
6. **Strengthening systems for dissemination** of latest livestock production technologies, improved husbandry practices, animal welfare, safe food production through extension, training and demonstration using participatory methods. Ways could be developed to disseminate required knowledge system to the farmers on a continuous basis using digital platforms
7. **Establishment of demonstration farms**, that are simple farms following best husbandry practices against a bench marked performance indicators, and importantly that are within the means of smallholder farmers to replicate. These farms can be a media to disseminate best practices to other farmers in the region
8. **Strengthening of the regulatory framework** across the value chains. For example, a robust animal identification that is integrated into the national livestock information system, animal welfare regulations at farm, during transportation and other market processes, traceability system for livestock products, standards for livestock products, environmental regulations for slaughter houses, farm biosecurity protocols, etc.,
9. **Organize and promote collective efforts of the farmers** in procuring and distributing farm inputs, product aggregation, processing and marketing using channels like cooperatives or any other legal forms of cooperation, to maximize the benefits accrued through productivity enhancement investments
10. **Improved access to markets and development** of Small and Medium Agricultural Enterprises (SMEs) through enhanced participation of youth and women, with a focus on feed production, livestock product aggregation, processing, value addition, marketing and provision of inputs and services (e.g., veterinary services)
11. **Strengthen livestock market infrastructures and policies** that could lead to transparent and informed market processes, improved animal welfare, control of disease spread and adopting fair price practices.
12. **Establish a robust digital platform** that would fulfil various functions as required for monitoring the overall performance of the livestock sector in the country. Some of the examples are – National animal identification and registration platform, farm management tools (daily activity management schedules, performance against bench marked targets, precision feeding, IoT based animal movement and health tracking,

farm inventory management, farm economic assessments), livestock market information broadcasting, animal and livestock product traceability, animal performance recording for genetic improvement of the animals, early disease warning tools, country' feed and forage inventory system, GIS mapping of range lands and its status as a tool to control and monitor the grazing systems, etc.,

5. Interventions and specific activities that would assist in improving the small ruminant sector performance under the SRAD

A. Productivity enhancement programs

1. Apply technologies to convert un conventional feed resources (e.g., date palm waste, sorghum and sesame stover, which is available in abundant) into feed for livestock through establishment of feed conversion and feed production units
2. Introduce and promote cultivation and use of alternate drought tolerant forage varieties suited for KSA (e.g., cactus)
3. Application of feed ration balancing methods to assist in precision feeding
4. Introduce community based sustainable range land management practices
5. Implement community based genetic improvement program for the native sheep and goat breeds of KSA. Application of genomic technologies in breed characterization that would assist to understand breed status and to design a community based genetic improvement programs for those breeds
6. Application of marker assisted and DNA technologies to select high genetic merit breeding stock (especially males) for breeding in the small holders' breeding herds, and for artificial insemination program
7. Design and implementation of artificial insemination program for small ruminants

B. Inputs and services

1. Improved accessibility to veterinary services involving private veterinary practitioners and empowering private veterinary pharmacy veterinarians to provide treatment and farm advisory
2. Implementation of system to regularly screen disease like brucella and implementing specific disease control programs
3. Strengthening the laboratory service delivery system towards surveillance, data analysis and reporting
4. Train the MEWA staff on extension methods and best practices for continued farmers' training and education
5. Develop digital extension modules on different husbandry practices in Arabic and make it available to the farmers through mobile apps

C. Aggregation, value addition, processing and marketing

1. Establishment of Farmers' cooperatives for collective marketing of live animals
2. Organizing farmers' cooperatives for small ruminant milk aggregation, value addition, processing, following food safety norms and marketing. Special products from specific regions and breeds could be marketed as premium and niche products
3. Implementing food safety norms for sheep and goat milk products (microbial quality, antibiotic residues)
4. Organizing and regulating wool harvesting system through mechanization, collection, grading and downstream processing, and creating market network for the wool products (e.g., wool carpets)

5. Development of an agribusiness model across value chain involving selected farmer entrepreneurs
6. Application of digital tools like FEAST to characterize feed resources and estimate the gaps and plan for feed production
7. Implementation of animal health decision support tools like Rift Valley Fever early warning system

D. Policies and enabling environment

1. Enabling policies and support for the private sector to participate in livestock sector value chain programs (feed and forage production, input supply, service delivery, supply chain and marketing)
2. Policies for community based sustainable range land management systems
3. Policy instrument for sustainable and systematic breeding programs applying latest technologies with a focus on conservation and promotion of indigenous animal genetic resources
4. Policies and development instruments for forage production and use of unconventional feed resources for small holder livestock production systems
5. Instruments for National Livestock Management Information System

- E. **Bench marking:** Benchmarking is a very useful tool to have an in-depth look at the performance of the farm business. KSA small ruminant sector performance could be bench marked against some of the developed country' performance such as Scottish sheep production standards or New Zealand sheep production standards (factoring in the production system variables of KSA) to achieve economic efficiency. The initial bench marking could cover KPIs related to breeding (e.g., flock replacement rate, lambing %, ewes to ram ratio, inbreeding level), animal health (e.g., mortality rate, abortion %, worm load, lameness%) and production (e.g., ewe efficiency, lamb growth rate, live weight production / ha)

F. Data for livestock development

1. Develop or strengthen the existing nationwide livestock information system using an appropriate digital platform
2. Introduce low-cost animal identification and traceability systems like muzzle-based finger printing technology for sheep and goats
3. Develop and integrate (into the existing national digital system) simple farm management mobile tools for the farmers to apply in their day to farm management practices and periodically evaluate the farm economic performance

Annex 1: A framework for KSA Livestock Information Management System (LIMS)

The livestock information and management system are a pre-requisite for KSA to facilitate the recording and processing of livestock data that would fulfil various functions as required for monitoring the overall performance of the livestock sector in the country. Some of the examples are – National animal identification and registration platform, farm management tools (daily activity management schedules, performance against bench marked targets, precision feeding, IoT based animal movement and health tracking, farm inventory management, farm economic assessments), livestock market information broadcasting, animal and livestock product traceability, animal performance recording for genetic improvement of the animals, early disease warning tools, country’ feed and forage inventory system, GIS mapping of range lands and its status as a tool to control and monitor the grazing systems, etc.,

The LIMS could leverage ICT to keep track of all available information pertaining to livestock in the country. This digital platform will allow information access and integration across the platform using an Application Programming Interface (API) based integration with different databases and multiple system software. The software preferably should be built on Progressive Web Application (PWA), which is independent of operating platforms that would enable use on different operating systems (Android, Windows, Mac, Linux, etc.,) and interchange of data between different systems.

LIMS could be a tool comprising of several separate and integrated systems such as – (a) Livestock Identification and Registration System which will include an animal movement and mortality module, (b) Animal Health Information System, (c) Animal Productivity Information System, (d) Farm management tools (e) Feed ration balancing tools (f) performance recording for genetic improvement (g) Livestock market information system (h) e-extension platform, etc.,

1. Some of the considerations, business and technical requirements in developing LIMS:

- i. **ICT Architecture** of the integrated Livestock Information System.
- ii. **Design documents** for individual modules such as (a) Livestock Identification and Registration System including animal movement and mortality recording, (b) Livestock Health Information System, (c) Livestock Productivity Information System, (d) Farm management tools (e) Feed ration balancing tools (f) performance recording for genetic improvement (g) Livestock market information system (h) e-extension platform
- iii. **Detailed implementation arrangements proposal, including necessary updates of the legal framework, estimates of relevant investment and operational costs:** the design stage should provide decision making information with regards to which public agency or semi-public/ private partner is going to implement/ be responsible for what, and what would the costs be for initial investment and for recurrent operating charges. Implementation arrangements will also provide indication regarding the “legal environment” necessary for LIMS and the various sub-systems to operate properly (Livestock Identification and Registration System, Livestock Health Information System, etc.).
- iv. **Implementation Roadmap** for the design and development of the Livestock Information platform & ICT System Architecture’.

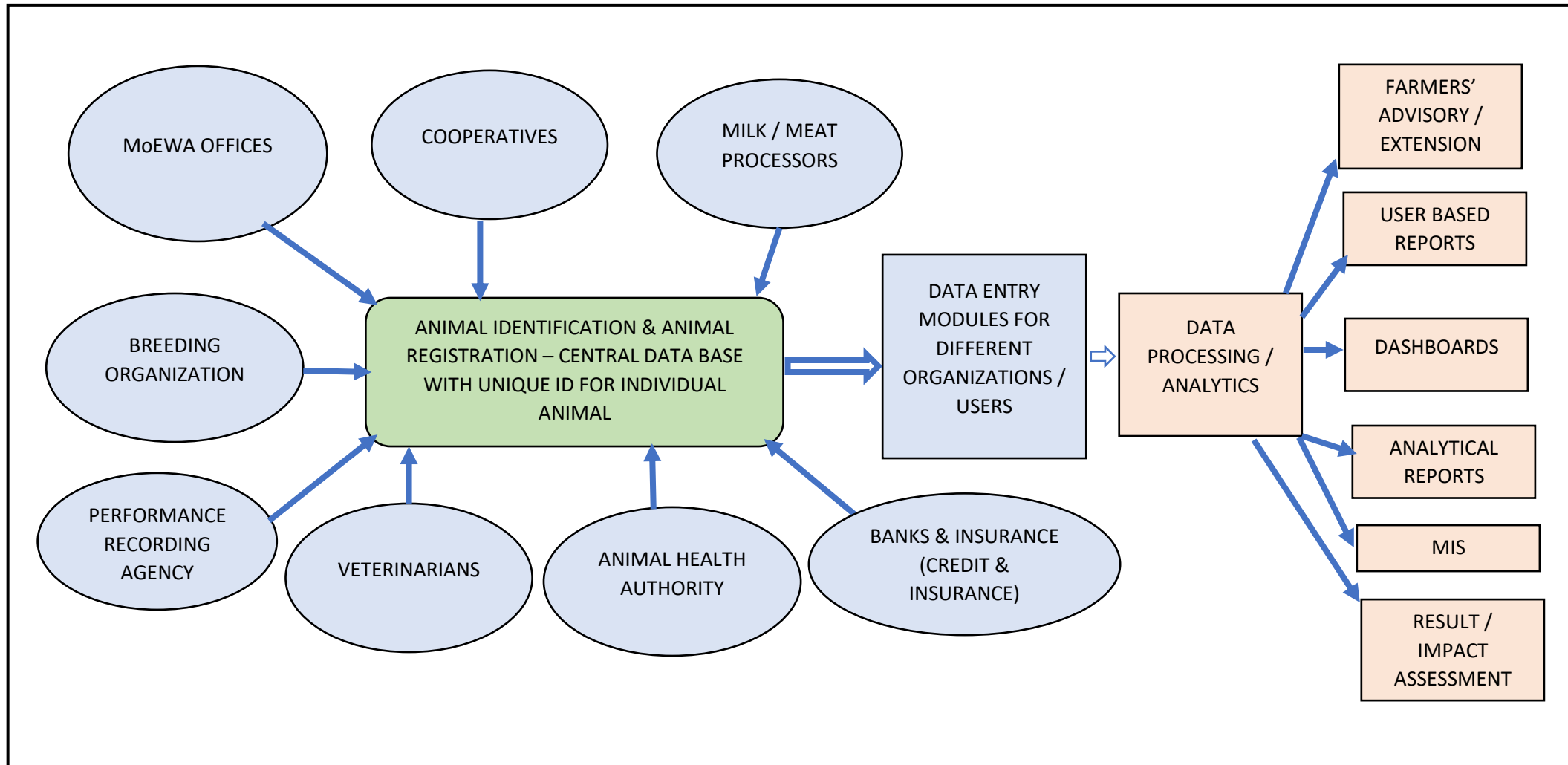
- v. ***Identify hardware requirements*** at different levels of hierarchy starting from the primary data entry personnel to intermediaries and top-level personnel, as well as data storage and data management system.

1.1. The Livestock Identification and Registration system is the heart of the system as it allows farmers to have their livestock registered on an individual animal basis each with a unique identification number, with updates for animal movement registration and death (full traceability).

1.2. The Livestock Health Information system captures official (veterinary-certified) data related to individual animal health, such as the date and the kind of all vaccinations and veterinary treatment received, and the date of the most recent health inspection by a qualified veterinarian or para-veterinarian. The livestock producer should have a copy of the electronic health certificate generated through the system for each and every animal in his/her herd and this information could be stored on the national data-base.

1.3. The Livestock Productivity Information system captures data related to animal productivity and it will vary according to the type of animal to be considered (i.e. milk production, meat production). Example of information to be included in the database would relate to breeding, body weight monitoring, rearing practices and overall farm management, animal nutrition and feeding, milk and/or meat production records, and any other information directly related to animal value and productivity (including possible periodical feedback system to be provided to the farmer on production efficiency).

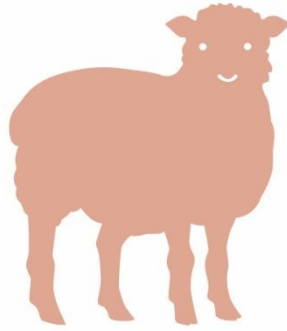
2. Suggested Framework for KSA LIMS



Annex 2: Example of Bench marking : Scottish Sheep Industry benchmark KPIs (www.fas.scot)

Key Performance Indicator	How it is calculated	Target
• Ewes to Ram ratio	Number of ewes to number of rams	Maximum 30
• Ewe mortality	(Ewes death over a year / ewes service in previous year) x 100	Less than 4%
• Flock replacement rate	(Purchased ewes / ewes serviced in the year) x 100	Less than 23%
• Scanning %	(Total no of lambs detected in scanning / total ewes serviced) x 100	115-200%
• Barren ewes %	(Ewes barren / ewes serviced in the period) x 100	Less than 2%
• Lambing %	(Lambs born/ewes serviced) x 100	110-195%
• Abortion %	(Ewes aborted / ewes serviced) x 100	Less than 2%
• Lambs rearing %	(Total lambs reared / no. of ewes serviced) x 100	105-190%
• Lambs' losses from scanning to rearing	[(Lambs scanned-lambs reared)/lambs scanned] x 100	Less than 5%
• Lambing intervention	(Ewes requiring assistance at delivery / No. of ewes delivered) x100	Less than 5%
• Eight-week weight	Average weight at eight weeks	More than 20Kg
• Average age at weaning	Average age at weaning	60-100 days

• Average lamb growth rate to weaning	$(\text{Average lamb weaning weight} - \text{birth weight}) / \text{Average age at weaning}$	More than 280 grams / day
• Ewe efficiency	$(\text{Lamb rearing\%} \times \text{Average lamb sale weight}) / \text{average ewe mature weight}$	1
• Post weaning lamb growth rate	$(\text{Average lamb weight} - \text{average weight at last weight}) / \text{days since last weight}$	More than 120 grams / day
• Average lamb growth rate	$\text{Average lamb sale weight} / \text{average days to slaughter (from birth)}$	More than 250 grams / day
• Ewe lameness	$(\text{Ewes lame} / \text{total ewes in flock}) \times 100$	Less than 5%
• Veterinary input	$\text{Total veterinary cost} / \text{ewe}$	105-190%
• Stocking rate (LU/ha)	$\text{Total livestock units (LU)} / \text{area (ha)} \quad (\text{One sheep} = 0.15 \text{ LU})$	1-2.5 LU/ha
• Total kg of liveweight / ha	$\text{Stocking rate} \times \text{rearing \%} \times \text{average weight of lamb sold}$	200-400 Kg / ha



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