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Handbook on Sahiwal Cattle Good Management Practices

KALRO
Kenya Agricultural & Livestock Research Organization

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PREFACE

Adoption of good livestock management practices by farmers would lead to increased herd productivity. In the context of increased productivity, management practices and extension packages play a very crucial role. Particularly, extension service will need to be broad-based and holistic in contents and scope, thus beyond technology dissemination. More innovative methods must be developed to identify systematically Sahiwal farmers problems and felt needs. It is, therefore, imperative that the body of knowledge on Sahiwal cattle management practices be continuously developed, improved, updated and disseminated.

We are entering a great livestock transition period in Kenya. In the coming years, one-third of today's Sahiwal cattle livestock keepers are expected to move from subsistence to market enterprises, another third to leave the sector, with the final third going either way. To help shape this transition for broad-based, safe and sustainable growth, we need, more than ever, sound management practices – breeding, feeding, healthcare, marketing - both *in* and *for* development.

This handbook was prepared with strong support and useful contributions from several experts: Dr. Samuel M. Mbuku (lead author), Dr. Mary Mbole-Kariuki, Mr. Thomas Magothe, Dr. Erick Mungube, Dr. Douglas Indetie, Prof. David Kihurani, Dr. Zabron Nziku, Ms. Neema Urassa, Mr. Cleopas Okore and Dr. Jack Ouda. Formatting and illustrations were done by Mr. Nathan Maweu and Alexander Wamonje, respectively. We are grateful to the African Union Inter-African Bureau for Animal Resources (AU-IBAR) Genetics Project and National Research Fund (NRF) for financial support.

Basically, this handbook on Sahiwal cattle management practices has been designed keeping the requirements of the farmers and extension agencies in mind. The handbook attempts to provide basic information on breeding, healthcare, nutrition, fodder production, routine management, marketing based on existing and new technologies, along with illustrations. Such information is usually not available from a single source. We sincerely hope that the handbook would be useful to Sahiwal farmers and practitioners in Eastern Africa.

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ABBREVIATION/ACRONYMS

AI	Artificial Insemination
AU-IBAR	The Africa Union Inter-African Bureau for Animal Resources
BB	Bovine Babesiosis
CBPP	Contagious Bovine Pleruo-pneumonia
DRC	Democratic Republic of Congo
DVS	Directorate of Veterinary Services
ECF	East Coast Fever
FMD	Foot and Mouth Disease
GHG	Greenhouse Gases
GiNs	Gastro-Intestinal Nematodes
GnRH	Gonadotrophin Releasing Hormone
LSD	Lumpy Skin Disease
MOET	Multiple Ovulation and Embryo Transfer
NCD	Neonatal Calf Disease
PD	Pregnancy Diagnosis
RVF	Rift Valley Fever
SADs	Stationary Attractive Devices
SAT	Sequential Aerosol Technique
SIT	Sterile Insect Technique
SSA	Sub Saharan Africa
TBD	Tick Borne Diseases
TMR	Total Mixed Ration

1 INTRODUCTION

The Sahiwal cattle is largely bred in the Montgomery, Punjab region of Pakistan or the present day Sahiwal district. The history of Sahiwal cattle in Eastern Africa dates back to the early 1930s when breeding bulls were imported from India and Pakistan for upgrading the Kenyan and Tanganyika Small East Africa Zebu cattle for higher milk production and enhanced growth performance under low-input production conditions. The promising results of the upgrading programme led to an increase in demand for Sahiwal bulls mainly by the Maasai pastoralists in Kenya and Tanzania.

The Sahiwal cattle are commonly of reddish dun colour although there are many animals with pale red; a dark brownish colour is common around the hump and neck; in males the colour darkens towards the extremities, such as head, legs and tails; the males have big hump; the teats are large and uneven; they have a well developed thoracic hump; their ears are long and drooping.

Colour variation in Sahiwal Cattle

The Sahiwal is principally a dual-purpose (meat and milk) breed and tolerant to semi-arid and arid conditions. In commercial ranches of Kenya, they are selected for beef. In the National Sahiwal Stud located in Naivasha, Kenya, they are improved simultaneously for milkand meat production.

However, despite the importance of Sahiwal, farming of the breed is affected by several challenges, of which unavailability of quality breeding stock, inadequate feed resources, prevalence of diseases (especially tick-borne), high cost of farm inputs (including fodder/ pasture seeds) and low milk value addition among producers, are the most critical. Today, these challenges prevail despite considerable efforts by the governments (Kenya and Tanzania) and her development partners in Eastern Africa. Therefore, there is a need to empower Sahiwal farmers, extension personnel and practitioners with knowledge in order to adopt scientific practices that can lead to increased milk and meat productivity at optimum costs. For this to happen, the basic tenets of Sahiwal breeding, feeding, health and marketing must be well understood.

2 BREEDING MANAGEMENT

2.1 Sexual maturity

Heifers should be mated when they reach 2.5 to 3 years of age or when they attain at least 270kg live weight.

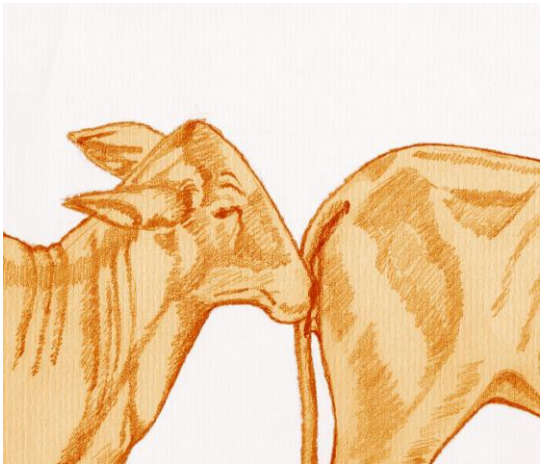
2.2 Heat detection

Efficient heat detection makes it possible to serve the animal at the right time. Under optimal feeding management, a cow will come on heat after every 21 days although this may range from 18 to 24 days. The duration of heat is between 15 to 18 hours but may vary from 8 to 30 hours among cows. Heat is divided into early and standing heat phase (Table 1).

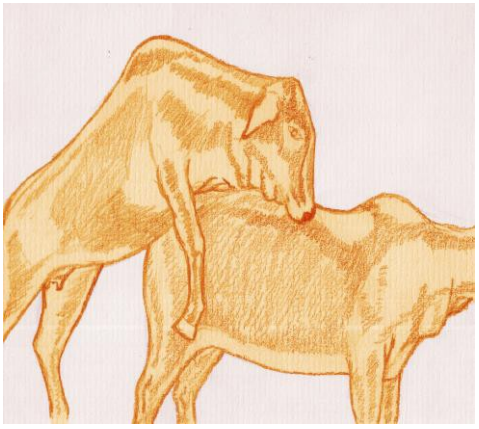
Table 1. Early and standing heat signs in a cow

Early heat	**Standing heat**
• Increased nervousness/restlessness • It mounts other cows • Has swollen vulva • It licks other cows • It sniffs other cows and accepts to be sniffed • It has reduced appetite	• Stands still to be mounted by other cows • It produces clear mucus from the vulva • There is a sharp drop in milk production • The tail is bent away from the vulva • The animal may stop eating
Early signs: Watch the cow closely	**Best signs: Take the cow for service**

Some behavioural signs of heat



(i) Licking and sniffing



(iii) Standing to bemounted

When to inseminate

Inseminating the animal at the right time increases the chances of conception since serving too early or too late may be too early before ovulation or long after ovulation has occurred. Therefore, present the animal for insemination around the time of ovulation. Apply the morning (AM) or afternoon (PM) rule as illustrated in the guide below for the best time to present the cow for insemination (Table 2).

Table 2. Heat detection time and suggested time for insemination for enhanced conception success

Heat observed	When to inseminate (AI)
Morning hours	Afternoon of the same day
Afternoon or evening hours	Next morning hours

2.3 Mating

Mating in Sahiwal cows and heifers can be done using bull service or natural service and artificial insemination (AI). Whatever the breeding method used, the objective is to achieve increased chances of conception.

2.3.1 Bull service (natural service)

This is a breeding method where a chosen bull is mixed with the reproductively mature cows for purposes of ensuring any cow which comes into heat is timely mated. Under this method, the farmer does not detect heat as the bull will accurately detect any cow on heat and mounts it.

Advantages of using bull service:

a) The cow can be mounted more than once thus increasing the chances of conception.
b) The semen is fresh and of good quality since there is no extension, handling and freezing.
c) The bull can conveniently be shared by many farmers.
d) This method helps to reduce repeated inseminations associated with AI.
e) The method does not require expertise on heat detection.

In order to achieve the intended benefits of natural service, it is important to:

a) Use bulls that are free from reproductive diseases.
b) Change breeding bulls from time to time to avoid inbreeding.
c) Ensure the bull is allowed sufficient rest so that the time for sperm development is adequate to avoid bulls inseminating cows with immature sperms which may reduce conception success.

d) Feed the breeding bull with a diet rich in energy and proteins but avoid overfeeding as the bull may become too fat

e) Regularly trim the hoofs of a breeding bull to minimize overgrown and deformed hoofs

Tips on how to increase chances of conceptions under natural mating:

- For seasonal mating use 1 bull for every 20 to 25 cows
- For continuous mating use 1 bull for every 50 cows
- Large proportion of heifers should be mated to older bulls
- Provide enough and balanced nutrition

2.3.2 Reproductive technologies

There are many reproductive technologies which makes it possible for dairy farmers to breed their female animals without the need to keep a breeding bull. The following reproductive methods can be used:

Artificial insemination (AI)

- This is the method of breeding where semen from a select bull is transferred into a cow's reproductive system via the vagina using special equipment. In this breeding method, the cow does not in any way come into contact with a bull.

Artificial Insemination in progress

- AI is done by trained technicians who are licensed by the Directorate of Veterinary Services (DVS) to operate.
- The technicians work in a defined area under supervision of the county or sub-county veterinary officer. They are equipped with liquid nitrogen tanks for proper storage of semen to ensure sperm cells in the semen remain viable.

Artificial Insemination semen storage cylinder

Forms of semen used for AI

Semen for AI is collected from breeding bulls and packed in straws. Each straw is a dose and is enough for one cow. Semen packed in straws contains fewer sperm cells than what is in the ejaculate from the bull. Therefore, conception rates where AI is used are lower compared to cows mated by bulls.

There are two forms of semen used for AI: fresh semen or frozen semen.

a) **Fresh semen**
   Fresh semen is collected from a breeding bull and processed, packed in semen straws for immediate use, preferably on the same day of collection.

b) **Frozen semen**
   This form of semen is collected from the breeding bull, processed and packed in straws and stored in liquid nitrogen tanks for later use.

- Semen used for AI may be sexed or unsexed. The use of sexed semen increases the chances of the farmer to get heifers as opposed to bull calves.
- Sexing involves the addition of products to semen to ensure fertility of female or male sperm cells in an ejaculate is enhanced. Sexing is done with preference for more heifers than bulls being born. Cows inseminated with unsexed semen have a 50% chance of giving birth to female calves. The cost of sexed semen is higher due to higher production costs.

Semen sexing agents

- These are products that are added to conventional bull semen to sex it. They include Heifer plus and Bull plus.
- Heifer plus works by enhancing the fertility of the female sperm cells and slowing the motility of the male sperm.
- The result is that during artificial insemination (AI), more ova (eggs) are fertilized by the female sperm, resulting in about 25% more female calves than when unsexed semen is used. When Bull plus is mixed with semen, the male sperm fertility is enhanced and more bull calves are born.
- The sperm count in the semen after sexing is not affected, while the overall fertility of the semen is increased up to 20%, enhancing the conception rate.
- The semen sexing agents can be mixed with thawed semen just prior to AI, or pre-mixed in the laboratory with fresh semen soon after collection before freezing. The pre-mixed semen is then thawed and insemination is done on ready cows.

Advantages of using AI

- It is cheaper than maintaining a breeding bull.
- A farmer can easily choose or change bull-semen to use.
- Minimal chances of spreading reproduction diseases.
- It is easy to control mating of related individuals.
- Semen from one bull can serve many cows and heifers (over 10,000) per year.
- It allows mating of cows and heifers of different sizes without injury.
- It assists in upgrading of breeds of inferior genotypes.

Disadvantages of using AI

- It is not a convenient breeding method for cows with silent heat.
- It results in failed services if technician is not properly skilled.
- Heat detection must be properly done for correct insemination timing.
- It is expensive for smallholder dairy farmers.
- It is inaccessible, and therefore, unreliable especially in the extensive production systems.
- If done under unhygienic conditions, the inseminator may introduce disease causing agents into the uterus.

Tips on how to increase chances of AI conceptions

- Timely detect cows/heifers on heat
- Inseminate at least six hours after onset of heat
- Use a skilled inseminator
- Inseminator should strictly follow insemination procedures
- Cows/heifers should be fed well for consistent ovarian activity (regular cycling), healthy and good body condition

Multiple ovulation and embryo transfer (MOET)

- This method of breeding is preferred for use in cows with superior genotypes to produce breeding heifers faster to benefit dairy farmers.
- The donor cows are treated with reproductive hormones to enable them to produce more eggs (super-ovulation).
- The donor cows are artificially inseminated and the embryos harvested prior to transferring to recipient cows for implantation and the pregnancy.
- The recipient cows are simultaneously treated with hormones to prime them up and make them ready to receive embryos from the donor cows.
- This technology is commonly used in advanced cattle breeding.

Advantages of using MOET

- Increases reproduction rates of individual or groups of cows/heifers.
- Embryos can be stored fresh or frozen in laboratories for later use.
- MOET can be used for banking embryos for future use.

Disadvantages of using MOET

- MOET is expensive compared to AI.
- It is very technical thus requires specialized skills.
- MOET is associated with complicated births especially if several embryos are transferred to a recipient cow or all fertilized eggs are not harvested from the donor cow.
- The method is suitable for larger scale dairy farmers.

The decision to use MOET depends on the availability of experts and the associated costs.

Estrus synchronization

- This is a technique which is used to induce a group of cows/heifers in a herd to come on heat at the same time.
- This technique allows artificial insemination, natural mating, collection and transfer of embryos to be carried out at predetermined days and time.
- Among the many synchronization protocols, the 10 day fixed time one is recommended.

Advantages of using estrus synchronization

- It improves timing of mating and calving to coincide with ideal economic and environmental conditions.
- Estrus synchronization does not require heat detection.
- This method is good for cows with silent heat and other infertility challenges since insemination time is fixed.
- Improves record keeping and management of group cows/heifers.
- Calves born are of uniform age thus easy to manage and select.
- It saves on time and labor required for constant heat observation and insemination.

Synchronized calves of the same age

Disadvantages of using synchronization

- The technique requires trained and specialized personnel.
- It is successful when feeding management is optimal as nutrition is critical for reproductive activities.
- It may interfere with normal reproductive processes if used for long period.

- It requires good record keeping to minimize chances of administering hormones on cows/heifers in early pregnancy.

Tips on estrus synchronization

- Estrus synchronization should be performed by qualified personnel
- Each candidate cow/heifer should be healthy and in good body condition
- Hormone injections should be administered at the same periods in the afternoons for inseminations to be in the morning
- Synchronized cows/heifers must not come in contact with any bull

Table 3. Fixed time AI synchronization procedure

Day	What to do
0	• Perform pregnancy diagnosis (PD) on each candidate cow/heifer • Disqualify pregnant cows/heifers • Inject cows/heifers that are not pregnant with 1 ml of Gonadotrophin Releasing Hormone (GnRH) • Ear tag cow/heifer with an identification number • Completely separate cows/heifers from any bull
7	• Perform a second PD on each cow/heifer injected at day 0 • Disqualify any pregnant cow/heifer • Inject each empty cow/heifer with 2 mls of Prostaglandin F2 alpha (PGF2α) hormone at about the same time as in day 0
9	• For each cow/heifer injected in day 7, inject 1 ml of GnRH at around the same time as in day 7
10	• Inseminate each cow/heifer within 8 to 18 hours after day 9 injection

2.4 Pregnancy

- Pregnancy is the period from the time fertilization and conception occurs to birth.
- During pregnancy, the fetus develops in the uterus of the cow until it is born.
- Sahiwals carry pregnancy for between 279 and 287 days (average of 9 months).
- Cows carrying bull calves tend to have a slightly longer gestation period compared to cows carrying heifer calves.

How to detect pregnancy (Pregnancy diagnosis)

Pregnancy in cows and heifers can be detected using rectal palpation, ultra sound or visual appraisal technologies.

Care of pregnant animals

- As the foetus develops rapidly during the last 3 months which is the last trimester of pregnancy, adequate care needs to be taken during this time.
- Pregnant lactating cows should be dried within a period of 15 days after the 7th month of gestation.
- Pregnant animals should be kept in a place with enough space for standing and lying comfortably.
- Provide suitable ration to pregnant animals to reduce the likelihood of occurrence of diseases like milk fever, ketosis and downer cow syndrome shortly before or after calving. Balanced diet also ensures adequate milk is produced during the lactation phase.
- Provide water *ad libtum* round the clock to pregnant animals for them to drink a minimum of 75-80 litres of fresh and clean drinking water per day.
- Avoid overfeeding on leguminous pastures which contain high levels of estrogens which can interfere with pregnancy.
- 4-5 days before calving, the animal should be placed in a separate, clean and ventilated area preferably with sunlight. The location should have bedding materials like straw for the comfort of the animal.
- The animal should be kept under observation during the last 1-2 days before calving.

2.5 Calving

- This is the process through which the calf is born.
- It occurs at the end of the pregnancy usually after 9 months although there may be variations since female calves are born slightly earlier than the male calves.
- The process starts with the appearance and breaking of amniotic membranes (water bag) to release fluids which lubricate the birth canal for ease of expulsion of the calf and ends with expulsion of the placenta.
- The birth process is shorter in cows and may take one and half hours while in heifers it may take up to three and half hours.
- After the water bag appears, check approximately after one hour to know whether the animal may require help.

Signs of calving

- The belly distends especially on the right flank.
- The udder is filled up and teats are stiff.
- The vulva is swollen with mucus and may discharge blood colored fluid.
- The animal becomes restless.
- Appearance of water bag at the vulva.

During birth

- Leave the animal to give birth naturally.
- Sahiwals rarely have difficult calving.
- If difficulties occur, consult a veterinarian.

After the calf has been born, the placenta should drop almost immediately. In instances where this does happen, then it is called retained placenta. Farmers should involve veterinarian to help in the removal of the retained placenta which must be done after 2 to 3 days.

As a precaution, it may help to treat such cows with antibiotics (injectable) prior to the removal of the placenta and after removal (injectable antibiotics as well as pessaries are inserted in the uterus) are recommended to minimize uterine infections.

Nutritional care of the cow after calving

- Immediately after calving, the cow has a low appetite and will not eat as much feed as the body may require.
- Cows undergo a lot of stress while calving, therefore, the animal should be given light, palatable, mild laxative ration and is helpful in early expulsion of the placenta.
- In addition, the animal should be given tender green fodder and fresh water as much as it wants to drink, but do not give hot water.
- Ensure the milking cow has constant access to clean drinking water and receives required quantity of mineral mixture daily.

Tips on good reproduction practices

- Heifers should be served at the age of 2.5 to 3 years of age or when they attain a live weight of at least 270 kg.
- Ensure cows are served 5 to 6 months after calving.
- Check for heat signs 19 to 21 days after insemination to avoid prolonged open periods.
- Monitor pregnancy development.
- For artificially inseminated cows/heifers, carry out pregnancy diagnosis 3 months after insemination.
- The cows should be maintained on adequate and balanced ration (nutrition).
- Maintain records for different reproduction events.
- Consult veterinarians who are experts on reproduction.

2.6 Selection of breeding animals

261 Sahiwal breed/genetic improvement

Breed/genetic improvement is important to Sahiwal farmers as it can enhance the performance of their herds, therefore, benefiting individual farmers due to increased productivity and profitability. Breed improvement occurs when the breed value of a Sahiwal herd is improved through selection. The improvement has the potential to:

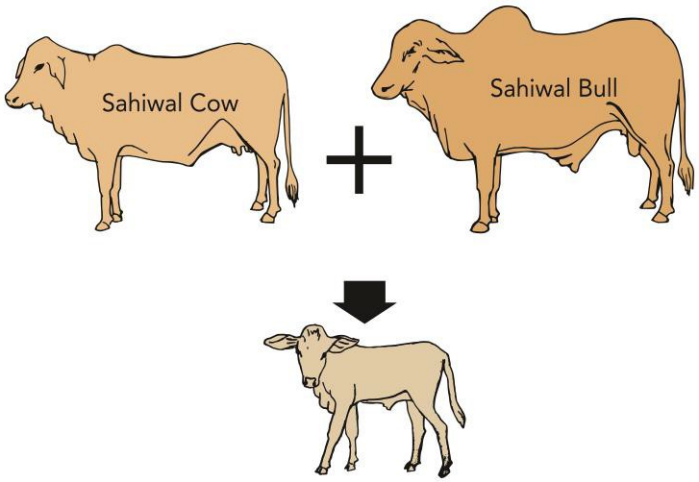
- Improve specific traits/values of a herd including milk, carcass, growth, fertility, coat color and resilience.
- Improve overall productivity and profitability.
- Assist in meeting market requirement.

Methods of breed/genetic improvement

Selection within breeds or lines (Pure-breeding)

This is common in organized breeding systems and community based populations. Pure-breeding is necessary for maintaining pure Sahiwal breed lines.

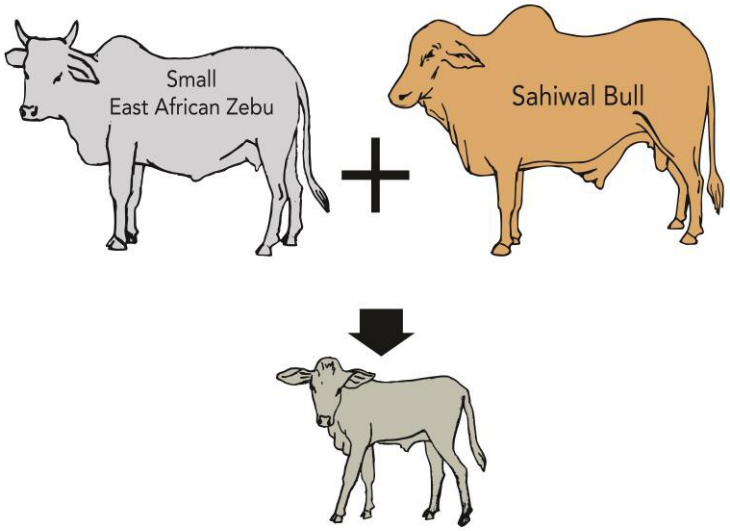
Pure breeding must be carefully done to avoid mating using animals with a common lineage as it will result in inbreeding which is undesirable.



Pure breeding ensures conservation of Sahiwal breed

Crossbreeding

This is the most prevalent system of breeding used across Eastern Africa. It is achieved by mating two or more unrelated cattle breeds such as Sahiwal breed and Maasai zebu. However, it must be well planned to avoid indiscriminate crossbreeding which can lead to loss of genetic diversity among Sahiwal populations.



Systematic crossbreeding helps to increase productivity if well implemented. Crossbreeding taps on heterosis (hybrid vigour).

262 Selection of Sahiwal breeding stock

A breeding stock is a group of Sahiwal males and females. Selection is the process of preferring certain Sahiwal cattle to be parents of future calves while culling others. Selection is an important tool for improving preferred Sahiwal cattle traits.

Preferred Sahiwal traits

- Coat colour (reddish brown)
- High milk yield
- Fast growth rate
- High fertility
- Large body size
- Tolerance to diseases and drought

Tips on good Sahiwal breeding practices

- Chose the best cows and bulls to be parents of next generation
- Mate only chosen parents when they are healthy and properly fed
- Cull unselected Sahiwal bulls and cows
- Replace or exchange bulls every two years
- Avoid mating related individuals
- Use appropriate reproductive technology
- Monitor and maintain breeding records

3 FEEDING MANAGEMENT

3.1 Why feed Sahiwal cattle

- Providing balanced nutrition is the foundation for productive and profitable animal husbandry.
- Without adequate nutrition, animals cannot express their full genetic potential nor will they be productively efficient.
- Low milk production, low reproductive rates, poor growth and increased illness may be as a result of imbalance or deficiency of nutrients.
- A balanced diet containing optimum energy, protein, vitamins and minerals levels is needed to ensure best performance with respect to production, reproduction and health.
- Therefore, providing nutritionally balanced rations to animals is necessary to gain economic returns from the cow.

3.2 Feeding calves

- Immediately after calving, allow the mother to lick the calf clean which promotes circulation within the calf's body and prepares the calf to stand up and walk.
- Allow the calf to suckle the colostrum immediately it stands and begins to walk.
- Colostrum intake should happen within 1 hour after birth.
- Colostrum provides immunity and protects calf from diseases in the first three months of life.

3.3 Feeding lactating cows

- Proper feeding is essential to ensure lactating cows receive adequate nutrients for maintenance, milk production, reproduction and for them to remain healthy and in good body condition.
- A lactating cow must eat a balanced diet containing energy, protein, vitamins, minerals and water.
- A cow should eat as much forage as it can take.
- If a cow produces more than 5 litres of milk per day, supplement with 1kg of dairy meal for every extra litre produced.
- Minerals should be provided for the cow to take as much as it can.
- A lactating cow should drink as much clean water as it can take, once or twice a day.

3.4 Feed types

Balanced diets for cattle are made up of four types of feed.. When the feed is combined in the right amounts, they supply all the nutrients needed to keep Sahiwal cattle healthy and productive.

3.4.1 Forages

- These are natural growing or planted pastures, fodders and legumes.
- They are eaten when fresh, dried or fermented.
- Sahiwal cattle primarily depend on natural grass pastures, legumes and crop residues throughout the year.
- They provide energy, protein, vitamins, minerals, water and fibre.
- Some important forages are described below;

Table 4. Common pastures and fodders found in Kenya

Forage	Attributes
 **Star grass** or **Bermuda grass** *(Cynodon dactylon)*	• Natural perennial creeping grass • Usually occurs over an average annual rainfall range of 625-1,750 mm • Tolerant to flooding and drought • Withstands fires • Withstands heavy grazing • Most nutritious when grazed every 4-5 weeks. • Can produce hay or silage when 30-40 cm tall and produces four cuttings per year.
 **African foxtail grass** *(Cenchrus ciliaris)*	• Natural perennial tufted and sometimes spreading grass • Grows in dry areas, especially on black cotton soil • Deep rooted (up to 2m) hence persistent, drought tolerant and quick response after rain • Does not survive prolonged flooding • Tolerant to fire • Tolerant to grazing pressure • Since quality rapidly declines with age, this grass should be cut at the right stage and

	fed fresh or conserved for future use or grazed at least every 8 weeks.
Red oat grass *(Themeda Triandra)*	• Natural perennial tufted grass • Grows in a wide range of soils and altitudes • Commonly grows in grasslands and open woodlands • Not tolerant to heavy continuous grazing • Tolerant to fire
 **Rhodes grass** *(Chloris gayana)*	• Ideal for planted pasture • Grows well in areas receiving 700 - 1,200 mm annual rainfall. • For broadcasting, seeds are best mixed with sawdust or fertilizer • Withstand regular cutting or grazing
 Calliandra *(Calliandra calothyrsus)*	• Planted fodder tree • High nutritive quality for ruminants • Tolerant to prolonged dry periods • Prefers sub-humid and humid climates of 650-1,500 mm and up to 3,000 mm annual rainfall • Tolerant to regular defoliation • Tolerant to fire, re-growing readily from burnt stumps

3.4.2 Concentrates

- These are feeds that supply more highly concentrated nutrients than forages.
- They contain high levels of protein or energy or both, and also some minerals.
- Concentrates include specially made feeds such as dairy meal, grains such as maize, grain by-products such as maize germ, high energy/protein feeds such as molasses and fish meal, and seed by-products such as cotton seed cake.
- Cereal grains such as maize, wheat and barley, if available and economical to feed, fall under this category.

3.4.3 Mineral supplements

These are commercially manufactured mineral supplements.

Feeding mineral mixtures

- Mineral mixture contains all the essential minerals in required quantities.
  - *Calves 20-25g daily*
  - *Heifers and dry animals 50g per animal daily*
  - *Milking animals 100-200g per animal daily*
- Helps improving growth rate in calves
- Better utilization of absorbed nutrients
- Increases milk production in animals
- Improves reproductive efficiency and reduces calving interval
- Increases productive life of animals
- Improves immunity of animals
- Prevents metabolic diseases like milk fever, which occur around calving period

3.4.4 Water

Importance of drinking water

- Helps in digestion of feed and fodder
- Distribution of absorbed nutrients to various organs
- Excretion of undesirable and toxic elements through urine
- Maintenance of body temperature.

Water requirements

- An adult healthy animal requires 75 to 80 litres of water daily.
- For every litre of milk produced, additional 2.5 litres of water is required.
- Animal should have a free access to clean drinking water.

3.5 Feed conservation

To sustain production, availability of good quality feeds all year round is essential. Feed availability dwindles during the dry seasons resulting to severe nutritional stresses for the animals. To alleviate the problem, embrace appropriate feed conservation practices.

3.5.1 Hay

Grass and legume forages can be dried and conserved as hay.

Process of hay making:

- Cut grass at start of flowering
- Wilt and dry the grass into hay
- Bale the dried hay using tractor or hay box
- Store hay safely in a shed to protect it from the sun and rain.

3.5.2 Maize stovers

After maize harvesting, the leftovers (stovers) can be used as forage during the dry season.

Tips for good maize stovers conservation

a) The leaf is the most nutritious component of maize stovers hence it is important to prevent loss of leaves in the process of conservation.

Maize ready for harvest showing high proportion of leaves

b) Maize stovers can be conserved in the field in stacks that reduce chances of penetration by rain water and direct sun heat.

Maize stovers conservation in the field for utilization by livestock

c) The bulkiness of maize stovers limits intake. Processing the stovers by grinding enhances the intake and prevents losses due to pests.

Chaff cutter used to chop maize stovers

d) Chopped stovers should be stored safely with regular inspection to monitor any spoilage e.g. mould growth or rotting

Processing and conservation of maize stovers

3.5.3 Silage

Fodder crops can be fermented and stored under anaerobic condition as silage. Green maize, fodder sorghum and Napier grass are commonly used to make silage.

Silage making process:

- The crop should be ready for harvest.
- The grains of maize at ensiling stage should be soft dough stage.
- Napier grass needs to be about a metre high (up to a man's waist)
- If there are legumes growing between the crop or bana grass, make sure the legumes have young pods.
- The area or silage pit must be clean and ready for the forage.
- If possible, a big piece of plastic should be spread out to avoid infiltration of water and air.
- The whole crop is chopped into small pieces using a chaff cutter to increase surface area.
- Place the green chop in a pit or plastic bag and ensure proper compaction.
- Seal the silage material by ensuring no air or water can penetrate.
- Silage is formed through anaerobic fermentation by microorganisms after two weeks.

- Carefully and stepwise open a small portion of the silage when need arises for feeding and seal the remaining silage immediately after the removal.

Compaction of green chop in a pit silo

Sorghum silage made in a pit

3.6 Rangelands management

- Rangelands are grasslands, shrub lands, woodlands, wetlands and deserts that are grazed by domestic livestock or wild animals.
- Rangeland management is the manipulation of rangeland components to obtain optimum combination of goods and services for society on sustainable basis.
- In East Africa, rangeland resources are plenty although they are currently poorly managed.

3.6.1 Types of rangelands

Tallgrass savannahs

Shortgrass savannahs

Desert grasslands and shrub lands

Woodlands

- Rangelands performance is highly influenced by rainfall thus availability for pastures may vary from place to place and from year to year.
- Sahiwal keepers have developed their grazing practices and patterns according to the quality and availability of available fodder and water in a way they are managing rangelands.

3.6.2 Why manage rangelands

- Ensuring the Sahiwal keepers have full access and sustainable utilization of feed and water resources in year round.
- Restoring or remediating past degradation to improve the underlying productivity of rangelands.
- Enhancing the coproduction of ecosystem services such as wildlife habitat, predators, pollinators, or endangered species of plants and animals.

Before management

After management

3.6.3 What happens if the rangelands are not managed?

- Loss of feed and water resources for Sahiwal cattle
- Loss of Sahiwal cattle due to lack of enough feed and water
- Movement of Sahiwal keepers from one place to another in search for pastures
- Conflicts and tensions between Sahiwal keepers and other land users due to Sahiwal cattle movements.

3.6.4 Ways to manage rangelands

- Bush and invasive weed control
- Over sowing/reseeding
- Protect some areas with standing hay for later use
- Fencing and paddocking
- Traditional systems (e.g. Ololili and Ngitiri)
- Rotational grazing

Bush clearing

Fencing

Cleared land for oversowing

Making strips for seedling

Sowing pasture seeds

After sowing, the looks good with enough pastures

3.6.5 Fencing rangelands

It is important to protect areas and allow animals to grazing according to plan.

Types of fences

Dead poles fence

Live poles fence

Tips for good rangelands management practices

- Rangeland management is the care of natural grazing lands
- Require planning and administering the use of rangeland to obtain maximum Sahiwal production consistent with conservation of the range resource
    - Correct number of animals (carrying capacity)
    - Correct season of grazing
    - Proper distribution of animals over a grazing land –water, salt licks, fencing and fertilization
- Know and follow land use legislations that are available
- Land ownership is critical for proper management of rangelands

4 HEALTH MANAGEMENT

4.1 Detection of sick animals

The following are some important parameters to measure health are body temperature, feeding behaviour, demeanour and change in physical activity.

a) **Body temperature**: an increase in temperature (fever) is often accompanied by shivering and rapid breathing. The body is warm to the touch. Confirmation the body temperature is done using a thermometer which is inserted into the rectum (reading is > 38.5°C)
b) **Feeding behaviour**: observe whether the animal is eating, drinking and ruminating normally. Sick animals often have a reduced appetite.
c) **Demeanour/ appearance**: a healthy animal is active, has ears erect, has a shiny, smooth hair coat and moist muzzle. The body condition is good (ribs and other skeletal structures markedly visible in a thin animal)
d) **Physical activity:** check if the animal is walking normally (raising its head and bearing weight evenly on all limbs) and moving the tail. Sick animals often isolate themselves from the herd and are dull
e) **Other parameters:** such as a sudden drop in milk production; urination and defecation (e.g. cessation, diarrhoea).

4.2 Common infectious diseases in cattle

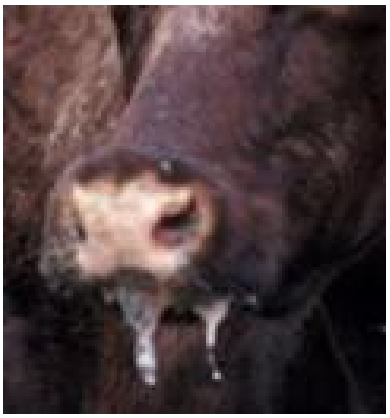
- Infectious disease of cattle are caused by virus, bacteria, fungi and sometimes parasites.
- The diseases result in reduced production, reproduction, economic losses attributed to restrictions in marketing (closure of livestock markets, quarantines and movement controls) and death in severe cases.
- Infectious disease are controlled through antibiotics treatments except those caused by viruses which have no treatment.
- Vaccination is the most effective means of disease control.
- The use of acaricides for controlling tick borne disease is also helpful although it associated with environmental (water and soil) pollution, rising cases of acaricide resistance.
- Despite this, good feeding management is advisable as properly fed animals better manage infections and diseases.
- The following infectious diseases affect the productivity of Sahiwal cattle in Kenya.
- The disease are described in the context of their cause, transmission, symptoms, prevention and control practiced.

4.2.1 Foot and mouth disease (FMD)

- This is an infectious and highly contagious disease of cattle.
- It is a notifiable disease and by law any suspected case must be reported to the nearest government veterinary authorities for necessary control actions.
- The disease spreads through contact with sick animals, contaminated structures, people or vehicles, water and feed.
- Where AI is done, cows inseminated with semen from FMD affected bulls may get infected with the disease.
- After an animal is infected with the virus, the first signs of illness usually appear within 2 to 14 days.
- The disease is quite severe in calves with affected calves diening from lesions which develop in the heart muscles as well as interferance with suckling and feeding.
- In adult cattle, FMD causes reduction in feed intakethus reducing milk production and may cause abortions in pregnant cows.

Symptoms/ Diagnosis

Foot lesion



Excess salivation

- FMD is transboundary in nature and outbreaks of the disease are associated with huge economic losses due embargoes imposed on livestock marketing due to interruptions in local, regional as well international markets.
- In most cases, movement restrictions, quarantines and closure of livestock markets are effected as a strategy to control the spread of the disease.
- The veterinary authorities once they receive a notification on suspected FMD outbreak will move in to confirm the suspicion through clinical signs and also collect samples including saliva, wound scrapping and serum for testing to confirm and serotype to know what sero-type is responsible.

- The disease is one of the most difficult cattle diseases to control.
- Vaccination is the surest means of controlling the disease although there is need to match the vaccine virus with the specific virus type associated with the outbreak.

4.2.2 Contagious bovine pleuro-pneumonia (CBPP)

- Contagious bovine pleuropneumonia (CBPP) is an infectious and highly contagious disease of cattle and is considered to be amongst the most important infectious diseases.
- The disease is also notifiable and is transboundary in nature.
- Affected animals have difficulty in breathing due to damage to the lungs, lose condition and a proportion die.
- All ages of cattle are susceptible but young cattle develop joint swellings rather than lung infections.
- Many cattle show no disease signs despite being infected (carriers) and others recover quickly after a transient mild disease.
- Infected cattle which recover from the disease remain carriers for as long as two years and may be responsible for passing on infection at a later date.

Cause and breed susceptibility

- The disease is caused by a bacterium called *Mycoplasma mycoides* var. *mycoides* which is difficult to see even with a light microscope but growth of the organism can be seen when infectious material is cultured in the laboratory.
- Cattle of all types (both *Bos taurus* and *Bos indicus*) are susceptible but domestic buffaloes are generally more resistant.
- Sheep and goats are resistant to the disease.
- There are variations in breed susceptibility in cattle with trypanotolerant breeds being more susceptible compared to the trypanosusceptible breeds.
- In cattle, the disease shows after three to six weeks but the incubation period may be as long as six months after exposure.

Transmission and spread

CBPP is introduced into a cattle herd through contact with an infected animal.
Transmission is through:

a) Direct contact
    - Close and repeated contacts between diseased and healthy animals

- Sharing of single accommodation, water, grazing, mass vaccination points, markets between healthy and sick animals in shared night accommodation or at water holes, dip will directly transmit this disease.

b) Indirect transmission from contaminated pastures and water, vehicles, people and feed sacks.

c) Aerosol route (in air) as the causative agent is present in liquid droplets in the breath and in urine. Although the CBPP organisms are killed rapidly in hot, dry environments, air-borne transmission may happen over distances up to 200 m.

Symptoms/ Diagnosis of CBPP

- Fast, difficult or noisy breathing
- Discharges from the nose or mouth
- Coughing, especially after exercise

Poor body condition

Affected on post-mortem

Prevention and control

- The disease is prevented and controlled through use of quarantines coupled with vaccination.
- In Kenya, vaccination is strictly under supervision of the DVS since the T1 44 vaccine used is reactive and causes loss of tails in vaccinated cattle and the vaccine requires cold chain which makes it very difficult to be used in the marginal areas with poor electricity connectivity thus very low vaccine coverage.
- It is also difficult to differentiate vaccinated from infected animals.

- Initially, vaccination is repeated at short intervals and thereafter done annually over several years, i.e. not less than 3 to 5 years. The test and slaughter method (stamp out) would be the most effective for eradication purposes but is shunned for the expensive compensations to the livestock keepers.

4.2.3 Anthrax

- Anthrax is an acute infectious disease of cattle and other ruminants which causes sudden death.
- The disease is notifiable and affects humans as well (zoonotic).
- Humans who come into contact with the sick or dead animals or worse still eat the meat of anthrax dead cattle become infected and may die if not quickly treated.

Cause

- Anthrax is caused by bacteria called *Bacillus anthracis*.
- This bacterium produces spores (small resistant cells).
- The bacteria forms spores when blood from an infected dead animal is exposed to air.
- The spores survive in the environment for many years.

Transmission and spread

- The bacteria which causes this disease is in soil, and therefore, cattle grazing on cattle pastures or drinking spore contaminated water will become infected.
- Direct contact between infected and healthy susceptible cattle will also spread the disease.

Symptoms/ Diagnosis

- The disease causes sudden death (in most cases within 2 or 3 hours of the animal being apparently healthy)
- In rare cases, infected animals may tremble, have high temperature and exhibit difficulties in breathing, may collapse, convulsion before death usually after a short period (within 24 hours)
- Tarry black blood oozes from orifices of dead animals like the mouth, nose, and rectum DOES NOT CLOT.
- NOTE THAT CARCASSES OF DEAD CATTLE WHERE ANTHRAX IS SUSPECTEDSHOULD NOT BE OPENED NOR POST-MORTEM CONDUCTED.
- Should the carcass be accidentally opened, the spleen will be quite enlarged.

- Laboratory confirmation can be done by obtaining a blood smear from the ear vein and thereafter Giemsa staining done to demonstrategram positive rods surrounded by a capsule around them.

Animal dies with blood oozing from mouth or nostril

Treatment

Due to the sudden onset of the disease, treatment may not be tenable although high doses of penicillin based antibiotics is quite effective in the later stages of some outbreaks.

Prevention and control

- Dead cattle must be disposed of properly
- Avoid opening the carcass as this expose the bacteria to air assisting with formation of spores
- The farm or premises where an anthrax case has been suspected should be quarantined until all susceptible animals are vaccinated.
- Vaccination against anthrax should be routinely done in endemic areas since failure to vaccinate may be risky since an outbreak can occur when non-immune cattle comes into contact with the spores.

4.2.4 Lumpy skin disease (LSD)

- Lumpy skin disease is an economically important disease which causes chronic debility in infected cattle almost comparable to that by FMD.
- The diseases appears shortly after on-set of the rains when insect vectors and other arthropod populations increase.

- The mortality rates is low but may sometimes be of up to 40 percent or more.
- The disease causes lesions which cause severe and permanent damage to hides. In addition, there may be lesions in the mouth, pharynx and respiratory tract resulting in a rapid loss of body condition and sometimes severe emaciation, which can persist for months.

Cause

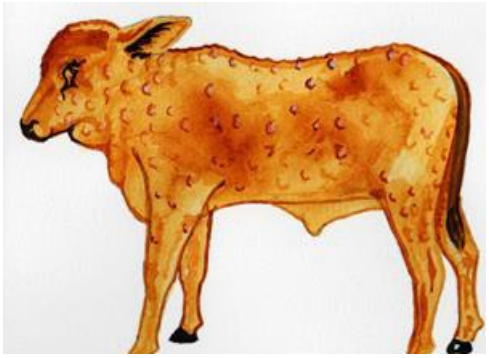
- Lumpy skin disease is caused by lumpy skin disease virus (LSDV), a virus from the family Poxviridae, genus Capri-poxvirus.
- Sheeppox virus and Goatpox virus are the two other virus species in this genus.

Transmission

- LSD transmission is mainly through biting arthropod vectors including mosquitoes (e.g. *Culex mirificens* and *Aedes natrionus*), biting flies (e.g. *Stomoxys calcitrans* and *Biomyia fasciata*) and male ticks (*Rhipicephalus appendiculatus* and *Boophilus decolaratus*).
- Although the LSD virus is produced from semen of infected bulls, sexual transmission is yet to be demonstrated.
- The role of fomites such feed and water contaminated with infected LSD virus appears plausible but has also not been demonstrated.
- Animals can also be infected with LSD virus through artificial inoculation with blood, saliva, ocular discharges or fluids from cutaneous nodules.
- Direct contact may spread the virus but only to a limited extent
- The incubation period of LSD is about 28 days although under experimental infection it may be shorter and is between 4 and 14 days.

Symptoms/ Diagnosis

- Clinical signs include fever, enlarged superficial lymph nodes and many skin nodules (2–5 cm in diameter).
- It can also cause poor body condition, reduced milk production and abortion.



Infected calf with many skin modules

Prevention and control

- Control of LSD depends on restriction of movement of cattle in infected regions
- Isolating infected animals
- Vaccination is the most effective control method
- Bury or burn (incinerate) dead animals
- Cleaning and disinfection of premises and implements are effective LSD prevention measures
- Although LSD is transmitted through biting flies, there is currently no evidence of the efficacy of vector control in preventing disease.

4.2.5 Rift valley fever

- Rift Valley fever (RVF) is an acute viral disease in domestic animals including cattle, goats and sheep and affects humans as well.
- The incubation period for RVF ranges between 2 to 6 days.
- Clinical disease in cattle is characterized by fever, severe illness, abortions, and a high morbidity and mortality rate.
- RVF is a notifiable disease.

Cause and transmission

- Rift valley fever is caused by a virus belonging to the genus *Phlebovirus* in the family Bunyaviridae.
- RVF is spread by different species of mosquitoes which are effective vectors for the RVF virus.
- Mosquitoes transmit the virus during feeding as they pick the virus from infected animals (with virus circulating in the bloodstream) and transmit it to apparently healthy animals.
- Some mosquito species like Aedes may transmit the virus from infected females to their off-springs via its eggs.
- The disease occurs during years rainfall amounts exceed the expected normal amounts which favours mosquito populations with outbreaks in Africa occurring at 5–15 year intervals.
- The 2007 outbreak in Kenya was linked to flooding in affected areas whereas that of 1998/99 coincided with heavy rains associated with *El Niño*.
-

Symptoms/diagnosis

- Occurrence of numerous abortions (abortion storm), with 80-100% pregnant animals aborting in succession and within a short period.
- High mortalities especially in young animals (20%) compared to about 10% in adults
- Nasal discharge
- Excessive salivation, and
- Loss of appetite, weakness, or diarrhoea

Prevention and control measures for RVF

- Surveillance to monitor for RVF infection in animal populations and immediate notification upon detection are essential elements for the prevention and control of RVF.
- Vector (mosquito) control population through spraying and management of mosquito breeding grounds is effective.
- Employ early warning systems to monitor variations in climatic conditions
- Vaccination using a modified live vaccine in areas where the disease is endemic is effective as it confers life-long immunity (caution do not vaccinate pregnant animals since they may abort).

4.3 Tick borne diseases (TBDS) affecting Sahiwals in Kenya

- Ticks transmit disease causing agents such as protozoa, rickettsia, bacteria or virus.
- The impact of TBDs is greatest in the tropical and subtropical regions where many tick species are found.
- The following diseases are transmitted by tick vectors.

4.3.1 East coast fever (ECF)

- East Coast fever (ECF) is a tick-borne disease (TBD) of cattle whose aetiological agent is a protozoan parasite called *Theileria parva. T. parva* is transmitted by a three-host tick called *Rhipicephalus appendiculatus.*
- The tick picks the parasite from infected cattle during feeding and passes it to apparently health but susceptible cattle.
- The disease is prevalent across the Eastern, Central, and Southern parts of Africa affecting 11 countries including Kenya, Uganda, Tanzania, Burundi, Rwanda, Malawi, Mozambique, South Sudan, Democratic Republic of Congo (DRC), Zambia and Zimbabwe.

- Approximately 50 million cattle are at risk of infection with ECF (with 10 million calves per year).
- ECF kills at least 1 million cattle per year with economic losses mostly felt in small-scale resource-poor households.
- The fatality rate for untreated ECF can be as high as 100% in cattle from non–endemic areas.
- In contrast, the morbidity rate is 100% among indigenous cattle, but the mortality rate is usually low.
- ECF has an incubation period of between 8 and 12 days with untreated cattle dying from the effects of the disease 18 to 30 days after infection.

Symptoms/ Diagnosis

- Fever (40-42^{o}C)
- Enlarged lymph nodes
- Anaemia
- Loss of appetite
- Difficulties in breathing
- Corneal opacity (cloud cornea)
- Nasal discharge which may turn to frothiness
- Nervous signs due to blockage of capillaries in the brain by infected cells
- Sometimes there is diarrhea

Dealth and frothy oral/nasal discharge

Prevention and control of ECF

In endemic areas, ECF can effectively be controlled by:

a) Controlling the tick vector through acaricides although rotational grazingmay also help.

b) Treatment with antiparasitic drugs, especially Buparvaquone (Butalex®), is effective in animals with clinical signs.
c) Success is high when treatments are commenced early.
d) Vaccination against ECF is done by simultaneously injecting virulent *T. parva* and an antibiotic (usually a long-acting tetracycline). This confers life-long immunity.

4.3.2 Bovine babesiosis (red water)

- Bovine babesiosis (BB) is a tick-borne disease of cattle caused by the protozoan parasites of the genus *Babesia*, found in blood.
- Source of infection for babesiosis is usually infected blood containing *Babesia* parasites and associated vectors of infected blood (especially ticks, but sometimes through mechanical means).
- Incubation period of babesiosis is 2 to 3 weeks or longer after tick infestation.
- Shorter incubation periods of (4–5 days for *B. bigemina* and 10 - 12 days for *B. bovis*) have been reported in the field where the parasites are artificially inoculated.

Symptoms/ Diagnosis

- High fever (about 40^{o}C)
- Ataxia (infected animals wobbles) and incoordination
- Anorexia
- Production of dark red or brown-coloured urine (thus the name red water)
- Signs of general circulatory shock
- Sometimes nervous signs associated with sequestration of infected erythrocytes in cerebral capillaries
- Anaemia and haemoglobinuria may appear later in the course of the disease
- In acute cases:maximum parasitaemia (percentage of infected erythrocytes) in circulating blood is often less than 1%.

Prevention and control of babesiosis

a) Tick control

- Use of acaricides is effective but environmental concerns, high cost of acaricides and rising cases of acaricide resistance is a challenge.
- The use of replants has also proved effective when combined with acaricides.
- Tick vaccines targeted at *Rhipiceohalus microplus* are also slowly becoming available for the control of ticks.

b) Treatment with Imidocarb (Imizol)

- The drug is available in the market and is quite effective if correctly administered to sick animals.

c) Enzootic stability

- Cattle develop a durable, long-lasting immunity after a single infection with *B. bovis*, *B. divergens or B. bigemina*, a feature that has been exploited in some countries to immunise cattle against babesiosis

d) Monitor endemic environments carefully before

- introduction of immuno-naïve animals
- introduction of new species or strains of disease agent
- interruptions in exposure to ticks and disease due tochanges in climate, host factors and management.

4.3.3 Anaplasmosis

- Bovine anaplasmosis is an infectious, noncontagious haemotropic disease of cattle caused by rickettsial parasite Anaplasma found in blood.
- The disease is reported world-wide but its effects to livestock production is more in tropical and sub-tropical regions.
- Animals surviving an acute attack often make a slow recovery, resulting in losses in milk or meat production.
- Generally, mortality is between 5 and 40%, but may reach 70 % during a severe outbreak.
- The causative agent, *Anaplasma marginale*, may be biologically transmitted by 20 or more species of ticks and may also be mechanically transmitted by a variety of biting fly species, particularly horse flies of the family Tabanidae.The incubation period of anaplsmosis is 5 to 21 days but may be shorter if the infection is experimental.

Symptoms/ Diagnosis

- Anaemia
- Fever
- Weight loss
- Breathlessness
- Jaundice (yellowing of mucous membranes)
- Uncoordinated movements
- Abortion
- Death

Prevention and control

a) Vector control

- The use of acaricides for controlling ticks and insecticides to kill biting flies is an effective control method.
- This can be combined with herd treatment with oxytetracycline injections administered every 3 to 4 weeks during high risk periods as this prevents clinical.
- The disadvantage with frequent tetracycline treatments is that animals become carriers.

b) Treatment of clinical cases

- Tetracycline is quite effective when correctly and timely administered to cattle with anaplasmosis.

4.4 Trypanosomosis

- Trypanosomosis also known as nagana is a disease of cattle caused by the protozoan parasite *Trypanosoma* found in blood of infected cattle.
- In cattle, the disease causes mortality of 50%-100% within months after exposure especially when nutrition is inadequate or other factors which cause debilitation.

Cause and transmission

- Trypanosomosis is caused by flagellate trypanosome parasites mainly *Trypanosoma congolense*, *T. vivax* and to a lesser extent *T. brucei brucei*.
- *T. brucei brucei* in humans also causes sleeping sickness.
- These three are transmitted by tsetse flies although its possible for *T. vivax* to be mechanically transmitted through biting insects like tabanids.
- Incubation period is 4 days to 8 weeks.
- Although acute cases may be seen, trypanosomosis is generally a chronic disease.

Symptoms/diagnosis

Signs include:

- Pale mucous membranes (e.g. in eye) due to anaemia
- Weakness
- Enlarged lymph nodes
- Weight loss (poor body condition)
- Infertility

- Reduced milk production

Loss of condition & weakness

Tsetse fly vector

Prevention and control

a) Vector control

The use of plain or insecticides treated traps and targets can be quite effective for area wide control of tsetse flies.

b) Treatment

- Tryoanocidal drugs can be administered to cattle for curing clinical cases (infected animals) or for prophylaxis purposes in areas with high tsetse challenge.
- Diminazene aceturate ('yellow product') is mainly used for treating clinical cases while Isometamidium chloride (the 'red product') for prophylaxis.
- However, drug resistance has been observed and undermines the use of trypanocidal drugs.

4.5 Internal parasites of cattle

- There are two types of internal parasites in cattle namely helminths and coccidia.
- There are three classes of helminths which include nematodes, trematodes and cestodes.
- Coccidia of the genus *Eimeria* cause coccidiosis in cattle.

4.5.1 Coccidiosis

Coccidiosis can cause significant economic losses since it reduces performance, can cause death from direct infections or by predisposing cattle to secondary bacterial and viral infections.

Transmission

- Coccidiosis is transmitted from animal to animal through the faecal–oral route (ingestion of contaminated feed and water).
- Infected faecal material can contaminate feed, water or soil; therefore, cattle can contract the disease by eating and drinking from contaminated sources, or by licking itself or other animals.
- Calves may become infected by nursing contaminated udders.
- The severity of clinical disease depends on the number of oocysts ingested.
- The more oocysts get ingested, the more severe the disease.
- The incubation period is approximately 17 days from the time *Eimeria* oocysts are ingested.

Symptoms

- Sick animals have acute diarrhea which may or may not be bloody.
- Reduced appetite
- Depression
- Pale mucous membranes
- Straining while defecating
- Weight loss
- Reduced growth rates
- Nervous signs in some cattle

Prevention and control

a) Prevention focuses on minimizing fecal contamination of the grazing area, feed, water and containers. Preventive measures used include:
   - Regular cleaning of water troughs/tanks particularly after introduction of new animals into the herd.
   - Clean faeces from feed bunks before each feeding.
   - Clean and disinfect holding areas between groups of cattle.
   - Drying and exposure to sunlight aids in the die-off of oocysts.
   - Avoid crowding animals
   - Reduce manure build up
   - Under intensive management, regularly change bedding material to ensure proper hygiene
   - Use coccidiostats in feed

b) Treatment
   - Treatment is possible when proper coccidistats are correctly administered.

4.5.2 Helminthosis

- Helminthosis is a major cause of mortality and sub-optimal productivity particularly in pastoral farming systems.
- The impact of gastro-intestinal helminths is high due to wider range of agro-ecological factors suitable for the survival of diversified hosts and helminth species.
- Heavy helminth infections if left untreated could be fatal to calves and small ruminants in addition to causing sub-clinical disease in adult cattle associated with lowered productivity, premature culling and making animals unsuitable as replacement breeding stock.

Transmission

- Cattle get infected with Gastro-intestinal nematodes (GiNs) through ingestion of infective larval stage 3 (L3) from contaminated pastures.
- The only exception is *Toxocara vitolorum*, whose infective stage is L2. *T. vitulorum* can also be transmitted from infected cows to their calves through milk.

Symptoms of GiNs infestation in cattle

- Weight loss
- Reduced feed intake
- Diarrhoea
- Mortality
- Reduced carcass quality
- Submandibular oedema (bottle jar) associated with blood and protein loss.
- Anaemia.

Starry coat

Prevention and control of GiNs

a) Preventive measures

These are measures which involve putting worm-free cattle on to a clean pasture, or by suppressing worm egg output by anthelmintic treatment in the early part of the grazing season, until the initial population of infective larvae on pasture has declined to safe levels.

b) Evasive measures

Evasive measures do not attempt to restrict contamination of the pasture with parasite eggs, but rely on movement of livestock to another pasture just before the larvae resulting from this contamination are likely to appear in significant numbers on the original pasture.

c) Diluting measures

This strategy exploits the concurrent grazing of susceptible animals together with a greater population of animals with acquired natural resistance to parasites of the same livestock species (generally dry adult stock), or of different livestock species, in order to reduce herbage infestation resulting from their combined faecal outputs of worm eggs.

d) Anthelmintic treatments

Anthelmintics are by far the most preferred method of helminth control although anthelmintic resistance is a cause for worry.

e) Selective dosing

This method minimizes selection pressure and slows down the rate of resistance development. One option is to use selective treatments of individual animals instead of systematic treatment of the whole herd. All new animals introduced into the herd should be treated as they may be a source of infection. Productive animals are also selectively dewormed

f) Strategic helminth treatment approach

- Strategic deworming programs are designed to prevent the accumulation of large numbers of infective larvae on pasture and to reduce the acquisition of infection by grazing animals.
- Deworm all animals in a herd only when helminth infection risk is high (high egg output).
- This strategy is not only effective but saves farmers a lot of money as it discourages the "deworm every three months" practice. Deworming

should be done a few weeks after onset of the rains and at the end of the rainy season.

g) Targeted treatments/FAMACHA

- In order to ensure animals are allowed to develop immunity to survive helminth infections and particularly the blood sucking species like *Haemonchus*, *Bunostomum* and *Oesophagostomum*, only consider deworming those animals whose FAMACHA eye score shows they are seriously anaemic.
- This strategy reduces wastage of drugs as well delay resistance development.

Trematodes in cattle

- These are large leaf-shaped flukes that are hermaphroditic, with potential for cross-and self-fertilization.
- They occur in the liver, bile ducts, blood vessels and stomach of ruminants.
- The genera *Fasciola*, represented by *Fasciola hepatica* (highland areas) and *F. gigantica* and *Dicrocelium* occur in the liver and gall bladder.
- *Schistoma bovis* occurs in blood vessels and *Paramphistomum* occurs in the stomach (stomach flukes).

Transmission

- *Fasciola* and *Paramphistomes* use the land snail as an intermediate host
- *Dicrocoelium* has two intermediate hosts; the snail and ants.

Symptoms

- Fever usually is the first symptom of the disease; 40–42 °C
- Abdominal pain
- Gastrointestinal disturbances: loss of appetite, flatulence, nausea, diarrhea
- Urticaria (reddening and itchiness on the skin)
- Respiratory symptoms (very rare): cough, dyspnoea, chest pain, hemoptysis
- Enlarged liver and spleen
- Ascites (water in the abdominal cavity)
- Anaemia.

4.6 Nutritional and management diseases

These are disease conditions which occur on the farm and in most cases are caused by improper feeding or care of the animal. They include:

4.6.1 Bloat

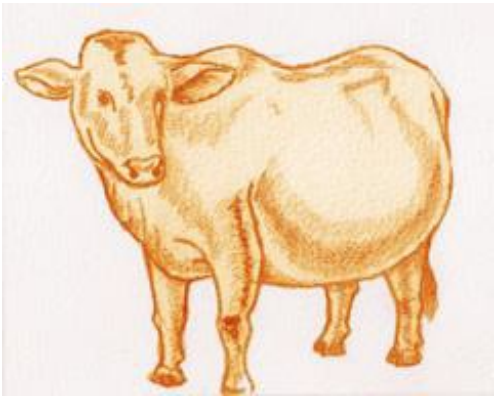
- This is a form of indigestion marked by excessive accumulation of gas in the rumen.
- Bloat causes sudden death because of the distended rumen pressing on the diaphragm which cause suffocation.
- Under normal circumstances, fermentation gases in the rumen are eliminated by eructation (belching).
- Interruption in the normal gas elimination process leads to unusual accumulation fermentation gases which makes the animal to bloat.

There are two types of bloat:

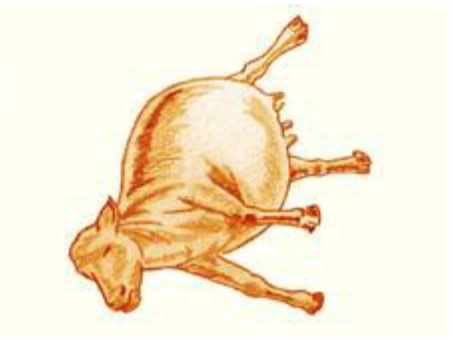
a) Free gas bloat - occurs when the oesophagus is obstructed (e.g. by solid feed such as potatoes).
b) Frothy bloat - a stable foam develops in the rumen, trapping the gas and preventing its release. This is the most common form of bloat.

Cause

- Consumption of readily fermentable diet e.g. grains
- Consumption of forage legumes like Lucerne, Clover and Alfalfa
- Feeding on rapidly growing lush pasture ingested while wet (with dew)
- Host-parasite reaction following grub treatment choking
- Enlargement of the lymph nodes between the lungs, which can compress the esophagus or interfere with the function of the vagus nerves, or
- An inherited tendency for bloat.



Distended abdomen



Death due to bloat

Prevention and control of bloat

a) Pasture management

- Avoid fast growing, clover dominant pastures
- Increase fibre intake of cattle to reduce bloating.
- Feeding grass hay daily can help to reduce the intake of 'bloaty' pasture

b) Treatment with anti-bloat chemicals

- Administer a detergent (e.g. Stop bloat) mixed with water via the mouth (i.e. drench) for frothy bloat.

c) Administer anti-bloat capsules

- Each capsule is approximately 150 mm in length and is administered as a large plastic pellet down the throat and into the rumen.
- They provide a continuous supply of ingredient for 80 - 100 days and must be given one week prior to the cattle being introduced onto 'bloaty' pasture.
- A second capsule is required if the bloat season extends beyond 100 days or if bloating occurs in your area during other times of the year.
- The capsules have been found to reduce bloat deaths by about 80%.

d) Stop bloat

This is commercial available liquid/suspension which is dispensed to the bloated animal orally.

e) Bloat blocks

- Bloat blocks or licks place minimal demands on management and so are popular with farmers.
- Several types are on the market and many contain TERIC 12A23B which is an effective detergent. Bloat control relies on each animal consuming an adequate daily dose of the block.

f) Water trough treatments

- Medication of the cattle through their water supply is another alternative.
- The addition of chemical makes the water less palatable so all other water sources must be fenced off.
- The daily dose that each animal receives depends on the amount of water consumed and the concentration of the chemical in the water.

g) Hay treatments

- Anti foaming agents may be added to the hay although many of the detergents are not very palatable.
- The addition of tallow, a tallow and bloat oil proprietary mix, or a 1:1 mixture of TERIC and molasses to the hay will provide about 12 hours of protection for those animals consuming the correct dose.
- A mechanical mixer is required to adequately coat the hay with the thick oils and tallow. Thinner oils and the TERIC mixture can be sprayed directly onto the hay).
- Surgical intervention; trocharise the rumen with a trocar and cannula or using a gauge 12 needle in free gas bloat.
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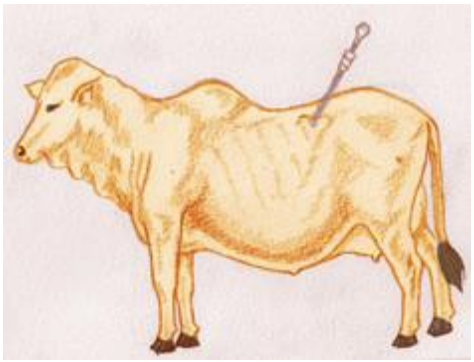


Trocharising the rumen

4.6.2 Foot rot

- Foot rot is a sub-acute or acute necrotic (decaying) infectious disease of cattle, causing swelling and lameness in at least one foot.
- This disease can cause severe lameness and decreased weight gain or milk production.

Cause

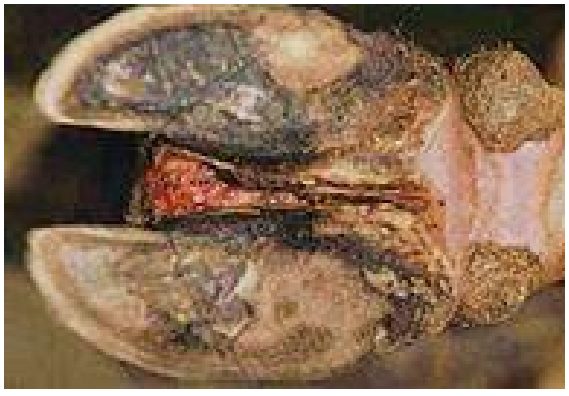
- Mechanical injury or softening and thinning of the interdigital (between the toes) skin by puncture wounds or continuous exposure to wet conditions are necessary to provide entrance points for infectious agents.
- Grazing stubble on recently mowed pasture may irritate the interdigital skin as well as standing in environments heavily contaminated with feces and urine.
- High temperatures and humidity will also cause the skin to chap and crack, leaving it susceptible to bacterial invasion.

Transmission

- Feet infected with *F. necrophorum* serve as the source of infection for other cattle by contaminating the environment.
- *F. necrophorum* can be isolated on non-diseased feet, as well as in the rumen and feces of normal cattle. *Porphyromonas levii* and *Prevotella intermedia* can also be isolated from the alimentary system of cattle.
- Once loss of skin integrity occurs, bacteria gain entrance into subcutaneous tissues and begin rapid multiplication and production of toxins, further stimulating continued bacterial multiplication and penetration of infection into the deeper structures of the foot.

Symptoms/diagnosis

- Extreme pain leading to sudden onset of lameness, which increases in severity as the disease progresses.
- Acute swelling and redness of interdigital tissues and adjacent coronary band.
- Lesions in the interdigital space are often necrotic along its edges and have a characteristic foul odour
- Evenly distributed swelling around both digits and the hairline of the hoof, leading to separation of the claws
- Fever
- Loss of appetite



Footrot infetion

Prevention

- Prevent mechanical damage to the foot caused by frozen or dried mud, brush-hogged weeds or brush stubble.
- Gravel is best.
- Reduce the time cattle must spend standing in wet areas.

- Kraal should be scraped and groomed.
- Other preventive measures used include footbaths, addition of organic and inorganic zinc to the feed or mineral mixes and vaccination.

Treatment

- First clean and examine the foot to confirm that lameness is due to foot rot.
- A topical treatment of choice such as walk the affected animal through a footbath containing 10% copper sulphateshould be applied at that time.
- Some very mild cases will respond to topical therapy only.
- Most foot rot cases require treatment using systemic antimicrobials.
- Use of a non-steroidal anti-inflammatory is helpful to relieve pain.
- Foot rot infections which does not respond to initial treatments should be re-evaluated by a veterinarian in a timely manner.
- In the more severe cases, management of the animal will be between salvaging for slaughter (following drug withdrawal times), claw amputation, or in valuable animals, claw-salvaging surgical procedures. A veterinarian will be able to provide information needed in making this decision.

4.7 Calf diarrhoea

Neonatal calf diarrhea (NCD), also known as calf scours, is a common disease which affects newborn calves. The disease occurs in the first few days after birth of the calf. The diarrhoea and other clinical signs seen are caused by:

- The interaction of several possible infectious causes and predisposing factors such as lack or inadequate intake of colostrum
- Failure to absorb colostral antibody
- Poor nutrition and environmental effects.

Cause

There are several causes of calf diarrhea. Some infectious causes include:

a) Bacterial agents

- *Salmonella*
    - Salmonellosis in calves is a common infection particularly in calves kept in confinement.
    - Signs of salmonellosis include fever, loss of appetite, depression, diarrhea, dehydration and often swelling of the leg joints
- *Escherichia coli*
    - *E. coli* is a very common and serious bacterial cause of NCD.

- NCD caused by *E. coli* is called colibacillosis.

b) Viral agents

- *Rotavirus*
  - Infection of calves with rotavirus occurs between day 1 and day after birth.
  - The disease will appear suddenly and spread rapidly through a calf herd.
  - The virus is associated with extensive damage to the intestinal mucosa resulting in rapid fluid loss and dehydration.
  - Other organisms like *E. coli* may infect the calf at this moment.

- *Coronavirus*
  - Coronavirus affects calves aged more than one week. It is not possible to differentiate this virus infection from other virus infections producing the same signs.
  - Faeces and tissues from affected calves may be submitted to a veterinary diagnostic laboratory where the virus can be identified.

Symptoms/diagnosis

The main sign is diarrhea

Prevention, treatment and control

Reduce exposure to infectious agents by:

- Keeping calves in in individual calf pens during their first month of life
- Portable calf pens have proven to be very successful
- Thoroughly clean calf pens
- Always keep the calf pens clean and dry
- Provide overhead shelter for the calf pens
- Isolate calves with diarrheal disease from healthy calves
- Thoroughly scrub and clean feeding troughs after use
- Ensure calves do not over feed on milk (restricted daily milk intake to 10% of the body weight) daily for the first 7-10 days.
- Calves should be fed on a regular schedule with fresh whole milk or good quality milk replacer. Inferior quality milk replacer can cause or contribute to diarrhea, as can overfeeding.

4.8 Reproductive and udder diseases in cattle

- Reproductive diseases affect the reproductive system of cattle (vagina, uterus and ovaries in females; penis and testes in males).
- The disease if not well managed can cause infertility and thus cause huge losses to farmers.
- Udder infections cause reduced milk production, lower the quality of milk produced.

4.8.1 Brucellosis

- Bovine brucellosis is a highly contagious bacterial disease, almost exclusively caused by *Brucella abortus* causing late term abortion (5th to 8th months of pregnancy) and infertility in cattle.
- The disease is also a serious zoonosis, causing undulant fever in humans.
- Retained placentas and reduced milk production are common features of brucellosis.
- Chronically infected animals may develop a carpal hygroma (swelling on the forelimb knee).

Cause

- The disease is caused by bacteria of the genera Brucella which spreads from the vaginal discharge of an infected cow or the aborted foetus.
- Infected bulls can also develop testicular pathology and transmit the infection during service.

Transmission

- Bovine brucellosis is transmitted from herd to herd through the movement of infected cattle.
- After abortion, large numbers of the organism are shed.
- Sometimes the bacteria may be secreted in milk throughout lactation.
- Animals become infected through ingestion of contaminated feed or water, or by licking a placenta of a cow after abortion, aborted foetus or genitalia of an infected cow especially after abortion.
- Most cows remain chronically infected.
- Urine, faeces and hygroma fluids are also sources of bacteria.
- Infected bulls may excrete the organism in their semen.
- Congenital transmission may occur through in utero infection.
- Humans are infected through handling infected cows or their tissues, or through drinking infected milk.

- Pasteurisation will prevent the latter.

Symptoms/diagnosis

- The dominant feature of the disease in cattle is abortion which usually occurs at between 5 and 8 months.
- Where infected calves are born at term, such calves die almost immediately
- Abortion rates in herds vary with 30% to 80% in fully susceptible herds although abortions may be more insidious
- Cows which abort usually have retained placenta and secondary metritis and may in some severe cases become permanently sterile.

Brucellosis control

a) Antibiotic treatment

Brucellosis cases may be treated with tetracyclines although success is varied and in most cases is not used as part of control schemes.

b) Vaccination

Vaccination should be done using live attenuated vaccines which provide good protection. However, vaccination can produce persistent antibodies, which interfere with subsequent diagnostic tests.

c) Eradication

A number of countries have successfully undertaken control programs that have led to eradication. The programs use combination of vaccination, test-and-slaughter, surveillance and abattoir trace-back. Experience has shown that vaccination should be maintained well into the advanced stages of the program to protect clean herds from serious breakdowns.

4.7.2 Mastitis

- Mastitis is the inflammation of the udder of the cow. The udder may swell and become reddened and painful.
- The milk production reduces, becomes watery with clots and sometimes pus is seen in severe cases.
- The disease is of two types: clinical form and subclinical form.
- Unlike the subclinical form which does not show any clinical signs, the clinical form is manifested by the extensive inflammation of the udder characterized by swelling, hotness, hardness and pain on touch.
- In chronic mastitis the udder may undergo necrosis and may lose function.

Cause of mastitis

- Bacteria
- Viruses
- Fungi
- Physical e.g. trauma
- Toxins
- Neoplasia

The infectious agents infect the udder particularly when the udder comes into contact with dirty environment or may be dung in contact with the udder. Dirty milking equipment, cloths for wiping the udder or even unclean milkers may also help in spread of the disease.

Symptoms/ Diagnosis

Mastitis may cause very severe sickness in affected cows. It manifests with

- Reduced yield
- Drop in temperature drop
- Vascular collapse
- Death

Prevention

- The milking area should be clean, removing manure and any rubbish.
- The milker should also wash hands prior to milking
- Use separate towel for every cow
- Ensure complete milking (stripping) of the four quarters
- Dip teats in an antiseptic after milking
- Ensure cows with mastitis are milked last.

Treatment

- Ensure a milk sample (collect a hygienic milk sample after stripping the udder to discard first few squirts of milk) is submitted to the nearest laboratory for culture, isolation and sensitivity testing of the bacterial isolate.
- Select an antibiotic formulation (intra-mammary tubes) as per the antibiotic sensitivity results and administer the drug through the teat opening after the evening milking.
- The treatment is repeated for at least three days. Before administering the drug, ensure the quarter has completely been milked.

- In some instances, it may be helpful to administer systemic antibiotics through an injection.

Mastitis control options

- Regularly screen lactating cows to detect those with subclinical mastitis and treat it before it develops to become clinical mastitis
- Cows with a history of mastitis (get mastitis repeatedly) should be culled.

4.9 Disease prevention and control options

4.9.1 Vector control

- In instances where disease causing pathogens are transmitted by vectors such as ticks and arthropods, consider vector control as the best bet since this will interrupt the transmission pathway and reduce transmission and spread of the disease.
- This involves limiting its ability to transmit disease or complete eradication.
- The methods used include control of the vector's habitat, reducing contact with the animal, chemical and biological control.

Tick control

- Tick control is done by applying acaricides on to the animals.
- The use of acaricides is under the guidance of the DVS on the basis of acaricide resistance patterns.
- Only recommended acaricides for cattle and currently synthetic pyrethroids like deltamethrin, cypermethrin, fenvalerate and fenpropathrin and the Amitraz group including Triatix®, Almatix®, Tickfix® are recommended for use in the control of ticks.
- The frequency of application of the acaricides is depended on the tick challenge although acaricide treatment in most cases is done once every week.
- Follow the instructions on the label regarding mixing with water and application.
- Application methods include Dips and Sprays with the former considered more effective.
- Some acaricides are formulated as solutions or suspensions and marketed as pour-ons or spot-ons.
- The acaricide is applied along the back line of a treated animal for it to spread and disperse over the whole body of the animal.

- Although these formulations are expensive, they have the advantage of not requiring water for reconstitution or any costly equipment for their application.
- Most pour-ons are made using synthetic pyrethroids and thus have a long residual effect and protect animals against both ticks and biting flies.
- However, it should be noted that sometimes, the pour-ons do not spread enough throughout the body surface to correctly control the ticks attached to the lower parts of the body.
- The pour-on formulation can be combined with 'push-pull' technology where repellants and attractants (chemical formulations which mimic the smell of animals) pull the ticks towards the animal.
- When ticks get attracted, they come into contact with the chemical and when they are repelled they are pushed away from the animal.
- In both instances the animal remains free of ticks.

Other non-chemical tick control methods which can be used include:

Habitat control

- Ticks thrive in conditions of high humidity, especially during the rains.
- Therefore, regularly under bush and weed control during rainy season to effectively reduce tick populations/tick challenge.
- Where land sizes are large enough, consider pasture rotation as it may help interrupt the tick life cycle.

Hand picking

This involves physical removal of ticks from the body of the animal and burn them. It is a practical method for farmers with smaller herds.

Preventing contact with alternative hosts

- These hosts include wildlife or other animals.
- Consider fencing the animal compound to reduce contact with wildlife.

Control of tsetse flies

- Controlling tsetse flies is the most desirable way of containingtrypanosomosis (nagana) in cattle.
- This can be achieved by:

Sequential aerosol technique (SAT)

- This involves the ultra-low volume spraying of non-residual insecticides 10-15 metres above tree canopy by fixed wing aircraft or helicopter (in more difficult

terrain) in 5-6 subsequent spraying cycles, separated by 16-18 days depending on temperature.

- The goal is to kill all adult tsetse flies in the first spraying cycle and then kill all emerging flies in the subsequent cycles before they start reproducing. Insecticide application occurs during periods of temperature inversion, i.e. at night.

Stationary attractive devices (traps and targets)

Target

Collection chamber in trap

- Stationary attractive devices (SADs) attract and either kill the flies through tarsal contact with insecticides embedded in the fabric or the flies are guided and trapped in a non-return cage.
- The method exerts an additional daily mortality of 2-3% to the female segment of the fly population.
- In order to be effective, the SADs can also be combined with 'push-pull' technology where repellants and attractants (chemical formulations which mimic the smell of animals) to attract tsetse flies to the insecticide treated targets for them to be killed or repel them.

Tsetse trap

Live bait technique

- This method involves the application of insecticide onto cattle as pour-ons, sprays or dips so that tsetse flies attempting to feed on the treated cattle get killed on picking up a lethal deposit of the insecticide through their tarsi and pre-tarsi.
- This can also be combined with push-pull technology for maximum effectiveness.

Sterile insect technique (SIT)

- The SIT is used if the objective is tsetse eradication and was successfully used in the island of Zanzibar to eradicate the fly.
- First, suppress tsetse density through the widespread application of insecticide treated SADs, live baits or fly trapping before deploying SIT to mop out residual flies.
- Irradiate male flies to sterilize them and release in the target area where compete with the wild male population for wild females.
- Mating of the sterile males with virgin, native females results in no offspring.
- SIT is non-intrusive to the environment, has no adverse effects on non-target organisms, is species-specific and can easily be integrated with biological control methods such as parasitoids, predators and pathogens.

4.9.2 Vaccination

- Vaccination is the process of administering a vaccine to stimulate development of immunity against diseases.

- The immunity may be in the form of antibodies or it is cell mediated.
- Usually, the impact of vaccination is better felt when a boost is done soon after the first jab.
- Vaccine handling is important as all conventional vaccines must be stored and handled at temperatures not exceeding 8^{o}C (cold chain dependent).
- The vaccine coverage is thus low particularly in the marginalized areas of the country where cold chain vaccine handling is difficult due to the poorly developed electricity and road networks.
- This notwithstanding, the place of vaccines in the control of infectious animal diseases is assured since challenges associated with antibiotic treatments like antibiotic residues in animal products (milk and meat) and antimicrobial resistance are on the rise.

4.9.3 Use of drugs

Drugs can be used for treating sick animals or for prophylaxis purposes. In most cases the use drugs is the most preferred by farmers. However, this method has challenges related to:

- Unintentionally introducing drug residues in animal products (meat and milk) which is public health hazard
- Drug resistance-the over-reliance on drugs increases chances of pathogens developing resistance as has been reported for antimicrobials, anthelmintics and trypanocidal drugs.
- In order to minimize this, promote rational use of drugs where drug treatments must justified.

4.9.4 Breeding for disease tolerance

- Certain breeds like Orma boran can survive, reproduce and remain productive under trypanosomosis risk with minimal trypanocidal drug treatment requirements.
- This can be exploited by introgressing the trypanotolerant traits into the Sahiwal cattle for it to survive in areas where tsetse challenge is high.

Tips and recommendations in Sahiwal health

- Keen observation of your cows is important for early detection of disease
- Foot and mouth disease, though not fatal in adult cattle, will affect weight gain and milk production, resulting in economic losses
- An animal with poor body condition is a sign of presence of disease including contagious bovine pleuro-pneumonia (CBPP), trypanosomosis and helminthosis
- Laboratory examination of blood samples from affected cattle is important to differentiate between babesiosis, anaplasmosis and trypanosomosis
- Routine management procedures like regular deworming, preventive measures against Mastitis, and use of footbaths to prevent foot rot, will help in the overall well-being of the animal
- Abortions in cattle can be due to a disease like Brucellosis

5 ROUTINE MANAGEMENT

5.1 Milk handling and hygiene

Milk is highly perishable and a favorable media pathogens to thrive. It has a high protein content making it a suitable medium for bacteria growth. For these reasons clean milk production practices are inevitable. It is advisable that farmers observe the following areas in order to produce clean and quality milk for human consumption.

5.1.1 The lactating cow

The cow produces milk for human consumption. The following are key points to note about a lactating cow:

- Ensure that lactating cows are in good health and should be free from zoonotic diseases e.g. brucellosis and tuberculosis
- Ensure that udder health is maintained to minimize mastitis which not only reduces milk production but lowers the quality of milk
- It is important to observe drug withdrawal periods for lactating cows under treatment
- Feed should not be contaminated with microbial agents or mycotoxins as these may affect the quality of milk produced and transmit foodborne diseases to consumers
- Ensure milking cows are not fed on feeds, pastures or weeds that may cause milk tainting and cause off-flavours (bad odour in milk) like high levels of fish meal or poultry droppings
- Milking cows should be provided with clean water ad-lib to drink.

5.1.2 Milk shed hygiene

The milking parlour (dairy) is another important area which if not well cleaned can compromise the quality of milk produced. The following are key considerations for keeping the milk parlour hygienic:

- The milking shed should have a cemented floor for ease of cleaning and disinfection
- It should be cleaned after every milking
- The shed should be well ventilated to ensure free circulation of air to minimize chances of it producing bad smell (odour)
- There should be a regular supply for potable water for cleaning
- Construct feed troughs for supplementary feeding during milking.

5.1.3 Milking utensils

The utensils used for milk influence the quality of milk produced. Therefore milking utensils selection is critical. The following must be considered while selecting milking utensils:

- Ensure utensils made of aluminium or stainless steel are used for milking as they are easy to wash and do not taint the quality of milk
- Clean by first rinsing the excess milk with cold water followed by washing using hot water plus detergents (soap), scrubbing with a good washing material or brush before rinsing with cold water and placing them on rack (facing down) to dry (the rack should be in an open place where direct sunlight can reach)
- Ensure utensils are cleaned soon after milking
- Utensils store should be clean and well ventilated.

5.1.4 The milker

Milkers can impact on the final quality of milk produced. Therefore, it is important that milkers be:

- Healthy-milkers should regularly undergo medical check-ups to be screened for presence of disease like tuberculosis, salmonellosis, typhoid and other foodborne illness which can easily be transmitted to milk consumers
- Maintain short nails and hair (for ladies with long hair should cover it when milking)
- Ensure the milker washers his hands with soap (detergents) and warm clean water before milking
- Do not smoke during milking as this is a risk factor for someone to be infected with milk borne disease such as brucellosis
- Be able to detect and differentiate abnormal from normal milk.

5.1.5 Milking process

- Clean the udder and wipe with a clean cloth/paper towel before milking (advisable to have a towel for every animal)
- Check for mastitis with a strip cap or any test kit
- Milking should be done quickly and efficiently without interruptions
- Ensure all milk is stripped from the udder of the animal to avoid mastitis
- Do not pull the teats but squeeze them
- Apply milking jelly (salve) on teats to soften them and reduce risk of cracks which can be entry points for mastitis causing bacteria.

- Dip the teats in iodine solution immediately after milking and before releasing the animal
- Always milk the healthy animals first while those with mastitis and other diseases later (do not mix clean milk with contaminated milk).

5.1.6 Milk handling

- How milk is handled after milking will determine its quality, safety for consumers and duration of storage without it going bad
- Sieve milk using a clean muslin cloth and sieve to remove physical contaminants like cow hair, dust and other insoluble particles (Note: thoroughly wash these materials and dry after every milking period)
- Store milk in a clean cold room (under refrigeration) if not sold or transported immediately
- Milk for household consumption should be boiled immediately before storing it under refrigeration
- Milk for sale should be chilled immediately to avoid enhanced multiplication of bacteria.

5.2 Farm structures

These structures are used for sheltering animals, restraining animals, paddocking and feed storage, among other uses. The design and other requirements of a structure are dependent on the operations for which for which the structure is intended. Common farm structures include:

- Boma
- Calf pens
- Crushes
- Milking shed
- Feed store
- Dip
- Fences
- Bore holes

5.3 Castration

Bull calves which are not meant for breeding purposes are castrated soon after birth. Such animals are raised to become steers for beef production. Castration is meant to ensure the animal loses its ability to produce sperm cells for fertilizing eggs.

Castration therefore involves total removal of both testicles or the testicles are left in place but blood supply cut off for them to become necrotic and eventually regress.

5.3.1 Castration methods

Elastic band castration

- Elastic band castration cuts off blood supply to the testicles and in the process makes the testicles to lose their normal function of sperm production.
- Specialized rubber band elastrators are used in elastic band castration.
- The rubber bands are fitted on the elastrator before applying it on to the neck of the scrotum.
- Restrain the animal well before the procedure is undertaken.
- The procedure does not require anesthesia.
- The target is for the applied rubber band to squeeze the spermatic cord which has the testicular artery and vein and thus cut off blood supply to the scrotum and testicles, which will totally decay and slough off within a few weeks.
- Care must be taken during the procedure to ensure that both testicles are fully descended and properly located inside the scrotum, and that the animal's nipples are not included within the ring.
- Elastration is normally limited to castrations done during the first few weeks of life.
- The elastrator band is most reliable for calves less than three weeks of age.

NB. Vaccination to protect against tetanus and blackleg is recommended.

Burdizzo clamps

- Castration procedure is undertaken using a special tool called a burdizzo which has a large clamp designed to break the blood vessels supplying the testicles.
- Once the blood supply to the testicles is cut off, testicular necrosis occurs, and the testicles shrink, soften, and eventually deteriorate completely.
- When the device is used, the operator crushes the spermatic cords one at a time, leaving a space in between in order to prevent an interruption of blood-flow to the scrotum.
- Good restraint is essential because the Burdizzo must be in place about 10 seconds to crush the artery.
- The jaws must be parallel and close uniformly across their width so pressure will be evenly distributed across their length.

Surgical (open) castration

- Surgical or open castration is the most certain method of castration because the testicles are removed completely.
- Surgical castration can be performed on any age calf.
- The procedure is conducted after administering local anesthesia to minimize pain at the surgical area.
- Sedation may be helpful during surgical castration.
- Each section of scrotum is slit at the base to expose the testis.
- The exposed testis is gently pulled to expose the spermatic cord which is ligated (tied) in two sections approximately 2 centimetres a part before cutting with a scalpel blade.
- If surgical castration is done well, bleeding is minimal.
- Surgical castration should be undertaken during the dry season to reduce chances of contamination and also the chance of flies laying their eggs in the surgical wound to hatch into larvae which may complicate healing.

Chemical castration methods

- Chemical castration includes injection of sclerosing or toxic agents (e.g. 88% lactic acid) into the testicular parenchyma to cause irreparable damage and loss of function.
- Chemical castration requires additional procedural time and technical skill, and takes longer to heal compared with surgical castration.

Hormonal castration (immune-castration)

- This castration procedure is performed by injecting immune-contraceptives to induce antibody production against gonadotropin releasing hormone (GnRH), resulting in decreased production of endogenous hormones.
- Male animals castrated using this method have been shown to have increased live weight, high carcass weight, average daily gain, and dressing percentage compared with surgical methods.
- Although testosterone production is reduced for approximately 6 months after immune-castration, persistent mounting behavior, consumer concerns and the need for repeat injections have made the technique less effective and desirable than traditional, physical methods.

Castration complications

Potential complications associated with castration include hemorrhage, excessive swelling or oedema, infection, poor wound healing, and failure. Use of the Burdizzo

clamp may be associated with a higher failure rate, most likely caused by operator error.

5.4 Dehorning

Dehorning entails the removal of the horn and horn-producing tissue after horns have formed from the bud. Debudding is the process of destroying the horn-producing cells of the horn bud using a chemical or hot-iron. This is done for calves below the age of two months.

Animals are dehorned for the following reasons:

- Reduce the risk of traumatic injury or bruising other animals in the herd
- Minimize chances of slaughter animals getting bruised by horned cattle during transport to slaughter and thus reason for trimming of bruised carcass parts causing financial losses
- Require less space at the feed bunk and in transit
- Decreases risk of injury to farm workers
- Produce docile cattle that are easier to handle
- Decrease aggressiveness at the feed bunk
- Facilitate easier use of handling facilities.

5.4.1 Dehorning methods

Hot iron dehorning

- Hot iron dehorners are available in versions heated by a furnace or fire.
- The head of the iron is a hollow circle molded to fit over the horn bud.
- Proper application of the hot iron will destroy the horn-producing skin at the base of the horn.
- This technique works well for calves up to 12 weeks old.

Dehorning spoon or tube

- Dehorning spoons or tubes provide a quick and efficient technique for removing horn buds in calves less than eight weeks of age.
- This method involves cutting the skin using a sharpened metal tube to remove the horn-producing skin at the base of the horn bud.
- It is recommended to use the proper sized tube to remove the horn plus about 1/8 inch of skin around the entire horn bud.

Scoop, gouge or barnes-type dehorner

- Scoop dehorners are used for dehorning calves of age ranging from 2 to 4 months using horns up to four inches (10 cm) long.

- Some operators claim better dehorning with a rectangular-shaped scoop because it removes an even ring of skin around and with the horn bud. This require confirmation.

5.5 Hoof trimming

Hoof trimming is done because of the following reasons:

- Prevent uneven over-growth of hoofs so that an animal may walk squarely on feet
- Prevent the weakness of limbs and possible lameness due to overgrown long mis-sharpen hoofs
- Prevents foot rot
- Minimize chances of the affected animal inflicting injury to itself or other animals in the herd
- Reduce risk of lameness which lead to premature culling.

Hoof trimming procedure is undertaken using a dehorning wire, a hoof trimmer, hoof knife and shear. It is important to note that not all cattle which are examined will require trimming, as over-trimming can result in greater incidence of lameness.

5.6 Records keeping

Farm records are kept for the following reasons:

- Keep track of all animals on the farm
- Helps to plan breeding thus reducing chances of inbreeding
- Records can assist while doing selection of animals with the right characteristics for breeding to improve the herd
- To rationalize labour
- Helps in feed planning and management
- Helps in disease management and keeping track about treatment
- Finding the effective treatment
- To assess profitability/losses
- Improves bargaining power on products
- Credit/loan access.

5.6.1 Identification records

- A good identification method should be cheap, clearly visible from a distance (able to be read at a distance) and preferably be permanent

- Identification of animals is usually done through use of numbering, by marking of the animal and by description of certain characteristics of the animal or taking photos.
- Tattooing, branding, ear-notching, punching and tagging are the most common identification methods

5.6.2 Breeding records

The importance of breeding records is to measure the productive efficiency of the herd and to enable selection. Important breeding records include:

- Pedigree/parentage (identification of parents and grandparents)
- Fertility (dates of all services)
- Birth details (dates of birth, sex of calf)

5.6.3 Production records

These records are useful in measuring the performance of the animals and the herd. Among important production records kept on a farm include:

- Daily milk yield
- Lactation length
- Milk fed to calves
- Milk consumed at home
- Milk sold
- Spoilt milk which is discarded
- Birth weight
- Weaning weight
- Age of heifers at first service
- Weight at first service
- Culling and sale weights

5.6.4 Feeding records

These record capture the type, quantity and quality of feed given to cattle. Feeding records should be used for most day-to-day management, evaluating pasture management practices and for planning of activities in the future. Feeding records include:

- Available fodder on farm
- Quantity fed
- Concentrate(s) used for supplementation
- Minerals.

5.6.5 Health and treatment records

Health and treatment records are necessary to keep track of the diseases reported on the farm over a period of time. These records provide information about the health status of each individual animal and on the whole herd. The records also help to ensure important vaccinations are given at the right time. The following are some of the disease and treatment records kept:

- Disease occurrence and date
- All handling to cure diseases (also non chemical treatment)
- Vaccination
- Dipping/spraying
- Treatment
- De-worming
- Postmortem

5.6.6 Financial Records

The records of the costs and earnings related to the animal farming are kept for cash analysis and enterprise appraisal (See annex 4).

6 MARKETING AND VALUE ADDITION

6.1 Marketing

- Market demand and preferences have profound influence on the type, amount and quality of livestock and livestock products supplied.
- Ensuring proper hygiene and standards is crucial particularly in production, handling and processing of Sahiwal cattle and related products to match and tap into the available lucrative markets.
- The following are some of the Sahiwal products available for sale: live breeding animals live animals for beef, milk, hides, manure and biofuels.

Tips: Sahiwal marketing and value addition

- Sahiwal Live animals
- Sahiwal cattle products
- Sahiwal processed [products
- Market information
- Innovative communication pathways
- Sahiwal cattle transport requirements
- Types of Sahiwal live cattle markets

6.2 Breeding animals

- Farmers purchase Sahiwal bulls for breeding purposes.
- Preference is for animals from known breeders as opposed to buying breeding animals from the markets.
- Animals sourced from the market may not be good for breeding as many of them are culls.

6.3 Value addition

6.3.1 Value added to live Sahiwal animal

Value addition initiatives done on the Sahiwal breed include:

- Identification for traceability purposes
- Breed registration
- Enlisting with livestock insurance schemes
- Proper finishing practices for the animal to meet the market demands.

6.3.2 Milk value addition

- The milk produced by Sahiwal cattle can be directly consumed as a nutritious beverage which is served in different forms (fresh boiled milk, milk mixed in tea or other beverages or cooked in vegetables and fish) according to the taste and preference of the consumer preferences.
- The Milk should be produced and handled hygienically to enhance safety of the consumer.
- Value addition initiatives like processing raw milk to produce sour milk, '*Mtindi*', which is a favourable beverage to many consumers all over the East African region.
- It is recommended that pasteurization and other forms of heat treatment be done during the processing to eliminate foodborne microbial pathogens as well as zoonotic ones like *Mycobacterium bovis*, *M. tuberculosis* and *Brucella abortus* which may be contained in the milk before fermentation of milk for consumption.
- Yoghurt, sweetened sour milk can also be processed with different flavours such as pineapple, vanilla, strawberry and passion according to the consumer taste and preference.
- Other value addition products which can be obtained from Sahiwal milk include butter, cheese and ghee which are sold for more money compared to the raw milk.
- Processing also increases the shelf life of milk and milk products.

Ghee

- Good quality ghee making requires clean and quality butter made from Sahiwal cow milk.

Sahiwal homede Ghee

- Ghee has a long shelf life and can be stored at room temperature for a few days.
- However, avoid using wet spoons while scooping ghee as they may accelerate the rate of spoilage of the product.

6.3.3 Sahiwal meat

- Sahiwal breed is one of the cattle kept for commercial beef production.
- Under optimal management, the breed outperforms the local small East African zebu breed in terms of carcass weight.
- Farmers therefore stand a better chance of enhancing their earnings by adopting this breed for beef production.
- Sahiwal cattle reared for beef under the free grazing system not only delay off-take (animal attain market weight at about 5 to 6 years) but also produces poor quality beef which is very fibrous and tough.
- It is therefore important for farmers to consider finishing systems where animals are fed with nutritious finisher rations to enhance their growth and weight gain for early off-take.
- Feedlot farming for beef cattle has the advantage of increasing earnings for pastoralists, reducing grazing pressure on the rangelands, reducing the effects of climate change and reducing cattle rustling.

Slaughtered and processed Sahiwal Beef for sales

Meat with spice

- Beef from Sahiwal has an even fat cover and thus lean and is acceptable by many consumers.
- Observing hygienic processing, handling, packaging and branding is crucial for safe beef thus reducing foodborne as well as zoonotic diseases.
- Traceability system involving the use of electronic chips in the ears of the animal is critical; a value addition initiative as it enables trace back in case of any issues associated with beef fold in the markets or even cattle rustling.
- After slaughter, beef from Sahiwal cattle can be consumed directly after roasting or cooking although the returns are however low.
- There exists the opportunity for value addition where beef could be processed into canned beef, sausages and corn beef whose final market value is higher than that of raw beef.
- At the cottage industry level, drying of beef in the sun or smoking makes it very tasty increases the shelf life.
- Drying and smoking should be hygienic.
- Blood collected at slaughter may also be cooked and served as a cultural food consumed in combination with meat.
- The blood can also be used to make blood sausage or thick soup for home consumption and for commercial use.

Dried beef chops increases shelf life

6.3.4 Hides

- After slaughtering healthy Sahiwals, their hides is processed into leather for producing items like shoes, bags, belts among other with high value.
- Producing a good and full sized hide is dependent on ensuring proper slaughtering, dressing, treatment and preservation procedure are followed.

6.3.5 Manure

- Manure produced by the Sahiwal cattle is important for crop production.
- Crops fertilized by manure not only attain faster maturity but perform better than those which are not planted with manure.
- Additionally, manure not only nourish the soil but also reduces over-reliance on inorganic fertilizers which are costly, get washed into water bodies and impact negatively on marine life.
- Dung from Sahiwal cattle can be heaped together to cure before being used for planting crops.
- However, there are concerns of greenhouse gas (GHG) emissions.
- Using dung to produce biogas reduces GHG emissions since gases like methane are transformed into CO_2 during cooking.
- After the biogas is produced, the residual waste can be used as manure with less risk to climate.

6.3.6 Biofuels value addition

- The dung from Sahiwal can be used for biogas production which can help in powering household operations like cooking, lighting homes and also warming water for bathing and laundry purposes.

Biogas plant using dung

- Although the initial investment for biogas plants is heavy, the benefits of this energy source far outweigh the cost considerations.
- It should be noted that biogas production is one way of mitigating GHG emissions and has positive environmental effects in that respect.
- Further, biogas will reduces the burden on women, reduce over reliance on charcoal and firewood thus reduce deforestation, pollution and generally contribute to environmental conservation.

6.3.7 Market information

Access to market information is crucial for farmers with interest in keeping Sahiwal cattle breed. The information can be shared using information, communication and technology (ICT) platforms usually through mobile apps. The information sought will include:

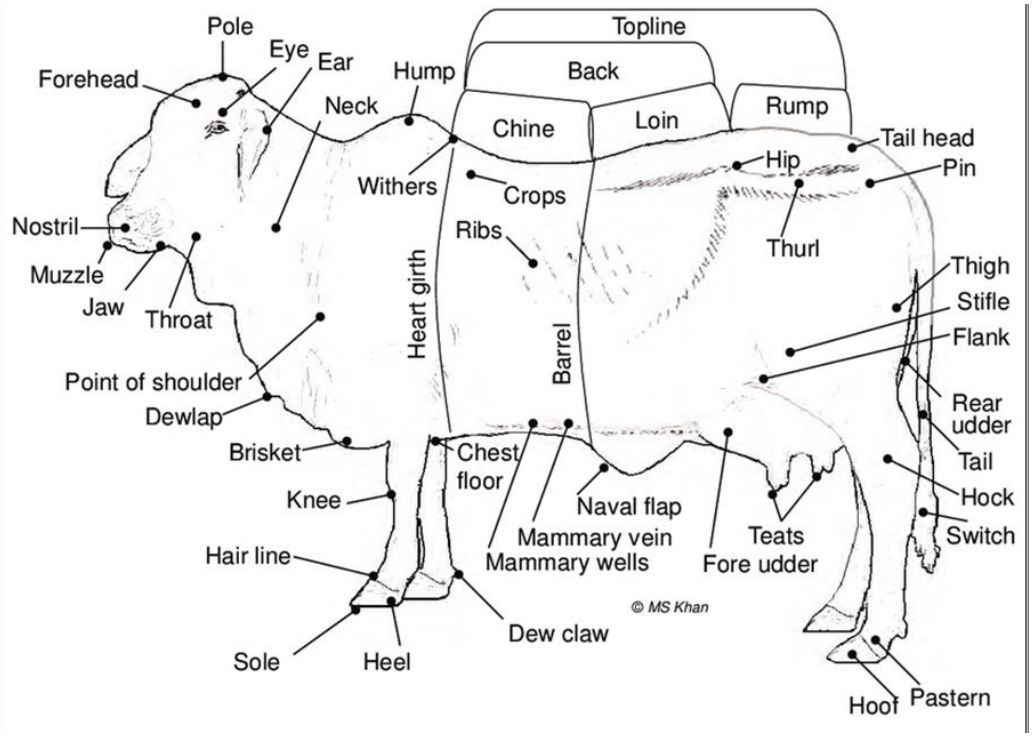
- Identification of markets
- Prevailing prices
- Availability of cattle for breeding and slaughter
- Sahiwal cattle grades applicable
- Animal health checks
- Licensing
- Permits
- Auction dates
- Quarantine information.

Innovative communication pathways which are ICT based and enabled by the mobile cell phones has the following advantages:

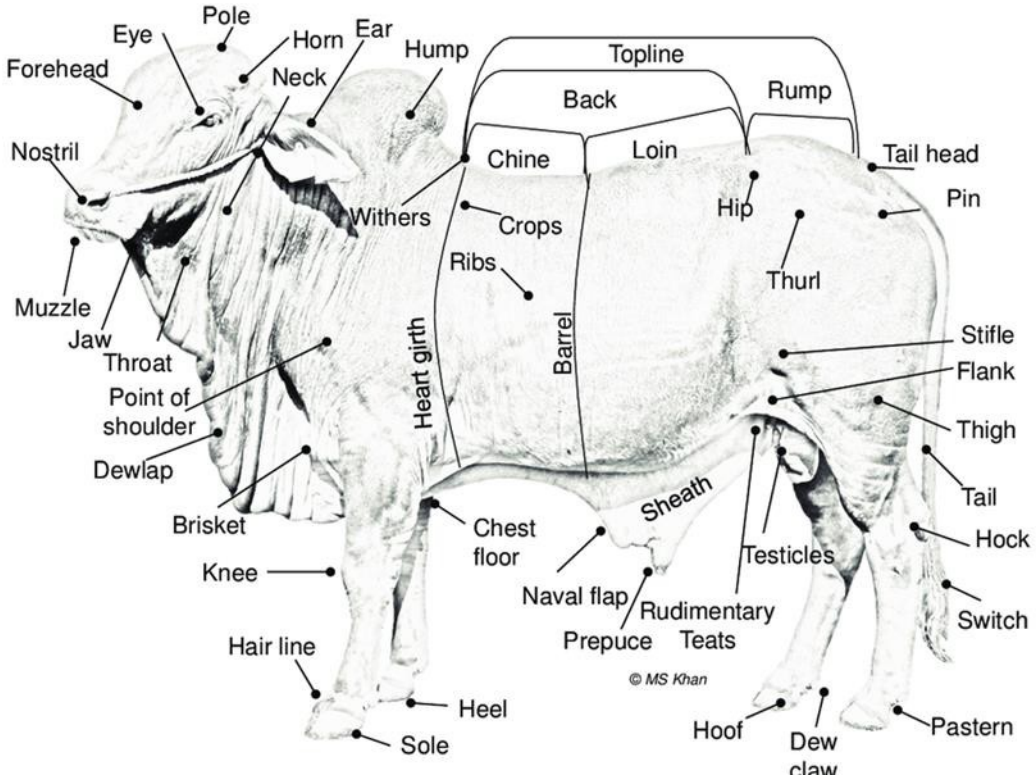
- Market exploration and negotiations become easy
- Promote Sahiwal and its products
- Increases interaction with many buyers of Sahiwal and related products
- Facilitates access to mobile financial transactions like M-Pesa Service
- Saves time and cost on the market exploration
- Enables to consult many buyers more quickly
- Increases bargaining power and price assurance
- Searching for stolen cattle becomes easier
- Facilitates traceability in case of any concerns

7 ANNEXES

Annex 1. Parts of a Sahiwal cow



Annex 2. Parts of a Sahiwal bull



Annex 3. Key breed standards of the Sahiwal cattle

Characteristic	Description
Coat colour	**Desirable:** Reddish brown to chestnut. **Permissible:** Slightly mottled white spots on underline.
Skin	Pigmented.
Head	**Bull**: Masculine, alert, straight and broad. **Cow:** Feminine, calm and alert.
Ears	Long, drooping, pointed and with black hair on the fringe.
Hump	Well developed in cervico-thoracic position.
Backline	Broad and level.
Rump	Broad, slightly rounded on top, fairly long with moderate front to rear slope.
Hind quarters and thigh	Broad, long and flat when viewed from the rear. Muscles clearly defined in bulls. Smooth in the case of cows.
Tail and tail setting	Smooth insertion well to the rear, the tail must hang down perpendicularly and must have a well developed switch.
Legs and hooves	Well-set, strong sound legs and feet, darkly pigmented hooves.
Udder and teats	Well-attached medium-sized milky udder, teats not too large or small and should be well-pigmented.
Sheaths	Normal, neatly attached, well-closed sheath opening with a good sphincter.
Testicles	Good size and held in scrotum with a clearly defined neck to scrotum.
Body conformation	**Bulls**: Bull symmetrically balanced with defined muscles. Deep in front but well–muscled in hind quarters. Good length of body, well-sprung ribs, good strong legs. **Cows**: Lean in neck and shoulders, well-developed hind quarters, slightly drooping rump.

Annex 4: Templates for some livestock records

1. Calf management and disease control records sheet

Calf identification Number			**Sire Number**	
Date of birth			Dam Number	
Sex				
	Kg	Date	Remarks	date
Birth weight			1st insemination	
Weaning weight			2nd insemination	
Age and breeding weight			Calving Date	
Average pre weaning growth rate (grams)			Bull used	
Average post weaning growth rate (grams)				
Body condition score			Vaccinations	

2. Cow cards for planned fertility management

Cow No.				
Last calving date	**Date of vet examination**	**Examination remarks e.g. pregnancy diagnosis**	**Service date**	**Expected calving date**

3. Disease occurrence and treatment record sheet

Date	Animal no.	Kind of disease	Treatment	Remarks

5. Vaccination records for planned disease control

Date	Vaccination	Quantity (Units)	Remarks

6. Deworming records for planned disease control

Date	Deworming	Dewormer and quantity	Remarks