A GUIDING MANUAL FOR ESTABLISHING A DISEASE -FREE ZONE (FOR RED MEAT PRODUCTION)

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Foreword

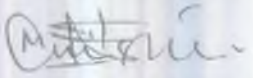
Agriculture continues to be among the key development agenda of the government of Ethiopia. In the present GTPII period, one of the four strategic issues set to achieve the higher level objectives of the agricultural development sector is increasing livestock production and productivity. To this effect, the Ethiopia's agriculture sector policy and investment framework (PIF) document clearly shows that the milestone idicators for growth in livestock production and productivity are set at 8% and 4%, respectively.

Ethiopia claims to have 57 million heads of cattle herds while its annual beef carcass weight equivalent production has not exceeded 385.9 thousand metric ton. In contrast, Australia keeps almost half of the Ethiopia's population (28.8 million heads of cattle herds) and is able to produce 2.3 million metric ton of carcass annually. These facts vividly show that there is a long way to go to modernize livestock production in Ethiopia and enhance its productivity to become competitive in domestic and export markets. Such a process requires to rely on sustainable supply and use of improved livestock technologies. Therefore, there is a need to intensify the existing livestock technology generation process by integrating the conventional and the new bioscience research approaches.

Recently, a roadmap document was prepared by the Policy Study and Research Center of Ethiopia to guide the country's move towards modernization of meat animal development and research. Following the roadmap, an implementation plan was prepared for improving Begayit cattle breed of Tigrai Region in particular. Series of consultative meetings were conducted with the facilitation of the Ethiopian Agricultural Research Council Secretariat and in the process the regional state of Tigrai has shown its keen interest to support the initiative for its implementation. To this effect, a memorandum of understanding was signed between Tigrai Agricultural Research Institute (TARI), Ethiopian Institute of Agricultural Research (EIAR) and Ethiopian Agricultural Research Council Secretariat (EARCS) to jointly work for the implementation of the initiative.

It is felt necessary to follow an integrated multidisciplinary approach for enhancing improvement of Begait cattle breed by establishing nucleus herd at Maiweyni Ranch in Humera area. To guide the implementation of Begait cattle breed improvement program, there is a need to prepare technical manual in each discipline (animal breeding and genetics, animal reproductive biotechnology, animal feeds and nutrition and animal health) that helps the undertakings to follow standard scientific principles and procedures. Hence, this manual is prepared to guide animal health related services required for establishing and maintaining a disease free zone in Humera area along with the intended Begait cattle breed improvement program.

MekuriaTadesse (PhD)



Chief Coordinator of EARCS

Acknowledgement

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1 Introduction

Although there is an on-going structural transformation in the Ethiopian economy, predominantly from agriculture to services, agriculture still comprises 45 percent of total output and continues to dominate employment. Within the agricultural sector, the livestock subsector plays a decisive role in the overall economy and serves as a source of draught power, food, income and social status. For instance, in the year 2009, the livestock subsector contributed up to 20% of the national gross domestic product (GDP) and 45% of the agricultural GDP (Behnke, 2010). Ethiopia is endowed with 56.7 million cattle, 29.3 million sheep, 29.11 million Goats, 2.03 million horses, 7.43 million donkeys, 0.4 million mules, 1.16 million camels, 56.87 million poultry and different types of fish resources (CSA, 2015). Considering the number and diversity of livestock resources it has and a rapidly growing economy, the livestock industry is expected to serve as a new source of income for the national economy. Furthermore, due to its geographical proximity to many markets, its ground and air transport infrastructure that directly connects to many niche markets, the country's livestock production potential, attractive government export policies, and even the growing trend of global meat consumption, has huge opportunities for livestock and livestock products export.

Despite its potential, due to the fact that livestock are reared for subsistence in traditional low input/low output extensive small-scale production systems, the production, processing and marketing systems haven't been improved. The traditional livestock production systems of the country which is devoid of proper animal health policies, strategies, and regulatory enforcement mechanisms; have become an opportunity for animal diseases to become rampant and widespread throughout the country. Animal diseases directly affect livestock production with consequences for food security and food safety, trade, rural development, and the environment, while also affecting the livelihood of farmers (EC, 2012). In addition to production loss, public health risks and environmental impacts, endemic livestock diseases such as foot and mouth disease (FMD), contagious bovine pleuropneumonia (CBPP), lumpy skin disease (LSD) and many others has prohibited Ethiopia from access to lucrative international livestock and livestock product markets, including the European Union. Furthermore, even the existed trade with Middle East countries is frequently hampered and embargo is sometimes imposed (AGP-LMD, 2013b) . Furthermore, in addition to existing export bottlenecks, the country is not even self-secured in food.

To fulfill the existed and forecasted global as well as domestic animal and animal product market demand, modernization of the livestock production systems is considered as the most critical component of the ongoing and future agricultural transformation agendas of the country. As part of the growth and transformation plan (GTP) of the country; the then Ministry of Livestock and Fisheries (MoLF) has developed a Livestock Master Plan and Second Growth and Transformation Plan (GTPII) for livestock, and the Ethiopian Policy Study and Research Center has also developed Ethiopian Meat Animals' Production System Modernization Roadmap. All of these government working documents have clearly indicated the potential intervention options to transform the livestock industry. Consequently, the recently developed Ethiopian Meat Animals Production System Modernization Roadmap has given due emphasis for modernizing the production system of meat animals, especially ruminants (ስዩም et al., 2017). The goal of this road map is to produce a quality meat that can fulfil the safety and quality standards of the World

Trade Organization (WTO), which are usually set by the Office International des Epizooties/Epizootics (OIE). To enter and remain competitive in the international meat trade like the European meat market, one of the prerequisites indicated by OIE is establishment and sustaining of a disease-free zone or compartment. Furthermore, the established disease-free zone has to get certification (on disease by disease bases) from OIE. In addition to the disease-free zone certification, OIE also assess and certifies other safety and animal husbandry related issues. Generally, in the current world trade environment, the capacity to demonstrate freedom from disease is a crucial component in maintaining an export trade in livestock products.

To this end, as there hasn't been any documented attempts in Ethiopia to produce animal and animal products as per the WTO standards in general and establishment of a disease-free zone in particular, its presumed that the existed technical knowledge and information on disease free zoning in the country is minimal. And hence. this manual is prepared to assist experts in establishing and maintaining disease-free zones in selected parts of the country.

2 Principles for defining and establishing disease free zone or compartment

Based on the WTO sanitary and phytosanitary (SPS) agreement (WTO, 2017), before trade in animals or their products may occur, an importing country needs to be satisfied that its animal health status will be appropriately protected. In most cases, the import regulations developed by the importing country rely in part on judgements made about the effectiveness of sanitary procedures undertaken by the exporting country, both at its borders and within its territory. This is usually done by OIE using scientific principles. To access international meat trade, a country, in part or entirely, has to be disease free. Disease free in this context implies the absence of specific disease that has implications on trade, rather than free from an entire set of animal diseases.

However, given the difficulty of establishing and maintaining a disease-free status for an entire country, especially for diseases the entry of which is difficult to control through measures at national boundaries, OIE recommends establishing and maintaining a subpopulation with a distinct health status within a country. Subpopulations may be separated by natural or artificial geographical barriers or, in certain situations, by the application of appropriate management practices. For the purpose of disease control and/or international trade, Zoning and compartmentalization are procedures recommended by OIE. While zoning applies to an animal subpopulation defined primarily on a geographical basis (using natural, artificial or legal boundaries), compartmentalization applies to an animal subpopulation defined primarily by management and husbandry practices related to biosecurity (OIE, 2017). In practice, spatial considerations and good management including biosecurity plans play important roles in the application of both concepts. A particular application of the concept of zoning is the establishment of a containment zone. In the event of limited outbreaks of a specified disease within an otherwise free country or zone, a single containment zone, which includes all cases, can be established for the purpose of minimizing the impact on the entire country or zone. Zoning and compartmentalization cannot be applied to all diseases but separate requirements will be developed for each disease for which the application of zoning or compartmentalization is considered appropriate.

As well as contributing to the safety of international trade, zoning and compartmentalization may assist disease control or eradication within a country. Zoning may encourage the more efficient use of resources within certain parts of a country and compartmentalization may allow the functional separation of a subpopulation from other domestic animals or wild animals through biosecurity measures, which a zone (through geographical separation) would not achieve. Following a disease outbreak, the use of compartmentalization may allow a country to take advantage of epidemiological links among subpopulations or common practices relating to biosecurity, despite diverse geographical locations, to facilitate disease control and/or the continuation of trade.

The exporting country should be able to demonstrate, through detailed documentation provided to the importing country, that it has implemented the recommendations in the OIE Terrestrial Code for establishing and maintaining such a zone or compartment. The procedures used to establish and maintain the distinct animal health status of a zone or compartment depends on the epidemiology of the disease, in particular the presence and role of susceptible wildlife species, and environmental factors, as well as on the application of biosecurity measures. The authority, organization and infrastructure of the Veterinary Services, including laboratories, should be clearly documented in accordance with the evaluation of Veterinary Services of the Terrestrial Code (OIE, 2017)- to provide confidence in the integrity of the zone or compartment. The final authority of the zone or compartment, for the purposes of domestic and international trade, depends on the Veterinary Authority.

The exporting country should conduct an assessment of the resources needed and available to establish and maintain a zone or compartment for international trade purposes. These include the human and financial resources, and the technical capability of the Veterinary Services (and of the relevant industry and production system, in the case of a compartment) including disease surveillance and diagnosis.

Biosecurity and surveillance are essential components of zoning and compartmentalization, and the arrangements should be developed through cooperation of public and private sectors that are directly or indirectly engaged in animal health services. The type of the private sector responsibilities may include the application of biosecurity measures, documenting and recording movements of animals and personnel, quality assurance schemes, monitoring the efficacy of the measures, documenting corrective actions, conducting surveillance, rapid reporting and maintenance of records in a readily accessible form. Whereas, the government veterinary Services should provide movement certification, carry out documented periodic inspections of infrastructure and facilities, biosecurity measures, records and surveillance procedures. In addition, the Veterinary Services should conduct or audit surveillance, reporting and laboratory diagnostic examinations.

During defining a zone or a compartment, OIE (2017) recommends to follow and

1. The extent of a *zone* and its geographical limits should be established by the *Veterinary Authority* on the basis of natural, artificial and/or legal boundaries, and made public through official channels.

2. A *protection zone (buffer zone)* may be established to preserve the health status of *animals* in a free *zone*, from adjacent countries or *zones* of different *animal health status*. Measures should be implemented based on the epidemiology of the *disease* under consideration to prevent introduction of the pathogenic agent and to ensure early detection. These measures should include intensified movement control and *surveillance* such as:
   a. *animal identification* and *traceability* to ensure that *animals* in the *protection zone* are clearly distinguishable from other populations;
   b. *vaccination* of all or at-risk susceptible *animals*;
   c. testing and/or *vaccination* of *animals* moved;
   d. implementing specific procedures for sample collection, handling, sending and testing;
   e. enhanced *biosecurity* including cleansing – *disinfection* procedures for transport means, and possible compulsory routes;
   f. specific *surveillance* of susceptible *wildlife* species and relevant *vectors*;
   g. awareness campaigns to the public or targeted at breeders, traders, hunters, *veterinarians*. The application of these measures can be in the entire free *zone* or in a defined area within and/or outside the free *zone like buffer zone*.

3. In the event of limited *outbreaks* in a *zone* previously free of a *disease*, a *containment zone* may be established *(explained in section 3.1.4)* for the purposes of trade. Establishment of a *containment zone* should be based on a rapid response including: -
   - ✓ appropriate standstill of movement of *animals* and other *commodities* upon notification of suspicion of the specified *disease* and the demonstration that the *outbreaks* are contained within this zone through epidemiological investigation (trace-back, trace-forward) after confirmation of *infection*. The primary *outbreak* has been identified and investigations on the likely source of the *outbreak* have been carried out and all *cases* shown to be epidemiologically linked.
   - ✓ A *stamping-out policy* or another effective control strategy aimed at eradicating the *disease* should be applied and the susceptible animal population within the *containment zones* should be clearly identifiable as belonging to the *containment zone*. Increased passive and targeted *surveillance* in accordance with OIE recommendations in the rest of the *zone* should be carried out and has not detected any evidence of *infection*.
   - ✓ Measures consistent with the *disease*-specific chapter of OIE terrestrial code should be in place to prevent spread of the *infection* from the *containment zone* to the rest of the country or *zone*, including ongoing *surveillance* in the *containment zone*.
   - ✓ For the effective establishment of a *containment zone*, it is necessary to demonstrate that there have been no new *cases* in the *containment zone* within a minimum of two *incubation periods* from the last detected *case*.
   - ✓ The free status of the areas outside the *containment zone* would be suspended pending the establishment of the *containment zone*. The free status of these areas could be reinstated, once the *containment zone* is clearly established, irrespective of the provisions of the *disease*-specific chapter of OIE terrestrial code.
   - ✓ The *containment zone* should be managed in such a way that it can be demonstrated that *animals and their products destined for international trade* can be shown to have originated outside the *containment zone*.
   - ✓ The recovery of the free status of the *containment zone* should follow the provisions of the *disease*-specific chapter of OIE terrestrial code.

4. *Animals* and *herds* belonging to such *subpopulations* need to be recognizable as such through a clear epidemiological separation from other *animals* and all things presenting a *disease risk*. For a *zone* or *compartment*, the *Veterinary Authority* should document in detail the measures taken to ensure the identification of the *subpopulation* and the establishment and maintenance of its health status through a *biosecurity plan*. The measures used to establish and maintain the distinct *animal health status* of a *zone* or *compartment* should be appropriate to the particular circumstances, and will depend on the epidemiology of the *disease*, environmental factors, the health status of *animals* in adjacent areas, applicable *biosecurity* measures (including movement controls, use of natural and artificial boundaries, the spatial separation of *animals*, and commercial management and husbandry practices), and *surveillance*.
5. Relevant *animals* within the *zone* or *compartment* should be identified in such a way that their movements are traceable. Depending on the system of production, identification may be done at the *herd*, *flock* lot or individual animal level. Relevant animal movements into and out of the *zone* or *compartment* should be well documented and controlled. The existence of a valid *animal identification system* is a prerequisite to assess the integrity of the *zone* or *compartment*.
6. For a *compartment*, the *biosecurity plan* should describe the partnership between the relevant private sector (or any other stakeholder) and the *Veterinary Authority*, and their respective responsibilities. It should also describe the routine operating procedures to provide clear evidence that the *surveillance* conducted, the live *animal identification* and *traceability* system, and the management practices are adequate to meet the definition of the *compartment*. In addition to information on animal movement controls, the plan should include *herd* or *flock* production records, feed sources, *surveillance* results, birth and *death* records, visitor logbook, morbidity and mortality history, medications, *vaccinations*, documentation of training of relevant personnel and any other criteria necessary for evaluation of *risk* mitigation.

Generally, the information required may vary in accordance with the species and *disease(s)* under consideration. The *biosecurity plan* should also describe how the measures will be audited to ensure that the *risks* are regularly re-assessed and the measures adjusted accordingly.

3 Specific tasks required for establishing and sustaining disease-free zones

The World Trade Organization recognizes OIE as the international agency for setting animal health standards for conducting international trade. The OIE maintains a list of "transmissible diseases" (http://www.oie.int/en/animal-health-in-the-world/oie-listed-diseases-2017/). that the disease list divides the diseases of concern by host (e.g., multiple species, sheep and goats, cattle, equine, swine, bees, fish, mollusks, crustaceans, and rabbits). Inclusion criteria covers four considerations: potential for international spread, significant spread within naïve populations, zoonotic potential, and emerging diseases. Accordingly, specific diseases, based on their impact, are targeted for zoning and/or compartmentalization and some of the critical tasks required to establish and maintain such a zone or compartment are indicated as follows.

3.1 Establishing livestock biosecurity system

As biological security, or "biosecurity," is not easy to define and elicits a variety of interpretations, it is important to clearly define the context in which the term is used in this manual. In this manual, the term biosecurity is defined as a broad set of preventive measures designed and implemented to reduce the risk of transmission of infectious agents, toxins, quarantined pests/pathogens, invasive alien species, and living modified organisms. In simple words, biosecurity is protecting the economy, environment and people's health from pests and disease. It includes trying to prevent new pests and diseases from arriving, and helping to control outbreaks when they do occur.

biosecurity plan addresses the risks associated with diseases and pests by focusing on three key actions (1) Exclude: Prevent the introduction of pathogens to a zone or farms. (2) Manage: Prevent the spread of pathogens among livestock within a farm or between zones/communities. (3) Contain: Prevent the spread of pathogens between farms or from farms to other animal populations. To establish and maintain a disease-free zone with in a country, there must be a practical biosecurity plan that focuses on different levels of implementation. In the absence of disease, a biosecurity plan is a form of insurance. The levels of implementation of biosecurity includes but not limited to national, regional, zonal and at farms levels.

3.1.1 National biosecurity plan

To prevent the introduction of infectious animal diseases in to the country/delineated free zone, a national biosecurity plan should be developed and implemented accordingly. Before developing a national biosecurity plan, the risks associated to Ethiopia, the existed and forecasted situation of diseases at national and international level has to be reviewed and documented. Moreover, based on the findings of risk analysis and other related scenarios, a national biosecurity plan could be developed. For developing a national biosecurity plan, considerations like:

- Existed situation on animal movement controls, condition of national borders
- Disease status of neighboring countries
- Trends in the global Emergence (re-emergence) of infectious animal diseases and also
- The global, regional and national Political, social and economic dynamics should be taken into account.

The National biosecurity plan should also explain the framework and scope of biosecurity planning in the Ethiopian livestock industry. It should also be intended for use by individuals and groups who need to understand the direction of the industry to:

- enable the consistent adoption of biosecurity practices in all regions of the country
- adopt a structured approach in planning, implementation, performance measurement, and continuous improvement through innovation
- support the efforts of livestock producers by designing programs that interface and coordinate with on-farm biosecurity practices
- coordinate activities among livestock industries; and
- communicate with Ethiopia's trading partners.

3.1.2 The farm biosecurity plan

Pathogens can enter to a livestock enterprise in various ways, described as biosecurity risk entry pathways (Table1.). It is important that producers have a good understanding of these pathways in order to apply protocols that minimize risk. Based on these pathways and also consistent to the national biosecurity plan, each farm must have a biosecurity plan. In order for a farm to develop a biosecurity plan, specific disease risks for their operation must be identified.

For nearly all diseases there is a relationship between exposure dose and severity of disease (virulence of the pathogen). By decreasing the animal's exposure dose through cleanliness, good nutrition, decreased stress and proper vaccinations, there is less risk for the animals getting sick which helps justify the cost of implementing biosecurity risk management. It is important to remember that many different solutions exist and because all animal facilities are different, there is not a one-size-fits-all answer.

The biosecurity risk entry pathways for a livestock industry is summarized by Kahn and Cottle (2014) in Table 1.

Table 1. Farm biosecurity risk entry pathways

Route	Risk explanation
Family and friends	must not be considered low risk
Visitors	may have been in contact with infected livestock in other parts of the country or even abroad
Farm staff	may keep livestock and other animals at home
Livestock agent	highly likely to have been in contact with livestock
Tradesmen and brokers	highly likely to have been in contact with livestock
Animal	
introduced livestock	may carry disease acquired at farm of origin, at the market or during transit from contacting infected animals or contaminated equipment
neighboring livestock and other animals	contact through permeable fences, windborne aerosol spread over short distance, comingling of stray stock
wild birds	wild birds can carry or transmit viruses to feed, water or cattle holding areas
sick and dead livestock	may be a source of disease
wild animals	includes dogs, cats, wild pigs, buffalo etc.
rodents	rodents can carry or transmit pathogens to feed, water or stock holding areas
pets	pets that move freely in and out of farm area can carry disease
flies and other insects	flies and other insects may carry pathogens
Inorganic	
Borrowed farm equipment	farm equipment can be heavily contaminated with organic materials such as dirt, manure, and plant material
market equipment such as trailers, prodders and flappers	equipment returning from sale yards, abattoirs, markets is high risk
vehicles including motorbikes, farm utility vehicles, stock transport trucks including Knackery trucks	lower risk but large amount of organic material can be carried on wheels and wheel wells
organic	
surface water	dams, ponds, channels, swamps, creeks, rivers, lakes may be contaminated by viruses and bacteria from neighboring or upstream livestock and other species
farm manure	moisture, split and uneaten feeds and organic material may be attractive to flies, birds, rodents etc. that can carry disease
Introduced feed	non-processed feeds carry greater risk of virus, bacterial and fungal contamination
contaminated feed	open bags in non-scavenger proof storage are high as are unprocessed feeds because, unlike pellets, they have not been heat treated and stored.

These biosecurity risk entry pathways should be considered during preparing farm biosecurity plans. More specifically, during farm biosecurity plan development, the following six basic biosecurity risk management aspects that can be applied at pre-entry, at the point of entry to a farm and post-entry should be addressed. These aspects are:

Barriers: - Barriers can be physical, such as fences, or procedural, such as having specific protocols for the introduction or induction of new livestock on to a farm. Boundary fences in particular must be well maintained and suitable for the livestock both on the farm and on the neighboring farms. Signs at the front gate should clearly describe what biosecurity protocols are in place on the farm. Signs should include homestead or mobile telephone numbers or other communication systems so visitors can easily contact producers without having to enter the property. There should be vehicle wheel dips, regularly filled with appropriate disinfectant, at front gates. Ideally there would also be a washdown bay at the front gate for removal of mud, dust and animal waste from the wheels and inside of trucks. Entrance roads should be well fenced so that visitors are restricted as to what they can access and the producer has control over all visitor vehicle movement.

Resistance: -Increasing the resistance of the herd to disease is a very useful biosecurity technique. This is usually a post-entry procedure and is done using basic husbandry practices like appropriate vaccination of all animals, and good nutrition so that animals are not stressed and therefore immuno-compromised and susceptible to disease. Parasites must be well controlled at induction on to the farm and then at regular intervals during the life of the animals. Paddocks (if any) need to be managed to minimize parasite burdens and the risk of re-infection of animals. Low stress handling and appropriate handling facilities all contribute to decreasing the stress load on animals and this has obvious health benefits.

Introduction: - New staff should be well trained and have a good understanding of animal handling and biosecurity. Providing staff with a simple biosecurity manual is one easy way of mitigating the risks associated with new people. Day to day, visitors should adhere strictly to biosecurity protocols. There should be only one entry point to the farm, designated visitor parking and signage so visitors know what is expected of them before they enter the property. Visitors should always wear clean clothes and have washed their hands and boots before coming on to the property. Where feasible, new stock should be purchased only from reputable, biosecurity-conscious suppliers, where their animals are identified and traced. Important information regarding livestock history is transferred through the supply chain to the end consumer so that they can be assured of the safety and quality of their red meat. In these circumstances, careful introduction and quarantine of new animals is vital. New animals should not be mixed for at least two weeks with animals already on the farm.

Dimensions: - When risk controls are being planned and implemented, advantage should be taken of time, distance and gravity to enhance biosecurity. 'Time' is associated with periods of quarantine. The principle is that a quarantine period may allow the numbers of pathogens to decline over time. 'Distance' allows for the separation of things such as farms, sheds or age groups of animals. Separating sources of pathogens is often more effective with increasing distance. 'Gravity' reduces exposure of livestock grazing on high

ground or housed in sheds to pathogens that might be carried into herds and flocks by movement of water or soil.

Load: - A pathogen load always exists on a farm. Minimizing that load is an important aspect of management, and an 'all-in all-out' system makes that management easier. In other words, any group of animals is treated as a distinct unit, and is not mixed with any other group at any time or for any reason, whether in the introduction phase on to the farm, for the duration of the group's life on the farm, or when the group is taken away from the farm. Controlling the pathogen load starts as soon as any group of animals arrives on the farm, with the application of good hygiene and sanitation practices (e.g. composting/disposal of quarantine pen feces and bedding), good vaccination protocols, immediate identification and isolation for treatment of sick animals, and removal of dead animals.

Monitoring: - This is a key step in managing biosecurity risk. The early detection of disease and pathogens is the best way to minimize pathogen build-up on the farm and to contain the spread of disease. Daily checks of animals, particularly if they are intensively farmed, are vital. Sick animals should be immediately removed, isolated and treated in separate pens and if a contagious disease is suspected then the herd or mob of origin should be quarantined until no more cases are detected. Veterinary advice on how best to treat and manage sick animals should be sought.

In order to prevent disease, spread on farm, awareness of where animals are located and minimizing contact with them is important. If animal contact is necessary, wear protective gear that can be removed and cleaned to minimize disease spread. When moving between animal groups, change any soiled protective clothing, especially if the health status of the groups are different (different age, different vaccination status), and wash and disinfect (or dispose of) protective footwear. Equipment used with different groups of animals should be treated the same way – clean/disinfect or dispose if appropriate. Trash that is generated on farm should be left on farm to minimize spread to other operations. If vehicles or equipment become soiled, wash and disinfect soiled surfaces before leaving the farm, again to minimize spread to other operations.

Animals may carry disease organisms that can cause disease in humans – referred to as zoonotic diseases. It is important to protect yourself while working with animals, or in the environment of animals, to decrease the risk of becoming ill. Protective outer clothing (coveralls, water-resistant barriers), footwear (cleanable or disposable) and gloves will protect your skin from contacting disease organisms from an animal or the environment. Zoonotic disease organisms can be carried on clothing and footwear and should not be worn away from the animal facility to minimize the spread of disease to family members (especially children and the elderly). Gloves should be worn when working with sick animals or those that you are unaware of their health status (infected animals do not always appear sick). Wearing gloves does not replace good hand washing habits- wash hands in warm water and soap after removing gloves, soiled outerwear and footwear.

Effective quarantine and movement control are also essential elements for preventing further spread of a disease agent from farm to farm. Movement control, in the form of a permit system,

allows otherwise uninvolved entities to continue necessary movements to maintain operations. Quarantine of susceptible animals, potentially contaminated products and conveyances, and the like prevents the dissemination of the disease agent and increases the speed and likelihood of successful disease eradication.

Properly implemented, biosecurity during an outbreak is imperative because it reduces the risk of transmission during the movement of personnel and material necessary for the extensive activities of the control and eradication campaign. Moreover, biosecurity measures should not only be limited to disease outbreaks or disease incidents. In principle as well as in practice, biosecurity measures should be applied at different stages of risk mitigation points. That is, based on an existed or speculated disease risks, there should be a national, regional, zonal and farm level biosecurity plans. All biosecurity plans should be prepared based on the ecology of an area, nature and type of a disease and existed potential risk factors. Furthermore, all biosecurity plans should be accompanied by strict decontamination and disinfection procedures.

3.1.3 Animal quarantine laws and statutes

For the proper implementation of biosecurity plans, there must be policy and legal frameworks and tools that are practicable enough to enforce the enacted laws and regulations. such tools may include, but not limited to, quarantines and health certificate requirements. Currently, quarantine is practiced only for live animals destined for export this duty is usually given to the federal veterinary authority but there should also be a means to implement at regional and/or zonal levels through the delegation of powers or any other means. In Ethiopia, there is no any quarantine practice that is applied to disease outbreak management and/ or any other domestic activities. But for establishing and maintaining a disease-free zone, regulatory frameworks and their enforcement mechanisms for animal quarantine and also animal movement controls should be put in place. The power to declare a quarantine should include the power to go onto private land and buildings to inspect for diseased animals and, if necessary, seize them. Also, if required, quarantine authorities should also be empowered, following proper procedures-to destroy diseased animals when necessary. Legal provision should exist for paying the owner a compensation (based on an assessment of a certain compensation value criterion) of the destroyed animal.

Effective quarantine and movement control are essential elements for preventing further spread of a disease agent. Movement control, in the form of a permit system, allows otherwise uninvolved entities to continue necessary movements to maintain operations. Quarantine of susceptible animals, potentially contaminated products and conveyances, and the like prevents the dissemination of the disease agent and increases the speed and likelihood of successful eradication. The details of Implementation of quarantines and the administration of a permit system for movement control should be described in the national livestock biosecurity plan and also in the region's animal health Emergency Response Plans. The federal veterinary authority should impose a federal quarantine on interregional issues from the infected region(s) and should also request the infected and adjoining regional (or country, if regional borders are also international borders with neighboring countries) to provide resources to enforce the quarantine. For its proper execution, quarantine implementation modalities between the regional governments and federal agencies and/ or ministries has to be formulated.

Its recommended that, regional quarantines should be placed on individual herds, flocks, or premises when a TAD is suspected and the federal quarantine should be maintained until the disease is either eradicated or until such time as an effective CA smaller than a whole region is implemented. In the absence of a declared emergency, federal quarantines should be used to control inter region and international movement of diseased animals and contaminated items, whereas regional quarantines could be used to control intraregional movement of such animals and items. In some instances, if deemed necessary, an extraordinary emergency may also be declared by the federal veterinary authority, allowing federal officials to have authority to control livestock movement within a region.

Movement control

Movement control refers to activities regulating the movement of people, animals, animal products, vehicles, and equipment based on certain criteria (determined by the disease agent suspected or confirmed). Movement control also involves record-keeping of a person, vehicle, or animal movement. These control measures should be established within 12 hours of a presumptive positive or confirmed positive report. The affected premises are defined as having at least one animal that is classified as having a presumptive positive or confirmed positive case of the disease in question. Practices related to the control of movement of people, animals, vehicles, and equipment are critical to the maintenance of biosecurity during a disease outbreak or other animal emergency. Examples of practices involving movement controls include maintaining a closed herd or flock, identifying animals, keeping accurate records, and protecting animals from contact with wildlife. Movement of people (including owners, family members, employees, and visitors) is also considered a major biosecurity risk. All routine movement for services such as feed and manure removal as well as equipment on and off of the premises should include biosecurity measures. To avoid some spills, load of trucks should be covered properly and routes passing other susceptible species should be minimized or avoided.

Depopulation and culling

Euthanasia of animals must be performed as rapidly and humanely as possible. Considerations must be given to owners, caretakers, and their families during this process. It is the responsibility of the responders to ensure that, when performing euthanasia on an animal, it is done with the highest degree of respect and emphasis on making the death as painless and free of stress as possible. If an TAD is confirmed, then depopulation (or culling) is likely to be ordered by the veterinarian in charge. Depopulation (culling) protocols include plans for the IPs, contact-exposed premises, and contiguous premises. Proper destruction of all exposed cadavers, litter, and animal products is required.

Carcass disposal

Many significant considerations pertain to animal carcass disposal, including animal health regulatory response, decontamination, environmental issues, and public relations. Each concern, if inadequately addressed by decision makers before, during, or after a carcass disposal event, can yield long-term consequences. Carcass disposal activities can result in detrimental effects on the environment. Factors affecting the impact on the environment include the disposal approach,

type and number of carcasses, site-specific properties of the location, and weather. A situation resulting in many animal deaths causes significant public concern; disposal of carcasses on a large scale is likely to causes public dismay and apprehension. Animal carcasses may be buried in a trench or at a landfill. Environmental considerations are obviously associated with these two methods. In addition, removal of infected carcasses to a landfill site may violate the movement orders in place to limit the geographic spread of disease. Animal carcasses may be incinerated as a method of disposal. To safe guard the environment and the public from un intended consequences, a carcass disposal law should be enacted and imposed.

3.2 Establishing and maintaining a disease-free zone

To establish a disease-free zone, the primary task is delineating the boundaries of the area intended for zoning i.e., identifying the boundaries of the free zone, buffer zone, surveillance zone and infected zone (figure 1). Delineating the boundaries of the free zone and its surrounding areas should be based on the disease risk analysis studies. Once the intended zones are identified and delineated, the next steps are: -

- identify and implement means of zonal segregation like establishment of physical or any other barrier to separate each of the identified zones (see figure.1),
- identify trespassing check point sites and animal, human and material traffic control points with in the buffer zone.
- Develop a zonal biosecurity plan i.e., based on the existing situation of the zones.
- establish an incident command post that manages and controls any disease incidents with in and around the zone.
- Develop a zonal coordination task force for the continual public awareness creation and harmonized resources mobilization.

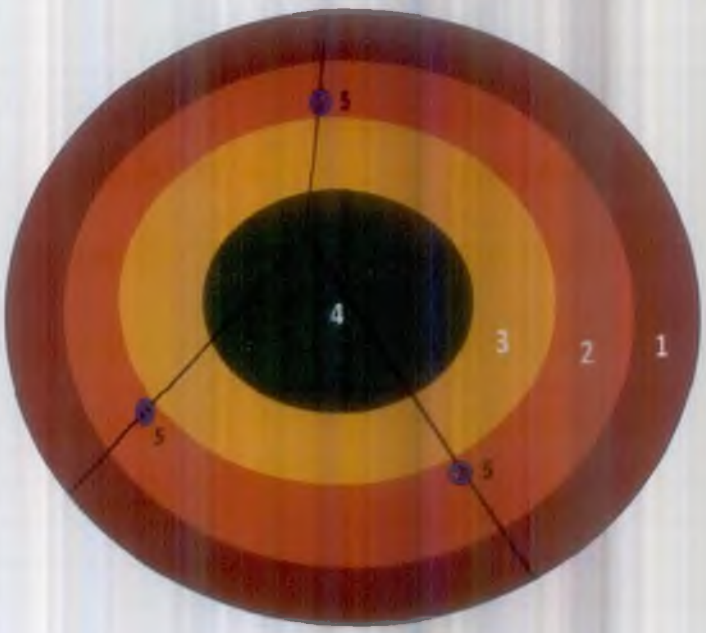

Figure 1. A systematic representation of disease free zone and its surrounding areas. The zones can be classified as-1) infected zone 2) buffer surveillance zone 3) surveillance zone 4) free zone and 5) a quarantine site for animals entering to the free zone. The width and breadth each zone could be described based on the epidemiology of the disease of interest, ecology of the area and other means.

3.2.1 Controlling a disease outbreak with in a disease-free/buffer zone

To maintain a disease-free zone; during an outbreak of a disease in addition to the existed routine biosecurity measures, the following measures should be taken immediately, without any delay.

A. ***Enhance the existed biosecurity measures:*** - During an outbreak, enhanced biosecurity measures should be implemented at the perimeter and within the control area. Facilities such as processing plants, slaughter plants, rendering operations, feed mills, and veterinary laboratories should be considered high risk. These high-traffic facilities should have truck-washing stations at entry and exit points to minimize disease spread from affected to unaffected premises in the area.

B. ***Movement restrictions:*** - Movement restriction is a key component to disease containment. When movement restrictions are in place, the incident commander should institute a system of movement permits to allow movement of equipment and personnel from one premise or control zone to another. These permits should only be issued when:
   - No animal on the premise of origin has shown clinical signs for two or more incubation periods.
   - No susceptible animals were added to the premise of origin within two or more incubation periods.

- Clinical inspection of susceptible species was conducted within 24 hours before movement and animals were found free of clinical signs of the disease of concern.
- Transport conveyances meet acceptable biosecurity standards.

No susceptible animal species or products posing a risk of disease transmission may leave the infected zone unless they (1) are going directly to be slaughtered at an approved slaughter facility established in the buffer-surveillance zone, (2) are going directly to a processing facility in the buffer-surveillance zone, or (3) meet the criteria described on a permit. No materials posing risk of disease transmission may leave the infected zone except by permit. Non-susceptible species are subject to normal movement control and may be allowed to move with a permit under specified conditions as prescribed by the incident commander.

C. ***Control measures (Area, Zone, and Premises Designations):*** - The designation of one or more control areas and various zones is essential for effective quarantine and movement control activities. Zones most commonly used are the infected zone, buffer-surveillance zone, free zone, and surveillance zone.

Control zone designation and size of the inclusive areas are determined by applying epidemiological methods and utilizing surveillance data gathered during the course of the outbreak. Figure 2 depicts the various zones in relation to a simple outbreak of vesicular disease.

Control area. The control area (CA) encompasses the infected zone and a buffer surveillance zone. The CA is established quickly to ensure rapid and effective containment of the disease. For the most serious Transboundary animal diseases (TADs), animal health officials may declare state of emergency on the entire regional state or at CA level (if deemed necessary). As such, movement of susceptible animals are halted for a period long enough to determine the scope of the disease outbreak. Potential modes of disease transmission should be considered when determining the minimum size and shape of the CA. The incident commander should control movement through the use of permits and maintain these restrictions until the disease is eradicated from the designated zones. Checkpoints and roadblocks should be located on all rural roads where they enter the CA. At checkpoints, all vehicles suspected of containing farm-related products, materials, or animals should be stopped. Although it may be impractical to establish checkpoints on interregional highways, checkpoints should be established at entrances and exits of major highways within the CA. Checkpoints should be staffed 24 hour per day and maintained for 30 days after the last infected animal is euthanized or until the situation indicates the checkpoints are no longer needed.

Infected zone. The infected zone (IZ) includes the perimeter of all presumptive or confirmed positive premises and as many of the contact premises as the situation requires. The boundary of the IZ includes the borders of the confirmed infected and presumptive premises. The size and shape of the IZ are determined by several factors. Terrain, weather, prevailing winds, susceptible animal populations (wild and domestic), and characteristics of the agent come into play in making this determination. Boundaries of the IZ are normally modified as surveillance and tracking results become available. Susceptible animals should not move into or through an IZ unless they are being taken to depopulation locations inside of the IZ.

Buffer-surveillance zone. The buffer-surveillance zone (BSZ) immediately surrounds the IZ and is used as an area to concentrate surveillance efforts to determine the limit or spread of an TADs. No minimum size is prescribed for a BSZ. Premises within the BSZ that have clinically normal susceptible animals are known as at-risk premises. Surveillance on an at-risk premise consists of a minimum of two inspections of animals per maximum incubation period of the disease under investigation. Any contact premises located outside of an IZ should be surrounded by a BSZ. The BSZ can be reduced in size as more surveillance data become available.

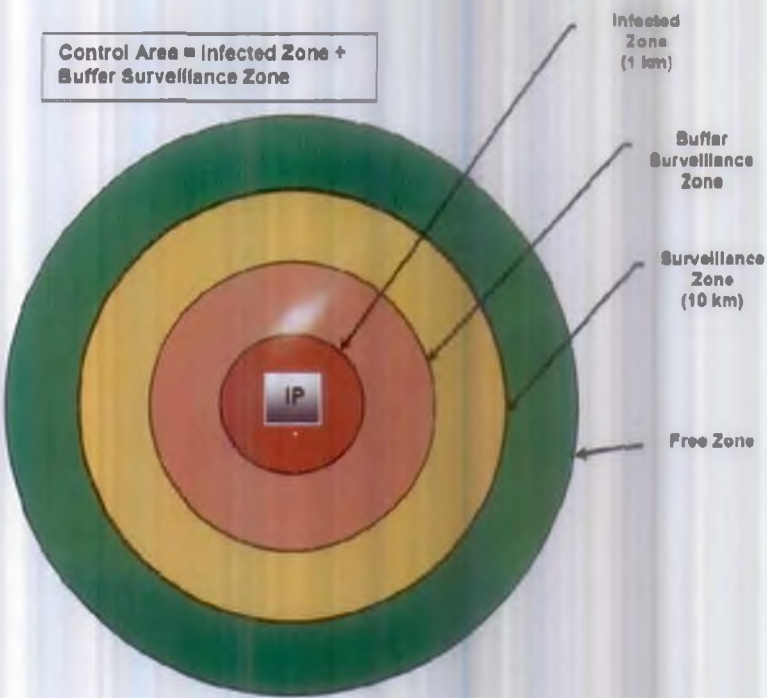

Figure 2. These are control measures that may be used to effect containment in the event of a disease outbreak. In this simplistic example, a cow with vesicular disease was designated by an animal health official as a suspect case of foot and mouth disease. The premise where the cow is located is on a farm designated an infected premise (IP) in the innermost circle. After laboratory determination, the cow became a confirmed case of vesicular stomatitis, a highly contagious disease affecting many species of animals. To effectively contain the disease, the incident commander implements control measures around the IP to organize the workforce by task, assign responsibilities, and define actions within each of the zones. In this example, the outbreak is believed to be limited to a single premise. The incident commander establishes an infected zone of 1 km, which encompasses the farm and surrounding pasture, and a surveillance zone of 10 km. All at-risk premises within the surveillance zone are checked by an animal health professional for the presence of the disease in susceptible animal populations. The incident commander designates a free zone for normal activities to ensue so that production efforts outside of the affected area are not hampered by the operation.

Free zone. A free zone (FZ) is an area where the disease under consideration has been demonstrated to be absent. Requirements for disease-free (or free) status are specified in the OIE International Animal Health Code. Within a FZ and at its borders, official veterinary control is applied for animals and animal products.

Surveillance zone. Surveillance zones (SZs) are established within and along the border of the FZ, separating the remainder of the FZ from the BSZ. Surveillance efforts in the SZ focus on premises determined to be at the highest risk of infection. The suggested minimum size of the SZ is 6.2 miles (10 km).

Classification of premises

As Ryan (2016) described, there are five types of premises: infected premises, suspect premises, contact premises, At-risk premises, and free premises. The description of each premises types is presented below.

- **Infected premises**. An infected premise (IP) is one where a highly contagious disease agent is presumed or confirmed to exist. The basis for this is through clinical presentation of the affected animals and laboratory results. All presumed positive premises and confirmed positive premises are classified as IPs. In addition, all other premises that meet a specific case definition are classified as IPs. For these premises, quarantine is imposed and all susceptible animals may be euthanized (if deemed necessary).
- **Suspected premises**. Suspected premises (SPs) are those that are under investigation for a report of compatible clinical signs but with no apparent epidemiological link to an IP or contact premises. These premises are under quarantine, movement restrictions, and surveillance for at least two maximum incubation periods. Surveillance consists of a minimum of three inspections of animals per incubation period of the disease under investigation. If a SP is negative after two incubation periods of surveillance, no further regular surveillance is required unless clinical signs are reported in the future. The owners of animals on an SP in an IZ may elect to euthanize and dispose of their animals, given approval of the incident commander (IC).
- **Contact premises**. A contact premise (CP) is one with susceptible animals that have been exposed to animals, animal products, materials, people, or aerosol from an IP. Risk of exposure must be consistent with the transmission characteristics of the etiologic agent. The CP is quarantined and subject to disease control measures, which may include euthanasia and disposal of susceptible animals. If susceptible animals on a CP are not euthanized, then they will be placed under surveillance for a period of time equal to two incubation periods. Surveillance and inspections continue until IZ or BSZ designations are removed. In the event that a CP is not located within a CA, the premises are treated as an independent IZ and surrounded by a BSZ.
- **At-risk premises**. At-risk premises (ARPs) are those premises in a BSZ or SZ that have susceptible animals but none of which are presenting clinically for the TADs in question. Susceptible animals from an ARP within a BSZ may be allowed to move with a permit.

- **Free premises**. Free premises (FPs) are those in the FZ, outside of an SZ.

3.2.2 Emergency animal disease preparedness and response (EADPR)

The impact of an animal disease emergency or outbreak in livestock could be devastating. Thus, prevention of entry, early detection and rapid response management are recognized as the most cost-effective methods of managing EADPRs. Rapid response management involves having the appropriate policies and procedures in place, building a competent trained response team and empowering the community and the private sector to be actively engaged in the recognition of, response to and recovery from EADPRs. Response to such a situation will require interaction between local, regional and often federal agencies and personnel. Preparedness efforts are essential for the prevention and control of such an event in the disease-free zone. Please note that, as each animal disease outbreak is unique, in addition to the general EADPR, disease based EADPR has to be developed and used with in the designated disease-free zone. This is because, the disease agent, animal species affected, and extent of spread affects the response and levels of control needed.

The effect of an animal disease emergency can impact animal health, economics and possibly even human health. The impact could be felt, in the case of eradicated TAD disease discovery in free zone, in as quickly as 24 hours. Exportation of livestock could be halted. Allied and reliant industries, such as restaurants, grocery retailers, food processors and distributors, and transporters have direct and indirect ties to red meat industry and would be impacted significantly. Costs would also be generated due to the needed measures for eradication and control of the disease (e.g., disease surveillance, diagnostic testing, tracing of exposed animals and their movement, implementing and maintaining quarantines, depopulation costs, indemnity paid to the farmer). Some losses due to emergence or re-emergence of an eradicated disease may take years to fully realize.

Animal disease emergencies involve four phases of management – prepare, prevent, respond and recover. This manual is designed to help you become aware of the different measures needed in each of these steps for animal disease emergencies. Below are Listed the various steps for each phase for animal disease emergencies.

a) **Preparedness scheme:** - Preparedness involves advance planning. This starts with identification of stakeholders and agencies involved or needed for a response. It is important to know members of your community and understand the roles and responsibilities they may have or may contribute to in the event of an emergency at the local, regional and Federal level. Familiarity should be established before the disaster strikes. To better respond animal disease outbreaks with in the delineated disease-free zone or buffer zones, there must be national preparedness scheme. In an animal health emergency, the response must be fast and well-coordinated to keep disease from spreading. The national preparedness scheme should be able to dispatch within 24 hours. In addition to providing resources and materials when outbreaks occur, the national preparedness scheme personnel should help regions or agencies prepare for future outbreaks through careful advance planning, training, and exercises. Its goal should be to make sure that, when faced with an emergency, partners understand the process for

rapidly requesting, receiving, processing, and distributing national preparedness scheme resources so responders get help quickly. The national preparedness scheme may offer many resources to address animal health threats during disease outbreaks. These resources (i.e., veterinary countermeasures) should include at least:

- personal protective equipment for on the ground responders to guard against infection and other onsite hazards;
- decontamination supplies to inactivate pathogens;
- vaccines to quickly protect livestock at risk of infection;
- vaccination equipment and supplies (such as needles and syringes) to effectively immunize large numbers of livestock;
- animal handling equipment, including corrals, to safely contain and restrain livestock;
- equipment for emergency euthanasia and depopulation of animals;
- assistance in securing outside companies, if needed, to provide trained personnel and additional equipment for large-scale depopulation, disposal and decontamination work.

b) **Response plan-** there should be a comprehensive animal disease emergency response plan. The plan could be in the form of National Response Framework (NRF). The NRF: -

- its applicability and Scope should provide national operational/resource coordination framework for disease incident management of national significance;
- should detail federal incident management structure/coordination processes;
- explain overarching roles and responsibilities.
- should also describe roles and responsibilities of federal and regional agencies involved in incident management, coordination between Federal agencies and the structure and coordination of responses. A basic premise of the NRF is that all incidents has to be handled at the lowest jurisdictional level possible – a due emphasis is on local response. For animal disease emergencies, local responders such as veterinary and animal health professionals as well as police, fire, public health, medical or emergency management professionals may be called upon to assist in the response. Additionally, the private sector is a key partner, particularly for critical infrastructure protection and restoration of the community.

To mitigate future animal disease emergencies, once a plan is in place, logistical training and exercises must be conducted with partners as per the EADPR scheme guidelines (expected to be developed this year). These exercises will give participants an opportunity to learn in detail about the response scheme and available resources; test their abilities to request, receive, process, and distribute EADPR equipment, supplies, and vaccines; clarify roles and responsibilities to aid in a logistics operation; and identify resource gaps and improve response plans before outbreaks occur

c) **Prevention**-includes measures that prevent the emergency from happening, reduce the chance of the emergency happening or reduce the damage of unavoidable emergencies. Awareness and management of disease risk is an important component for livestock operations so that an animal disease emergency can be prevented. Whether it is part of everyday operations or in the event of an outbreak, awareness of common biosecurity or biological risk management protocols are essential to those interacting with animal

facilities. Specific prevention steps exist for certain diseases, and control practices relate to how the disease is actually spread.

d) **Response-** the response needed for an animal disease emergency will be dependent on a number of factors. However, almost all disease outbreaks involving livestock will involve regional Veterinarians and usually the Federal Government to some extent. Those outbreaks that involve a TAD disease (the one targeted for eradication) will have international trade issues. Response is crucial for an emergency incident, including an animal health emergency. The goal is to put your preparedness plan into action expediently, safely and effectively. The level of response needed will vary on a number of factors including the disease suspected or confirmed, the number of animals or premises affected, the animal health and public health impact from the disease, the economic or trade implications of the disease. Actions taken will be made by the regional veterinarian (or in the case of a national emergency – in conjunction with the Federal).

Upon suspecting a disease of high consequence, the local veterinarian is required to contact th regional or the federal veterinarian in charge, based on the legal jurisdictions. At this point a disease diagnosis expert (for laboratory confirmation of the disease) is sent out to investigate. Based on the disease type and technical ease, diagnostic services can be given at regional or federal level by a specially trained expert to conduct investigations of high consequence animal diseases. In practice, there must be a standby emergency response team equipped with the right logistics. The response team has to investigate within 24 hours of the local veterinarians' initial call. The response team should also assess the situation and examine the animal(s). Working in close collaboration with the regional and/or federal veterinarian, the team should obtain the appropriate samples and forward them to the appropriate veterinary laboratory for testing. Depending on the level of suspicion of a TAD, the sample may be shipped overnight or hand carried to the laboratory. While the sample is being processed, the affected farm may be placed under a hold order to prevent the movement of animals off of or onto the premises. Actions taken will be made by the regional veterinarian (or in the case of a national emergency – in conjunction with the federal).

3.3 Establishing dependable meat animal identification and traceability system

As global development of food industry and trade expands and competition for market share intensifies, concerns related to food safety have become a priority. Food safety concerns have recently demanded integration of livestock identification and traceability into routine food supply chains. This is because, accurate and complete tracking records can reduce the market risk by limiting the scope when a threat is suspected, as potentially affected products can be better defined and contained. However, in food commodities, the establishment of tracking and tracing capability meets many barriers that have prevented their broad use. The principal problem is establishing a feasible identification system capable of quickly tracking animals from birth to slaughter, and tracing meat from farm to consumer (Zhao et al., 2011).

For many importing markets, food safety is a major concern and strict regulation is now becoming a prerequisite for countries that import live animals, or animal products. Consequently, the exporting country has to provide a health certificate for each animal proving that the animals

are free of disease or have been vaccinated and that they have been monitored throughout a significant part of the value chain. A well-designed Livestock Identification and Traceability System (LITS) enable such a certificate to be issued.

A fully-functional traceability system is based on animal identification i.e., associating a unique animal identification number to an animal; the assignment of a unique identification number to a physical land location (premises identification); and associating the animal identification number with a premises and time. LITS is one of the concepts recognized in the WTO SPS agreement. Under the WTO SPS agreement, the OIE is the reference organization for animal health and zoonotic diseases. The SPS agreement gives WTO members two options: To base health measures on the international (OIE, Codex, International Panel on Climate Change (IPPC)) standards (preferable); or to conduct a scientific risk analysis. The latter is conducted in scenarios where there is no relevant standard, or when a member chooses to adopt a higher level of protection than that provided by the OIE standards. As such, exporters are required to establish a LITS system based on pre-established standards to produce and supply safe foods and to avoid unwanted trade penalties.

In Ethiopia, there is a traditional livestock identification system that has been used since antiquity mainly to prove ownership rather than for animal health or disease control purposes. This type of identification lacks reliability as a tracking system so there is currently no established LITS that complies with the international meat and meat products standards. The current policies relevant to LITS are inadequate and even the exited ones lack the right tools for their enforcement. For instance, the country doesn't have specific policies and regulatory frameworks for LITS cost sustaining and sharing, animal movement control, Livestock registration and recording system, retention of livestock records, veterinary laboratory traceability, confidentiality and accessibility of LITS data, livestock traceability enforcement; and obliterations, tampering or removal of official livestock and identification devices.

The federal veterinary authority is currently in the processes of piloting an LITS project. Regardless of this pilot project, the LITS system that has to be established in the disease-free zone has to be a system that could enable life time identification and tracking of meat animals and it has to also fulfill the OIE minimum LITS requirements. Thus, in order to have an effective LITS system the following two basic components need to be put in place- including a robust identification system (for example brands, marks or a device) and a system that tracks an animal, or group of animals, along the value chain to the final destination. It is only when these components work together that a LITS system becomes functional (Britt et al., 2013). The LITS system should consist three major components, namely, a) a premise identification system, b) an animal identification system, and c) an animal tracing system. Usually, each animal will be assigned a unique identification number, which is embedded in the ear tag (rumen bolus) attached to the animal. Moreover, the animal tracing system will contain information about the animal's location and movement records needed to help safeguard animal health. At a minimum, information is collected and stored concerning the animal's place of origin, the name and address of the owner, the date and location of movements from the animal's place of origin and to any other destination, and means and route of transportation. It can also include more elaborate animal identification factors such as information on the sex, breed, and parentage of an animal, and the names of all feeds and pharmaceuticals used in fattening or raising them. Animal tracing

information provides animal health officials with timely, accurate records that show where animals have been and what other animals have come into contact with them.

For ear tag application and reading, it is essential that an appropriate infrastructure is available on the farm, livestock market places, feedlots, quarantine stations and abattoirs. The infrastructure may include, but is not limited to, crushes, animal quarantine facilities, Radio-frequency identification (RFID) readers (if an electronic identification system is employed) computers and internet.

Furthermore, the federal veterinary authority in consultation with stakeholders, should establish a legal framework for the implementation and enforcement of the LITS guidelines. A sound framework for evaluating regulatory support, policies and instruments is essential if supply chain efficiency is to be improved and consumer and producer interests are to be preserved through a traceability system.

3.4 Improving disease risk analysis, surveillance and reporting capabilities

Over recent years there have been considerable methodological developments in the field of animal disease surveillance. The principles of animal disease risk analysis were conceptually applied to surveillance in order to further develop approaches and tools (like scenario tree modelling) to design risk-based surveillance programs. Moreover, the SPS agreement of WTO has placed an increased emphasis on the importance of sanitary and phytosanitary measures, requiring improved surveillance and monitoring systems, adequate laboratory diagnosis, risk analysis capabilities, and quality assurance. The agreement demands that a country should demonstrate its animal health status by means of scientifically based surveillance efforts.

Please note that as its costly and not practical to include all animal diseases in the national surveillance and monitoring program, emergency animal preparedness and response, risk analysis and any other animal health programs, there should be a disease prioritization and listing of target animal diseases. Hence, before planning and running an animal health program to establish a disease-free zone, the livestock diseases intended to be controlled or eradicated should be identified, listed and targeted. In addition to listing of endemic livestock diseases intended for eradication, there should also be a list of foreign animal diseases that should be proactively prevented their entry to Ethiopia at ports of entry. To develop a list of endemic animal diseases for eradication or foreign animal diseases for prevention, the following eight criteria could be used as a guide.

1) high epidemic/epizootic potential, or the ability to rapidly spread and infect a large number of animals
2) high economic impact
3) large impact on trade, both domestic and international
4) high animal morbidity and mortality, or the capability to cause disease and death respectively
5) high potential to infect multiple species
6) inability to detect the disease rapidly
7) ability to vaccinate for the disease

8) high zoonotic potential

The listed animal disease either they are endemic or foreign should be surveyed for their presence or absence and should be documented and reported accordingly. And hence, for establishing and maintaining a disease-free zone with in Ethiopia, issues that could help for the development of a national animal disease monitoring and surveillance system (risk analysis, surveillance and reporting) are describe here below.

3.4.1 Disease risk analysis

Risk analysis processes have already been developed to provide an objective, reproduceable, transparent and documented assessment of the risks posed by a course of action or chain of decisions. Standardized techniques have also been developed and are utilized routinely to aid decision making by governments and international organizations such as the OIE in assessing the risk from disease to humans, domestic animals and wildlife.

Risk analysis is a process that includes risk assessment, risk management, and risk communication. Risk assessment is the process of identifying a hazard and evaluating the risk of a specific hazard, either in absolute or relative terms. It may be qualitative or quantitative. Risk management is the pragmatic decision-making process concerned with regulating the risk. On the other hand, risk communication is an open two-way exchange of information and opinion about risk leading to better understanding and better risk management decisions. Risk assessment basically answers three questions. The first, "what can go wrong?" provides the identification of the hazard of interest. The second question, "what is the probability it will go wrong?" evaluates how likely it is that the hazard will occur. The third question asks "what are the consequences if the hazard does occur?" The answer to the latter two questions is defined as "risk". Though formally defined as probability and magnitude of the occurrence of the hazard, the term "risk" is used informally in several other ways. It may refer to the hazard itself, the probability of an event's occurrence, or to behavior or activity that could bring harm to an individual. When hearing the word risk, it is necessary to think about the context in which the word is used. Risk assessment also utilizes information such as anecdotal evidence, expert opinion, and other items from less structured sources. However, the evidence used in a risk assessment and the sources of that evidence must be displayed so that there is no ambiguity about the kind of information used in the analysis. The pertinent information is structured to assist the risk manager in making a decision about mitigating the likelihood or consequences of the adverse events.

The application of risk analysis to the spread of disease in animals and their products can be used for import risk analysis and protecting disease free zine with in a country.

- Import risk analysis are generally undertaken for legal or trade reasons.
- To safe guard animals reared in the free zone, Veterinarians must use systematic and science-based evaluation of animal health status of a given zone. Thus, zoning and risk assessment will support active and free local and/or international trade in animals and their products while providing the safety needed to maintain good health in our herds.

Please note that, disease risk analysis, as it is very critical to maintain and improve the animal health status of a disease-free zone, it has to be done routinely in a scheduled manner. The methods used to collect and analyze the data and communicate the findings should be based on the OIE standards and guidelines.

3.4.2 Disease surveillance

Animal disease surveillance may be defined as the process of demonstrating the absence of disease or infection, determining the occurrence or distribution of disease or infection, while also detecting as early as possible exotic or emerging diseases. Animal disease surveillance is one of the most important components of an effective and efficient program for disease prevention and control. Disease surveillance is the key to early warning of a change in the health status of any animal population. It is also essential to provide evidence about the absence of diseases or to determine the extent of a disease that is known to be present. The detection of any of the OIE listed high consequence livestock pathogens must be reported to the OIE within 24 hours. OIE monitors the disease status of animal diseases of severe economic or public health consequences. Surveillance activities has to be performed based on OIE recommendations. Thus, the Principles of surveillance and the method to be followed are described in detail in the terrestrial animal health code OIE (2017). As all infections may not show clinical times at a specific time point, usually, laboratory-based diagnostics should be used to roll out the presence or absence of a disease. These, the laboratory infrastructure and its associated facilities should fulfill the international standards of quality and safety.

Furthermore, development of the surveillance systems needed to address emerging and foreign animal diseases will necessarily require design and architecture that are highly probability-driven to maximize surveillance sensitivity and specificity and to minimize cost (Thurmond, 2003). Establishing a surveillance programs across a wide area with diverse ecosystems and political administrations as Ethiopia is a complex challenge. In such environments, developing and maintaining an effective national animal diseases surveillance system requires cooperative partnerships among government agencies, livestock and wildlife organizations, private companies and communities, individuals involved in animal industries. Surveillance may be based on many different data sources and can be classified in a number of ways, including: the means by which data are collected (active versus passive surveillance); the disease focus (pathogen-specific versus general surveillance); and the way in which units for observation are selected (structured surveys versus non-random data sources). On the other hand, surveillance activities could also be classified as being based on structured population-based surveys, (such as systematic sampling at slaughter, random surveys or surveys for infection in clinically normal animals, including wildlife); or structured non-random surveillance activities (such as disease reporting or notifications, control programs or health schemes, targeted testing or screening, ante-mortem and post-mortem inspections, laboratory investigation records, biological specimen banks, sentinel units, field observations, farm production records, wildlife disease data).

For animal disease surveillance and monitoring, the data collection, analysis, associated technical methodologies and reporting systems should be done following the OIE terrestrial animal health code guidelines. The requirement for effective surveillance is to allow detection of known and emerging diseases and to protect trade partners from the risk of a foreign animal disease (FAD)

outbreak. This in turn requires ensuring the quality of a surveillance system for maintaining the safety of consumers and trading partners.

Diseases are detected at the local level, either by the producer or the local veterinarian. In some cases, the diagnostic laboratory or slaughter facility may make initial detection. Veterinarians are required to report animal disease of high consequence (OIE lists or national list) to the regional or federal Veterinary authority. Of course, there should be a national disease reporting system that collects information in animal disease incidents. Once detected, the incident should be handled at the regional/Federal level first working with the local level. Currently, TADs surveillance and monitoring lies on the responsibility of the federal veterinary authority. Upon a disease incident, once the animals are euthanized and disposed of, then the site or sites must be cleaned and disinfected, following standard procedures. Likewise, some compensation (indemnity) may be provided to the owners of the animals. Based on the indemnity policy (which is not existent currently), the regional or federal indemnity funds will need to be made available. During and after an animal disease emergency, businesses must attempt to continue function, as recovery takes time.

Diagnostic laboratories

To test major identified threats especially with in the designated disease-free zone of the country, diagnostic laboratories across the country should be designed and established. , This should allow enhanced diagnostic surge capacity and decreased shipping distances of samples. For the ease of data sharing and reporting, all the national and regional laboratories should be connected via a national animal health laboratory network. The national animal health laboratory network (NAHLN), may consist a group of regional, federal, university and research veterinary diagnostic laboratories that work with animal diseases, including those that are endemic, exotic, zoonotic, or emerging. All of the laboratories in the network should use common testing methods and software platforms to process diagnostic requests and share information. The NAHLN has to be a multifaceted network composed of sets of laboratories that focus on different diseases.

There should also be a national laboratory regulatory body that could oversee the facilities and standardized methodologies, train laboratory analysts and supply the required consumables for the diagnostics in the network laboratories. The regulatory body can be a program office with in the NAHLN that is competent enough to coordinate all network activities, ensuring that all participating laboratories have laboratory review and approvals based on their quality management systems; appropriate standardized operating procedures, permits, and equipment; secure mechanisms to provide standardized data; and funding mechanisms in place for financial reimbursement. By this program, personnel working in NAHLN laboratories should also be approved to conduct screening tests to detect various animal diseases. Furthermore, working groups (regional/national) should also be formed for technical laboratory support, quality assurance and bio-safety. These groups will conduct extensive consultations, site visits and assessments of the network laboratories to establish a baseline of their respective needs as to equipment, training requirements, quality assurance, bio-security and to institute standardized testing protocols. As a result, harmonized diagnostic protocols for the identified diseases, for eradication from the delineated disease-free zone in short time and gradually from the country will be in place, equivalent test standards will be recognized, appropriate bio-containment will

also be achieved, and ISO accreditation or its equivalent should be implemented and maintained by network laboratories.

To ensure timely disease surveillance and monitoring, the diagnostic data across the laboratory network has to be integrated through an electronic interconnectivity, i.e., between diagnostic sample collectors, animal health laboratories network and national databases. The NAHLN should use data and messaging standards established by the central regulatory body to ensure that diagnostic information is quickly and accurately shared with network labs and decision makers. To do this, NAHLN Portal should be established and the portal has to be a secure Web site that allows network laboratories to exchange information with the regulatory body office (i.e., standard operating procedures, proficiency testing status, financial agreements, and assay performance monitoring data) efficiently. By streamlining information sharing, the NAHLN Portal can help enable the network to respond to adverse animal health events quickly and efficiently.

When a large-scale animal disease outbreak occurs, tracking its progress and performing diagnostic tests on thousands of biologic samples is a big challenge. To get the job done, it is very important that all the parties involved—Federal referral laboratories and laboratories managed by regional governments and universities—communicate and collaborate effectively. The regional and university laboratories in the NAHLN may perform routine diagnostic tests for endemic animal diseases as well as targeted surveillance and response testing for foreign animal diseases. regional and university laboratories also help develop new test methodologies. At the Federal level, National diagnostic veterinary Laboratories (NDVL) may serve as the national veterinary diagnostic reference and confirmatory laboratory. NDVL should also participate in methods validation and providing training, proficiency testing, assistance, materials supply, and development of prototypes for diagnostic tests. Networking these resources provides an extensive infrastructure of facilities, equipment, and personnel geographically accessible no matter where disease strikes.

Coordinated and managed in such a way, the laboratories will have the capability to conduct zonal, regional or nationwide surveillance testing for the early detection of an animal disease outbreak. They could also have the capacity to test large numbers of samples rapidly during an outbreak and demonstrate that the intended zone is free from the disease after it's been eradicated.

Wildlife disease surveillance and monitoring: in addition to the livestock disease control and prevention programs, there should also be a wildlife disease surveillance and monitoring programs. Such programs, in collaboration with other stakeholders (local, regional and federal institutions), help in addressing wildlife diseases that may impact the public and Ethiopian livestock. The goals of such a program is usually to:

- Develop and implement a nationwide system to survey for wildlife diseases of agricultural and human health concern; and
- Strengthen the national as well as regional animal disease control capacity by responding to a variety of emergencies, including disease outbreaks.

Usually, as these goals can't be accomplished by a single agency, the program has to develop partnerships and cooperative projects with different stakeholders. This emphasizes the importance of sharing information and techniques, such as animal sampling, wildlife disease surveillance methods, and laboratory practices. When possible, the program could also work to develop infrastructure—increasing available knowledge, techniques, and expertise—to respond not only to current, but also new and emerging animal diseases. Within the National Wildlife Disease Control Program, a nationally coordinated surveillance and emergency response system should support the existing surveillance and monitoring activities; facilitate information sharing among involved partners; promote the further development of laboratory infrastructure (such as personnel, equipment, and procedures); and respond to a variety of wildlife-related emergency requests from local, regional and federal agencies.

Through surveillance and emergency response system, the program should work closely with the national animal health laboratory network. These laboratories, which undergo an accreditation and validation process, should provide support for routine diagnostic work and critical surge capacity for laboratory testing, a crucial service in large-scale animal disease outbreaks. During emergencies, the surveillance and emergency response system should work with the Federal and regional governments to formulate effective and efficient responses. Wildlife disease biologists should also be available to respond quickly and assist with disease outbreaks and other emergency activities that require their unique skills and abilities.

3.4.3 Disease notification/reporting

Data derived from disease reporting systems can be used in combination with other data sources to substantiate claims of animal health status, to generate data for risk analysis, or for early detection. Effective laboratory support is an important component of any reporting system. Reporting systems relying on laboratory confirmation of suspect clinical cases should use tests that have a high specificity. Reports should be released by the laboratory in a timely manner, with the amount of time from disease detection to report generation minimized (to hours in the case of introduction of a foreign animal disease). Whenever the responsibility for disease notification falls outside the scope of the Veterinary Authority, for example for diseases in wildlife, effective communication and data sharing should be established with the relevant authorities to ensure comprehensive and timely disease reporting.

For early detection of any disease incident, there should be a centralized disease notification system that is easy to access, at any time. For this purpose, the central disease information collection center should be equipped with the necessary infrastructures, like: -

- data base and server with online interface for submitting and retrieving disease information online using conventional computer systems and/or mobile phone/tablet platforms. This platform should be able to collect, store and process disease data (from farm records, laboratories, abattoirs, feedlots, quarantine stations, biobanks, wildlife authority etc.) that could be used for decision making.
- Telephone line dedicated for disease notification. This telephone line could serve to collect information at the earliest possible time from the community.

The disease notification system can be coordinated and managed by skilled expertise and the system that it operates should be multilevel (local, regional and federal responsibilities) community-based disease notification system. This disease notification and reporting system should be an individual animal and area-based diseases reporting system. It has to collect a timely and quality data from producers (primarily the community), quarantine stations, market places, feedlots, abattoirs and diagnostic laboratories. For its proper implementation, a national disease surveillance and notification strategy, based on international standards, should be developed.

3.5 Assuring welfare of meat animals

Animal welfare refers to the state of the animal; the treatment that an animal receives is covered by other terms such as animal care, animal husbandry, and humane treatment. Animal welfare is now recognized as a characteristic of product quality and customer requirements in the global livestock industry. There is increasing recognition by livestock industries that animal welfare is an integral part of good animal husbandry. In many countries, several food safety-based quality assurance schemes have been implemented either within businesses and/or across industries and these usually include animal welfare components. Good animal welfare requires disease prevention and veterinary treatment, appropriate shelter, management, nutrition, humane handling and humane slaughter. The basics of animal welfare can be summarized by the so-called 'five freedoms(FAWC, 2009)': -

- freedom from hunger and thirst – which means access to fresh water and a diet for full health and vigor;
- freedom from discomfort – animals are entitled to an appropriate environment, with shelter and comfortable rest areas;
- freedom from pain, injury and disease – implying human action in prevention or rapid treatment;
- freedom to express normal behavior – with adequate space and facilities, and suitable company;
- freedom from fear and distress – so that they do not suffer from the prospect of stressful conditions and treatment.

Ensuring animal welfare is a human responsibility that includes consideration for all aspects of animal well-being. where an animal is failing to cope with a problem, it is said to be stressed. Stressed animals are difficult and dangerous to handle, and the more stressed they are the more stressed the handlers become, especially if they lack expertise and the correct infrastructure for handling animals. When animals and handlers are stressed there is increased likelihood of injury to either the animals themselves or to the handlers through accident or outright attack. Stress can be minimized using recommended animal handling techniques. The most effective insurance against injury is adequately training people in the low-stress handling of animals.

Low-stress livestock handling has productivity benefits for farming enterprises-by producing quality meat. It will deliver improved livestock health and production. and better meat quality to the customer. As consumers become more aware of the conditions in which animals are reared

and ultimately slaughtered, they are demanding to know that those conditions conform to the five freedoms, so far as it is practicably possible for human beings to ensure them.

Moreover, after adequate equipment and infrastructure have been installed, the single most important determinant of good animal welfare is the attitude of animal handlers and management in general. Places where animal welfare is poor often have a manager who does not care. A good manager enforces standards to maintain good welfare. Employees are well trained and people who abuse animals are punished. This is done, mostly, 1) through creating public awareness, 2) having animal welfare policy and national guidelines and 3) animal welfare regulatory frameworks and enforcement mechanisms.

Meat consumers are increasingly demanding that animals be reared, handled, transported and slaughtered using standard animal welfare practices. Due to the increasing globalization of the entire livestock industry, OIE guidelines are being used in more and more countries to determine standards for animal welfare. These guidelines cover welfare during both slaughter and transport of livestock species including cattle, sheep and goats. As OIE guidelines are minimum worldwide standards for animal welfare, many of the major meat importing countries are now issuing even more stringent requirements than the OIE minimum standards. Animal handling and welfare auditing programs are now being conducted in many countries around the world. These countries have made compulsory to follow the standards and guidelines and has already developed detail technical specifications and regulatory frameworks for its implementation.

In spite of the presence of animal welfare policies and regulations in many other countries including European union (Passantino, 2006), in Ethiopia, there is no any animal welfare policy, guideline, or any regulatory frame work that could help protect the welfare of farm animals. Thus, for exploiting the planned disease-free zone through improved live animal and meat export trade and also to penetrate new lucrative meat markets overseas, animal welfare policy and strategy along with its coherent regulatory frameworks should be developed

3.6 Creating competent veterinary service

To control prevalent and endemic disease and to prevent the introduction or transmission of any exotic diseases to Ethiopia especially to the intended disease-free zones, there must be a robust and competent animal health service. Its known that, by the help of veterinary services, many countries have been able to control and prevent many deadly animal diseases. To improve livestock productivity by controlling and preventing animal diseases, the need for establishing an effective and efficient veterinary service delivery system is of beyond question. The type of veterinary services may include, clinical services, vaccination, AI, disease diagnosis and herd health management. These services need quality assurance and inspection systems from the government. To differentiate the roles of the public and private sector in the animal health services, the veterinary service should be rationalized. Supported by law, a proper guideline on the delivery and regulation of veterinary services should also be in place. Furthermore, based on the OIE veterinary service recommendation, the veterinary service should be a fully functional system that operates on an established and internationally recognized principles and producers. Some of the principles and procedures are described below.

As a signatory of the World Organization for Animal Health (OIE), Ethiopia is bound by the organization's guidelines, which call for veterinary services of member countries to be provided by professionals. Moreover, as the country is planning to create a disease-free zone, recommendations and guidelines on veterinary services provided by OIE has to be followed, in some cases, if possible could also be improved. To do this, based on international standards, the primary task is developing veterinary service guidelines, principles, regulations and enforcement mechanisms.

Besides to the development of policies, preparation of working documents and regulatory frame works, the experts needed to run such services, infrastructure, technology, finance, and administrative structures that are required to deliver a quality veterinary service has to be in place. Based on the experience of developed countries and even many developing countries, veterinary service run by a private sector is more efficient and cost effective compared to state run services. Even in Ethiopia, the veterinary service delivery system is expected to show a shift from state owned operation to a private owned one. When the service shifts from public to private, the government will have the capability to properly regulate the system. Thus, here in this manual, more focus is given on delivering quality veterinary services.

3.6.1 Veterinary service quality assurance

Establishing and running quality veterinary system requires a wholistic and multifaceted approach starting in its planning up to execution. The approach may include, but not limited to,

- A comprehensive, clear and practical animal health policy, strategies, guiding principles, laws and enforcement mechanisms,
- Evaluation and appraisal of veterinarians (officers and practitioners) competence based on objective and verifiable indicators,
- Based on the OIE recommendations, developing of national and regional veterinary infrastructures along with their facilities and also critically and continually inspecting and certifying it and
- Continual involvement, promotion and awareness creation of the public.

The quality of the Veterinary Services depends on a set of factors, which include fundamental principles of an ethical, organizational, legislative, regulatory and technical nature. The Veterinary Services shall conform to these fundamental principles, regardless of the political, economic or social situation of the country. Ethiopia's Compliance with these fundamental principles by a Veterinary Services is important to the establishment and maintenance of a higher confidence level that could be recognized by meat or live animal importing countries.

The quality of Veterinary Services, including veterinary legislation, can be measured through an evaluation, whose general principles are described in the OIE (2017).

3.6.2 Assuring the safety and quality of meat produced

Meat quality refers to intrinsic attributes critical for the suitability of meat for eating, processing, and storage, including retail display. The main attributes of interest of meat are safety, nutritional value, sensorial properties, lipid composition, oxidative stability, and consistency. In recent years the meat market has undergone changes that require high standards of quality, so aspects related to environmental sustainability and animal welfare have become critical in meat production. In addition, there is growing awareness of the link between diet and health and

which is reflected in the demand for more information and for products which are healthy and of consistently high quality. Therefore, meat quality and safety are becoming dynamic and challenging concerns which require the generation of new information and of continuous reevaluation of existing knowledge for meeting market demands by assuring high quality standards and prevention of recognized risks to human health. Consumers give increasing importance to the extrinsic quality attributes of meat in response to rising concerns on safety, health, convenience, ethical factors, etc. The role that attributes such as animal feeding assurance, environmentally friendly production, respect for the animal welfare, etc. play in the consumer quality evaluation process has become critical (Bernués et al., 2003).

The prime objective of meat quality and safety assurance is to ensure that meat and meat products for human consumption comply with food safety requirements and are wholesome. To do this, a whole of food chain approach should be taken in to account and this should also incorporate the need for accurate identification, traceability, effective recall and animal welfare objectives. Thus, its critical to identify the critical points of meat quality and safety control. Desmarchelier et al. (2007) described (Figure.3) the key risk mitigation strategies, it's always important to follow a comprehensive and risk-based approach to sustain and improve the required quality and safety of red meat in this dynamic global market.

Farm and feedlot-The potential for contamination of meat with microbial and chemical contaminants begins on the farm, and thus a truly holistic meat safety program involves risk mitigation strategies involving the live animal from its conception. Meat quality also is significantly influenced by the health and welfare of the live animal, and a good meat quality assurance program addresses the events leading up to the point of slaughter as well as processing variables. In Ethiopia, assurance schemes for livestock, such as Livestock Production Assurance and the National Feedlot Accreditation Scheme and other related schemes/programs has to be developed and used. These programs should require livestock producers to develop a plan for their property, based on HACCP principles, and compliant with current codes of practice on welfare, environment protection and use of medicines or chemicals. When animals are traded, they should be identified, and accompanied by a certificate, providing relevant "chain information" for safe meat production, such as medicines administered to the mob, source, supplementary feeding and grazing history.

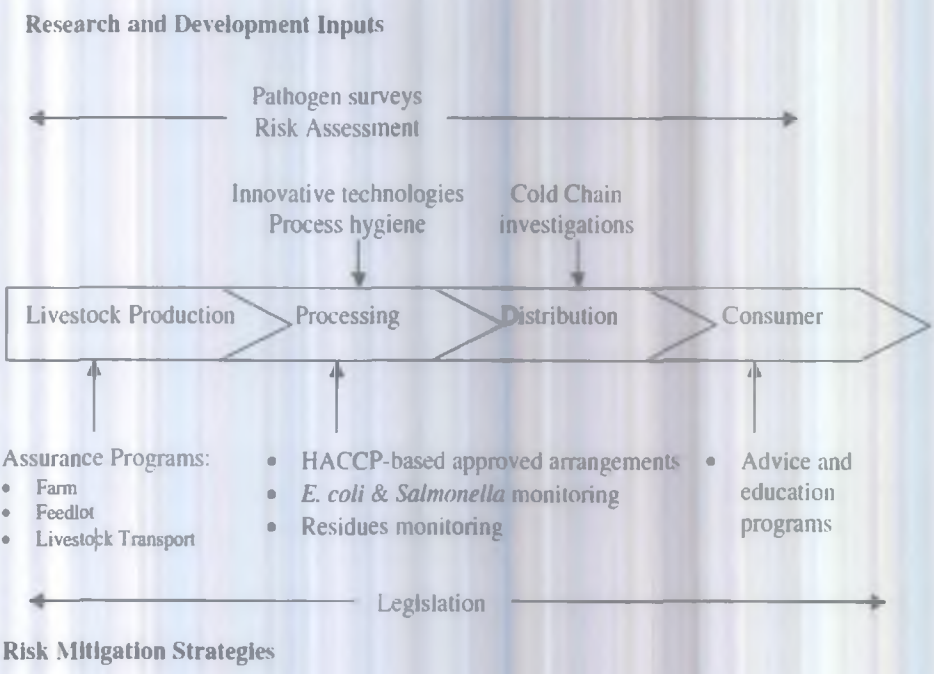

Fig.3. Key risk mitigation strategies

Livestock transportation- Ethiopian livestock can travel long distances between properties and to slaughter. The welfare of these animals is of prime importance to the Ethiopian red meat industry, and a quality assurance program for livestock transport has to be developed in order to optimize animal welfare and hence meat quality and safety.

Chemical residues- For minimizing the risk of residues being present in meat, all medications and other chemicals (e.g. pesticides, weed killers) used in livestock production chain should be approved by a competent authority. There should also be a residue survey to promote ethical treatment of animal and prevent presence of any drug residues in meat. This will help to minimize the emergence of drug resistant pathogens in animals and humans.

Abattoir assurance- to safe guard the quality and safety of meat produced, there should also be an abattoir assurance scheme. The scheme may include:

- Implementation of HACCP principles in the meat processing chain especially in abattoirs
- Implementation of Pathogen monitoring during meat processing, storage and transportation.
- Eating quality- to promote quality meat production, the Ethiopian red meat industry should develop a science-based meat grading scheme. This may include a palatability assurance program, based on HACCP principles (PACCP) to label meat with a guaranteed grade and best cooking method to maintain premium eating quality.

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ስዩም በድዬ, ሚሊዮን ታደሰ, ገብረመስቀል ማሙ, ገብረዮሃንስ ብርሃነ. 2017. የኢትዮጵያ የሥጋ እንስሳት እርባታ ስርዓት ማ ዘመ ን ፍኖተ ካርታ, የኢፌዴሪ ፖሊሲ ጥ ናትና ም ርም ር ማ ዕከል, አዲስ አበባ፣ ኢትዮጵያ.

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