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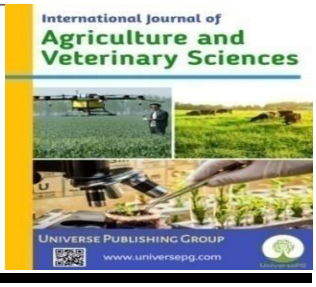

Assessment of Biosecurity Status in Health and Livestock Sectors: A Brief Study

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ABSTRACT

Biosecurity plays an irreplaceable role in preventing diseases and increasing productivity on farms. Estimation of bio-security measures implemented in Harar & Dyer Dawar dairy-farms was conducted to examine the relationship between implementation of bio-security measures and demographic and socio-economic characteristics of owners & farm features. The main objective of the current study was to investigate the bio-security status on cattle farms and the factors affecting bio-security of cattle farms in Harar & Dire Dawa, eastern regions of Ethiopia. A chi-square analysis of the found results represented that there was a significant relationship between the applied biosecurity measures and the position of the farms. Of the 124 bio-security practices taken for the biosecurity compliance assessment of study farms, dairy biosecurity scores level from 33 to 74. The ratio/value of bio-security scores varied from 27.1% to 61%. From the 21 cattle farms included in the current study, nine (9) farms achieved a score percentage greater than (>) or equal (=) to 51% (ranging from 50.3% to 61%), thus their bio-security conformity was evaluated as "good". The remaining 12 farms achieved percentage scores lower than 51% (varying from 27.1% to 47.4%) and were therefore marked as "poor". In the current work, bio-security was classified into four (4) components, isolation (19.24± 3.91), sanitation (16.64± 6.82), traffic control (16.94± 2.4), & physical management (3.24± 1.06) with their particular mean ± standard deviation of each value. Out of ten (10) cattle farms position in the Harar city, only eleven (11%) were assessed as having a "good" bio-security level. Furthermore, out of ten studied dairy-farms in Diyar Dawa city, eighty-one (81%) were evaluated for “good” bio-security adoption level.

Keywords: Dairy, Isolation, Biosecurity, Sanitation, Preventive medicine, and Traffic controls.

INTRODUCTION:

Biosecurity requires the adoption of a set of attitudes and behaviours by people to reduce the risk of disease in all activities involving animals and their products (Haggag *et al*., 2018). Biosecurity was defined as the “implementation of measures that decrease the risk of introducing and spreading disease agents. A pair of attitudes & behaviors need to be adopted by humans to reduce risks in all works involving domestic, captive/exotic & wild animals & their products” (FAO, 2008; Monterubbianesi *et al*., 2019). Again biosecurity was defined as a set of management procedures that

prevent the risk of introducing new diseases to a farm and to minimize or to eliminate the spread of disease within the herd (Fasina *et al.,* 2012; Can and Altuğ, 2014). The significant reasons for high incidence of zoonotic and other infectious diseases of animals are breach in bio-security in livestock management, closer contact between wild-life and humans and rearing of livestock in close association with people (Brown, 2004; Manuja and Manuja, 2014). Thus the natural environment surrounding the farm is significant for understanding the disease risks (OIE, 2013; Hayle *et al*., 2020).

Risk of diseases increases, if the farm located near other farms, abattoirs, livestock markets, waste disposals, hatcheries and carcass centre. The location closer to animal transport routes and waterways also adds to the risk. So, orientation of barns, buildings, ventilation inlets and outlets, unloading and loading areas, treatment and isolation or quarantine locations should be designated in such a manner that minimizes the risk of disease introduction & spread (Canadian Food Inspection Agency, 2011; Manuja and Manuja, 2014). Segregated rearing areas for young, sick & new animals with visibly demarcated boundaries decrease the risk of disease transmission. Natural features, including vegetation, waterways and topography, can benefit a bio-security plan by providing natural barriers and drainage (Manuja and Manuja, 2014). Biosecurity was founded on knowledge of the epidemiology of transmissible diseases, including the duration of the contagiousness period in infected animals, the main routes of pathogen shedding, the survival of the pathogen in the environment, and the routes of infection (Monterubbianesi *et al.,* 2019). In intensive cattle production, the incidence of infectious diseases plays an significant role in profitability. Damage incurred by disease can cause severe direct & indirect economic losses due to reduced growth and/or production rate, impaired fertility, or increased susceptibility to other diseases (Najdrowski, 2005; Hassen *et al*., 2022).

On-farm biosecurity can be assessed by analyzing patterns of practices (Delpont *et al*., 2018). Some studies regarding biosecurity in cattle farms have found that the overall application of bio-security measures was low (Renault *et al*., 2018a; Damiaans *et al*. 2019). The most frequently cited reasons for this low level of bio-security are the expected required investment in labor, time, and capital (Damiaans *et al.,* 2018). Study reported that cattle owners across a number of states generally fail to implement commonly recommended biosecurity practices (Moore *et al*., 2008). Biosecurity practices and farmers' perception were investigated in different countries (Sayers *et al.,* 2013; Laanen *et al.,* 2014; Dewulf *et al*., 2014; Gunn *et al.,* 2008; Robertson, 2019; Compo *et al*., 2017) emphasized that although many farmers were aware of bio-security practices, many failed to adopt the protocols recommended for their establishments. Traditionally intensive industries, implement biosecurity more effectively than small-holder or extensive industries; however others have emphasized the significant role of education ensuring that biosecurity practices are adopted by the livestock industries to decrease the risk of disease entry, in order to enable maximum productivity from these industries (Robertson, 2019).

Study were done on bio-security practices in middle Ethiopian goats feedlots (Alemayehu & Leta, 2014). These studies have reported poor implementation of bio-security measures by farmers, as well as various constraints & challenges focused by cultivars such as cost, utility, importance, work load and lack of transparency and knowledge. In order to advise farmers and facilitate behavioral changes, it is better to understand the perceived importance, efficacy and constraints related to biosecurity measurement, from the farmers' point of view. This would allow us to communicate more effectively with the farmers. The work was done: to fill the gap on bio-security status and prioritization of key biosecurity areas on dairy farm and to appreciate the bio-security status between the study areas of Harar & Dire Dawa.

Review of Literature

The term bio-security has been defined in various ways. Often its scope is limited to 'management measures' that reduce the risk of an animal introducing an infectious disease (Caldow, 2004; Brennan and Christley, 2012). Again, OIE Terrestrial Animal Health Code defined biosecurity as 'a set of management and physical measures designed to reduce the risk of introduction, establishment & spread of animal diseases, infections or infestations to, from and within an animal population (Bellini, 2018). Instances of certain com-

mon livestock diseases have increased in recent years and it is widely claimed that better biosecurity practices are needed to improve animal welfare and enhance the financial viability of the dairy sector. The 2004 Animal health & welfare strategy for Great Britain emphasized the responsibility of animal owners in managing animal health risks and stated that veterinarians uniquely placed to promote animal health, welfare and should be at the forefront of delivering proactive disease (PD) control services (Defra *et al.,* 2004). Again veterinarians have been focused as one of the most significant (Gunn *et al.,* 2008 & Derks *et al.,* 2012) and the most reliable & credible sources of information's for cultivars on bio-security (Garforth *et al.,* 2013; Bekere *et al*., 2022).

In essence, the biosecurity part of dairy-cattle addresses the risks associated with diseases and pests by focusing on three key actions: prevent the introduction of pathogens to cattle on dairy-farms, prevent the spread of pathogens among cattle within a dairy farm and prevent the exit of pathogens between cattle farms or from dairy farms to other animal populations (Anon, 2014). Combating diseases of livestock in developing countries can make a substantial contribution to poverty alleviation by generating employment, providing funds for education and training, improving opportunities for trade in livestock and animal products and supplying raw materials to industry. Animal diseases were found among the most significant limiting factors for livestock production. Their impact can vary from reduced productivity and restricted market access to the elimination of entire flocks & herds, with the resultant loss of biodiversity and valuable genetic resources. Some emerging or evolving infectious diseases have the potential to move quickly from local to international significance and to pass from animals to humans (Bellini, 2018; Gammada *et al*., 2022).

Thus Farm-level biosecurity was a series of management practices designed to minimize or prevent and control the introduction of infectious disease agents onto a farm, spread within a farm production operation, and export of these disease agents beyond the farm that may have an adverse effect on the economy, environment and human health. It is an essential aspect of on farm food safety, keeping food products wholesome and of having highest quality, which is important for the health and welfare of consumers (Cook, 2013). Biosecurity is important not only to avoid catastrophic or exotic animal diseases, but also to decrease risk of endemic diseases, such as; Digital dermatitis, Johne's disease, infectious mastitis &/or enzootic bovine leucosis (Bickett-Weddle and Ramirez, 2004). Biosecurity practices also designed to be adapted when emerging diseases are discovered, such as Schmallenberg virus in Europe in 2012 (Brennan *et al*., 2012). Thus biosecurity measures necessary for recently occurring pandemic (COVID,19) to limiting it's spreads. Bio-security plans refer to health management strategies, comprise key components like; formal diseases risk identification and risk assessment on a particular farm. These plans make proper use of the issues into a set of working instructions or protocols. These are a protocol on general hygiene procedures, a protocol on entrance, procedures for animals, cars, professionals, cattle, a protocol on disease diagnostics and animal treatment, or a protocol on good medicine application practice (Noordhuizen and Cannas da Silva, 2009; Stankovi and Zlatanovi, n.d). The success of a dairy farm business depends on the quality of management decisions that depend on the continuous evaluation of new information and technology (Bergevoet *et al.,* 2004; Joerger, 2016; Islam *et al*., 2020; Bekere *et al*., 2022).

With the farm manager's time often being the most limited resource (Holland *et al.,* 2014), it is important to examine which of the crucial areas of management that dairy farmers must focus greater attention. Managing facilities or equipment on a regular basis by livestock producers may be part of the recipe for economic success; additionally the fundamental aspects of management and decision-making are still integrally important (Campe *et al.,* 2015). In addition to management decision-making: farm size, milk production levels and milking systems used are also identified as factors that influenced dairy farm profitability positively. Research instructs that uptake of bio-security measures on cattle farms is lower with a few practices being rarely completed (Sayer *et al.* 2013). Study taken in the UK & Ireland suggests lower uptake of bio-security practices, even though cattle farmers considering bio-security as significant (Brennan & Christley, 2013). Milk production shortage was estimated at

128 million liters by 2020 and consumption in urban areas was estimated at a minimum 290 Million liters of milk in 2011 (with Ethiopia very low average of 19 liters/ year/person) and would expected to reach 375 million liters by 2020 (with 4% annual growth) Consumption (Confidential, 2015). These indicate excess demand for dairy product, which necessitate intensification of dairy-farm. However, there was ignorance of implementation of bio-security, the pillars of dairy business success especially, in developing country. Inadequate planning to the accomplishment of bio-security in such circumstances could have advantageous negative impact on cattle health, with attendant economic losses (Van Schaik *et al*., 2002) as well as public health risk. Bio-security in this period is the management levels accomplished to demises the risk of introducing severe pathogenic disease to herd (Caldow, 2004), preventing financial losses & protection of peoples health.

Previous studies have examined the accomplishment of bio-security in various agricultural enterprises (Mee et al., 2012), most highlighting that awareness of bio-security may exist but its accomplishment at the farm level is often weak. Biosecurity is the prevention of disease causing agents entering or leaving any place where farm animals are present, it involves a number of measures and protocols designed to prevent disease causing agents from entering or leaving a property and being spread. However designing control methods that result in a biosecurity farm is not as simple and most difficult aspect of implementing a bio-security plan is, deciding which control measures to use and then determine how these measures will be implemented (Villarroel and Vet, 2014). Some diseases are zoonotic and they can be transmitted between humans and animals, and therefore it demand public and occupational health reasons for having biosecurity measures.

Importance of Bio-security Measure

There are a range of benefits proposed to arise from implementation of bio-security practices to assist in the prevention & control of disease on cattle farms. These include improved animal welfare (MAFF/ DEFRA, 2002), increased profit margins improvement in vaccine effectiveness and reduction in incidences of antimicrobial and anthelmintic resistance. In addition, consumer factors such as the demand for quality assured products (Hennessy, 2008) and public awareness of zoonoses (Dargatz, 2002) encourage uptake of preventive practices. Different studies have shown positive associations between bio-security and some production parameters and between bio-security and farm profitability (Corrégé *et al.,* 2012; Siekkinen *et al.,* 2012; Rojo-Gimeno *et al.,* 2016; Col-lineau *et al.,* 2017). In addition, a higher bio-security level had a positive impact on reducing the amount of antimicrobials used in production (Postma *et al.,* 2016; D. Maes *et al.,* 2017). A disease outbreak in any herd could be financially devastating to the operation thus a program designed to prevent diseases are, a tight biosecurity program that designed to maximize disease resistance and minimize herd exposure to infectious agents. By identifying some of the diseases that are likely to be of greatest risk, prevention & control measures can be developed and implemented to focus on ones that are most likely to create problems (Wallace *et al.,* 2003).

Infectious diseases commonly found on dairy farms such as; bovine respiratory syncytial virus, bovine viral diarrhea virus, clostridial diseases; contagious mastitis from Staphy aureus, *Streptococcus agalactiae*, *Mycoplasma bovis*, *Haemophilus somnus*, infectious bovine rhinotracheitis, digital dermatitis, leptospirosis, listeriosis, *Mycobacterium paratuberculosis*, respiratory form of mycoplasmosis and pasteurellosis, etc. All of these diseases can limit productivity from lower milk production to reduced milk quality, from impaired reproduction to reduced calf survivability, from chronic debilitating infection to death. Any one of these diseases can become established in a naive, resident herd when new cattle are introduced. Pandemics, epidemics, zoonoses and emerging infectious diseases seem to speak of a generalized threat to life, affecting people, wild animals and livestock as well as plant life (Hinchliffe *et al*., 2013).In the two decades prior to 2001, one estimate suggests that there were 177 new or re-emergent human diseases, three-quarters of which were thought to have originated from animals and animal products (Taylor *et al.* 2001; Hinchliffe *et al.*, 2013). This alarm at the unpredictability and mutability of disease, most of which tend to fall under the catch all of bio-security (Gole and Hamido, 2020).

The concept of BRM recognizes that cattle diseases cannot be terminated, but that livestock producers can

manage disease risk through effective control measures. For diseases that are always present (endemic), reducing the value of infectious parts the animal was exposed to can positively affect the farm's economic impact & help justify the cost of implementing BRM (Hersom *et al.*, 2017). The rise in emerging & re-emerging pathogenic diseases, increasing globalization and increased human interaction with animals justify implementation of bio-security.

Traffic Control System

Depend on literature, list of on-farm bio-security measures should be created, which focuses on spreading characteristics of infectious agents. Since animals (livestock, wild animals, pets), people (farmers, workers, visitors), vehicles, equipment, water, feedstuff, bedding, manure and air can all be carriers of infectious agents, the measures were grouped into their corresponding categories. The most important biosecurity measure for dairy farms are minimizing the introduction of off premises cattle, feedstuffs, movement of people, vehicles and equipment where animals are kept. Other possible measure implementing best practice (hygiene and protective clothing) in situations where there is direct contact with animals. Consider points where disease could enter the ranch/farm, and how it could spread. Traffic control with in an operation should be designed to stop or minimize contamination of animals, feed, and equipment. It is important to remember that traffic includes more than vehicles. Limit visitors access to barns and lots, post a warning sign asking visitors to keep out and giving instructions or a telephone number to call instead of entering the operation. Keep a record of all visitors that enter the premises. Visitors to a ranch/farm operation present several potential problems (Hersom *et al*., 2017). People who have trave-led outside of the countries should be denied access to a ranch/farm for a minimum of 14 days to control accidental introduction of foreign goat diseases. Traffic control with in the operation should be designed to stop or minimize contamination of livestock, feed, feed handling equipment, & equipment used on animals.

Quarantine and Isolation System

This includes all animals that have been in facilities other than the subject dairy farm: markets, shows, temporary housing at other farms & veterinary clinics. Every time that an animal meets premises other than the subject dairy, it can become colonized or infected with pathogens. The best control method to avoid introduction of disease via off-premises cattle is the establishment of an isolation area. The objective of having an isolation area is to prevent direct and indirect contact between animals in the isolation area and resident animals. Off-premises animals should be isolated for 3-4 weeks to allow enough time for manifestation of clinical signs of disease that the animals may have acquired recently prior to introduction to the dairy. New animals should be tested for highly problematic diseases such as bovine viral diarrhea (BVD), brucellosis, tuberculosis, Johne's disease and trichomoniasis. If lactating cows are imported, their milk should be cultured for the presence of contagious mastitis pathogens. All diagnostic tests should be performed prior to introducing the animals onto the dairy. A specific testing protocol should be designed for BVD, where incoming animals are tested prior to arrival and if pregnant, their offspring should be tested at birth to prevent retaining PI calf (persistently infected). The most important step in disease control is limiting contact, co-mingling, and movement of livestock. This issue is of special importance for new animals arriving on the farm/ranch, including replacement animals, breeding animals, or animals returning from livestock shows. An important bio-security option on ranches is to separate livestock by age and/or production groups. Isolate animals with unfamiliar symptoms or those with symptoms that do not improve with usual treatment (Hersom *et al*., 2017).

Feedstuffs and water

Now a day's, many feedstuffs purchased and therefore can originate in multiple locations. Visual inspection of such feedstuffs may be the good that a cultivar can do because testing all batches of all feed stuffs for any disease creating agent is difficult, and thus biosecurity can be break in this area. Every feedstuff until that batch is lossed without incidents. In the case of a feed-related disease, samples will be available for sampling (Villarroel & Vet, 2014). The water source and the water delivery system, because both can become contaminated with disease-causing agents such as toxins from spills from manure contamination (Harun *et al*., 2022).

Water quality should be tested regularly to make sure it is potable as it is a high potential for diseases, pests and weeds to be carried in feed and water supplies, thus protecting the health of your livestock or crops, which is important to minimize the risks associated with feed and water (Beggs, 2017). Contaminated feed and water can result in the introduction of diseases such as toxoplasmosis from contamination with *Toxoplasma gondii* cysts from cats (Rego *et al*., 2016; Cenci Goga *et al.,* 2013), and ingestion of pasture contaminated with eggs of *Echinococcus* spp is important in the infection of small ruminants (Abdulhameed *et al.,* 2018). Ensuring that feed sheds and water sources are protected from vermin and other animals is essential in reducing these risks.

Movement restriction of wildlife, and other vectors

There are highly significant infectious diseases of cattle that can be carried and transmitted over long distances by other animals for example; bovine tuberculosis is known to exist in several wildlife species, particularly badgers and deer. Securing a herd against these vectors can be very challenging; geographical location may be the strongest defense, but many wildlife risks are unmanageable. Insect and arachnid vectors create specific risks for diseases such as Blue Tongue and Red Water disease (Ridge *et al.,* 2014). Dead animals should be removed and disposed of by burning, burial, or composting to decrease the survival of pathogens and to avoid access by scavengers (Carr and Howells, 2018; Abdulhameed *et al*., 2018; Robertson, 2019). Manure and used bedding material should also be composted and disposed off to prevent access by other animals (Van Limbergen *et al*., 2018), control of vectors particularly of birds, rodents, flies, and other insect that have the potential to transfer pathogens to livestock should be implemented (Curran *et al*., 2014).

The introduction of equipment contaminated with feces and other animal products (e.g., hair, feathers, saliva) to a farm is also a potential disease introduction risk (Ranjan *et al*., 2011). Workers on livestock enterprises should be discouraged & prevented from working at other livestock enterprises & from keeping similar livestock (Oliveira *et al.,* 2017). Staff should also be discouraged from visiting other livestock units, animal markets, animal shows, and slaughter houses, or if they do, should have no contact with animals on the employing enterprise for at least three days after such events (Guercio, 2012). The density of livestock enterprises, proximity to neigh-boring same-species units, and proximity to slaughter houses and major transport routes have also been proposed to influence the risk of disease introduction to a herd/flock (Desrosiers, 2011; Robertson, 2019).

Vehicles and people

People working with dairy cattle should be given appropriate training and should be tested by a recognized agricultural authority body. In reality, however, this was very interesting how many farm workers were trained to work with animals. On many farms in Hungary there are workers who, after losing a job not related to agriculture in a town or in a city, had the only option to find a job on a dairy farm (Gudaj and Brydl, 2014). People visiting livestock enterprises including veterinarians, livestock advisors, inseminators, hoof-trimmers, and feed suppliers are also a potential risk for disease introduction into a unit (Oliveira *et al.,* 2017). To reduce risk, only essential visitors should be allowed to visit the area/ buildings where animals are housed, and protective clothing and footwear should be provided by the enterprise to these visitors (Oliveira *et al*., 2017. So, protective clothing and footwear should be provided for all workers and visitors, and should not be used on any other unit or outside the enterprise. Similarly, visitors and workers should be required to shower-in and shower-out of enterprises in order to reduce the risk of disease introduction and escape from an enterprise (Robertson, 2019).

Service sector personnel and visitors are required to follow the bio-security conditions set by the producer with respect to limited access, clothing, and footwear worn, and movement of equipment and vehicles. Training, good communication, and regular updates are essential for all personnel (Robertson, 2019). Many vehicles travel from farm to farm-delivering products (semen, cleaning products, etc.) and services (veterinarian, hoof trimmer, AI technician) or collecting animals (cull animals, bull calves, carcasses) and milk. To prevent introduction of disease agents with vehicles, it is recommended that outside vehicles have no access to areas where the animals are housed. Vehicles should deliver and collect products in designated areas that are at the entrance of the farm, away from the animal pens.

Clear signs restricting access to un-authorized vehicles should be placed in visible areas. Since most dairies use artificial insemination, monitor semen tanks and use these biosecurity practices: Purchase semen from known sources with certified production techniques, buy semen, embryos or bulls from suppliers, who have control programs for infectious diseases, know the bulls' health history, keep semen tanks locked and allow only qualified people to handle semen. The importance of implementing bio-security to aid in controlling infectious disease at farm level was recognized internationally (Negrón *et al*., 2011), and the process can be particularly relevant in regions experiencing a changing agricultural demographic, including farm enterprise expansion. Documenting the implementation of on-farm bio-security measures is beneficial in providing baseline data to monitor 'bio-security uptake' by farmers, and in establishing further sociological and demographic studies that identify training requirements within farming communities. Bio-security practices and farmers' perception were investigated in different countries (Gunn *et al.,*2008; Compo *et al*., 2017) emphasized that although many farmers were aware of bio-security practices, many failed to adopt the protocols recommended for their establishments. Traditionally intensive industries, implement biosecurity more effectively than small holder & extensive industries; however others have emphasized the important role of education in ensuring that biosecurity practices are adopted by the livestock industries to reduce the risk of disease entry, in order to enable maximum productivity from these industries. Moreover specifically, study were done on biosecurity practices in middle Ethiopian goat's feedlots (Alema-yehu & Leta, 2014). This works reported a poor implementation of bio-security measures by the producers, along with the various constraints & challenges expressed by the producers such as cost, usefulness, importance, work load & lack of clarity & knowledge. Disease control & prevention in a dairy require a multifaceted approach with knowledge of the current diseases situation in an enterprise, the likely disease threats, and how the risk of introduction can be minimized. Such approach requires a sound knowledge of the discipline of livestock epidemiology, with a understanding of disease transmission and spread, risk factors for disease, and methods to prevent disease. It can be concluded that, biosecurity was critical to ensuring the health & productivity of livestock within an enterprise, region, & country, and that knowledge of veterinary epidemiology is essential for developing sound biosecurity practices. To smooth the adoption & emphasize the key concepts of bio-security and biocontainment within enterprises, a series of acronyms have been developed the same as (Smith, 2007), including isolation, resistance and sanitation (IRS) and (PennState, 2019), sanitation, traffic control, assessment, isolation, resistance, and security (STAIRS) as well again, isolation, traffic-control, sanitation as defined by FAO, (2008), & animal physiology management was used to smooth the adoption and emphasize major areas biosecurity that needs improvements.

MATERIAL AND METHODS:

Locations and Study Area

Present work was carried out collaborately in the two countries Ethiopia and Bangladesh in milk sheds. Diyar Dawa city is located in the lowlands at an altitude of 1276 meters above sea level (m.a.s.l.). Harar, additionally, is a walled city in east Ethiopia, a regional city of Harari region and a regional capital of East Hararghe region of Oromia region. The city has a projected population of 231,000 for the year 2014 (CSA, 2013; Dairy *et al*., 2016) and located at about 524 km from Addis Ababa located at an elevation of 1,884 m.a.s.l. These two (2) towns are home to privately own commercial dairy-farms and are the main milking centers of eastern Ethiopia. Apart from these modern dairy-farms, the vast surrounding rural districts are other sources of supply of milk and milk products (CSA, 2013; Dairy *et al*., 2016). Milk shed areas comprised several privately owned dairy farms comprising different numbers of predominantly cross-bred and Holstein Fresian dairy cattle.

Methodology and Study Design

The survey was a cross-sectional census survey, which involves collection of information's from all dairy-farms established in Dire Dawa & Harar cities. Therefore, it does not require sampling. At first, in this proposed survey all dairy farms was identified using official registry of dairy-farms & located with the help of local veterinary health officials or snowball technique until all farms were included and then, farm owners or their manager's were requested to parti-

cipate in the study and the required information's was gathered, after obtaining their verbal consent. Again, the number of those dairy owners who refused to participate also documented.

The farms were classified according to herd size & level of production into smallholder farm (<10 animals), medium farms (11 to 51 animals) & large farms with more than 51 animals (Megersa *et al*., 2011).

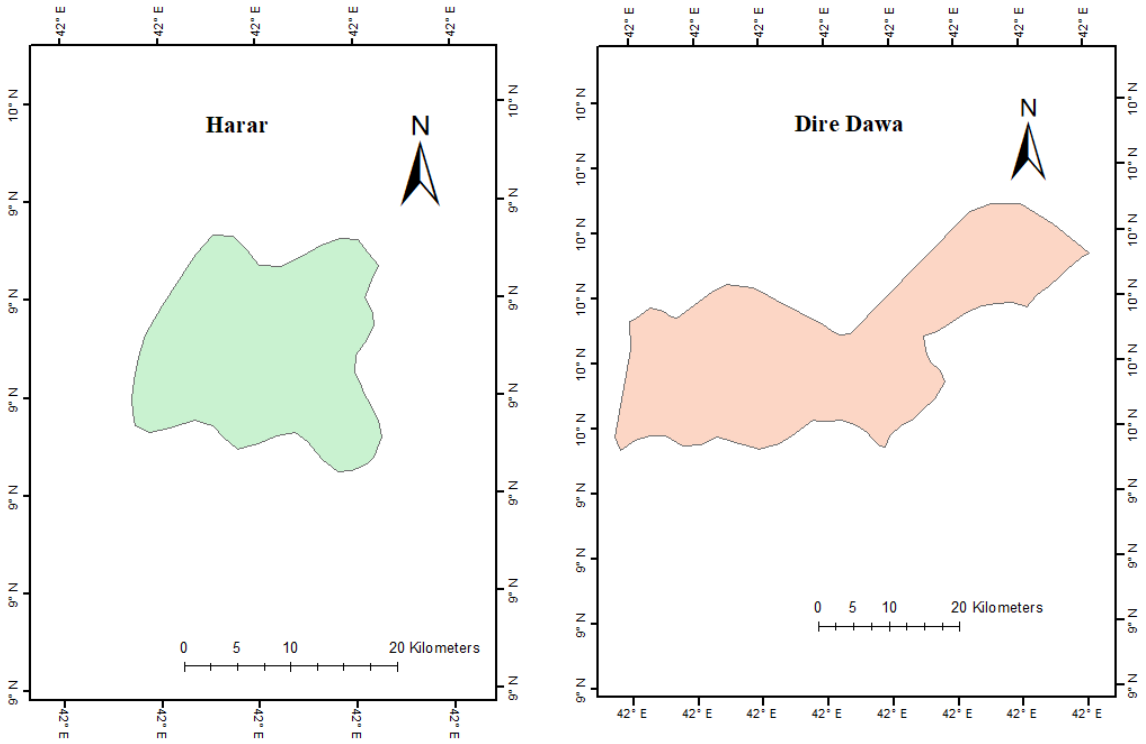

Fig. 1: Representing the Maps of the study area.

Collection of the Data

A questionnaire based survey was under taken to study the frequency of used of different biosecurity measures. Information about bio-security was obtained through on farm observations & interviews taken with owners & workers using a structured questionnaire. In the questionnaire contained 124 questions, mainly closed & semi-closed.

Questionnaire design

The question paper was divided into four (4) sections and the 1st question set consisted of gender, age, marital status, & occupation, education level, experiences, previous training in dairy-farm management, membership of a dairy farm cooperative, demographic and socio-economic characteristics of the farm owners, and knowledge of bio-security among others. The 2nd part was awareness of disease control and bio-security such as owners' understanding of livestock diseases, knowledge of bio-security, sources of bio-security in-formation, and the importance of bio-security & presence of a biosecurity plan. The 3rd category was farm characteristics such as farm area, year of establishment, farm size (m2), presence of buildings on the farm, presence of cattle barns, number of cattle (herd size), and cattle breed. The last category was bio-security measures such as isolation, traffic control, sanitation as defined by the FAO, (2008), and animal health management which was developed to collect data on biosecurity practices. Before starting the field work, the questionnaire was pretested and the questions were adjusted accordingly. The investigators among small samples of dairy farmers carried out pre-testing of the questionnaire. Adjustments were made by replacing some words, deleting irrelevant questions, and reformulating and splitting some questions as (Kouam, 2018).

Analysis of Data

Data collected in the work were stored in Micro-Soft Excel spreadsheets & analyzed used Statacorp statistical software version 20. They were analyzed used

descriptive statistics to analyze frequencies and percentages. Goat's farms were classified on the basis of bio-security status according to the method described by the Wijesinghe *et al*. (2017) with thin modification. A total of 124 marks were allotted in the questionnaire according to the strength & importance of bio-security. The total mark achieved by each farm was converted into a percentage and a farm above or equal to 51% was said to have "good bio-security" and below 51% poor biosecurity. The conglomerate of respondents' demographic and socio-economic and farm characteristics with bio-security compliance was assessed using Fishers exact tests statistics. The statistical significant conglomerate was tell to exist when $P < 0.05$.

RESULTS:

Demographic Features of the Farm Owners

Total of the 21 dairy-farm owners were interviewed in this work. From the respondents, 13 (71%) were Male while 6 (30%) were Female. Of the interviewed, 12 (60%) were older than 44 years age, 17 (85%) were married, and 14 (74%) had higher education level. Regarding their occupation, 16% were civil-servants, 31% were traders & 56% had occupations other than the two (2). 61% of the owners had experience of one to ten (10) years while 41% had more than ten (10) year's experience. 85% didn't have previous training on farm management, only 6% were producers of dairy co-operatives and 36% claimed to have knowledge of bio-security.

Table 1: Demographic and socioeconomic characteristics cattle farm owners.

Socioeconomic characteristics	Number	Percentage (%)
Gender		
Male	13	71
Female	6	30
Age (years)		
31 – 45	8	40
>45	12	60
Marital status		
Married	17	85
Not Married	3	15
Education Level		
Secondary education	5	25
Higher education	14	74
Occupation		
Civil servant	3	16
Trader	6	31
Others	11	56
Experience (years)		
One to ten (1-10)	12	61
More than ten (10>)	8	41
Previously training on the cattle farm management		
No	17	85
Yes	3	15
Producer of a dairy farm cooperative (s)		
No	19	95
Yes	1	6
Knowledge regarding biosecurity		
No	13	65
Yes	7	36

Aware on Disease-Control & Biosecurity

As represented in **Table 2**, from 20 farm owners interviewed 16(81%) disclosed their under-standing of goat diseases particularly those affecting dairy cows. Mejority respondents replied that prevention of diseases was cheapest method whereas 84% of them said prevention was less-time consuming while 15% described treatment was less costly. Majority of owners interviewed (65%) responded did not have knowledge on biosecurity while the remaining 35% claimed.

Table 2: Rate of livestock owners aware of animal disease-control & biosecurity.

Awareness	Number	Percentage (%)
Owners under-standing of animal diseases		
Yes	16	80
No	4	20
The cheap method		
Treatment	0	0
Prevention	20	100
Less-time consuming		
Treatment	3	15
Prevention	17	84
Knowledge on biosecurity		
Yes	6	35
No	13	65
Source of biosecurity information		
Veterinary	3	15
Internet	2	10
Professional	2	10
Not aware	13	64
Importance of the bio-security		
Very important	9	45
Important	4	20
Don't know	7	35
Presence of the Bio-security plan		
Yes	1	5
No	19	95

Farm Characteristics

Each 10 (51%) of the farms were situated in Harar & Dire Dawa and majority of dairy-farms, nine (45%), were established according to Ethiopian Calendar (Eth. Cal.) between the years 2001 and 2005 whereas each 4 (20%) were made on the years 1996 to 2000 and the years 2006 to 2010. All of the farms were established on areas lower than 5002 m^2 in size. A great majority of cattle farms (6 that is 35%) were established on areas of less than 1001 m^2 while 13 (61%) had sizes between 2002 and 5001 m^2. All of the farms had buildings in the farm, however, 4 (24%) described there were no cattle-barns. Majority (66%) of dairy-farms comprised <101 animals and of Holstein Friesian breed.

Table 3: Features of the animal-farms established in Harar & Dire Dawa towns.

Features	Number	Percentage (%)
Farm location		
Harar	10	50
Dire Dawa	10	50
Year of the establishment (Ethiopian Calendar)		
1991 - 2000	6	30
>2000	14	70
Farm size (m^2)		
<2000	8	40
>2000	13	61
Presence of the buildings		
Yes	20	100
No	0	0
Presence of cattle barn(s)		
Yes	15	75
No	5	25
Number of the cattle		

<100 animals	13	65
100-150 animals	7	35
Breed of the livestock		
Holstein Friesian	13	65
Crossbred	7	35

Biosecurity Status

Total of the 35 bio-security practices were included to assess implementation level of the traffic-control component of bio-security measure (**Table 4**). The biosecurity score ranged from 12-21 and the percentage varied from 34.3% - 60% and number of farms with "Good" bio-security level for the traffic-control were 9 and that of "Poor" level were 11 and with regard to the isolation component, 32 bio-security practices were selected and used to evaluate the adoption level. The biosecurity score and percentage of isolation component varied from 11-27 and 34.4%-84.4%, respectively. Only 3 dairy farms gained "Good" in the implementation of the isolation component of bio-security measure while the remaining 17 were "Poor". Alarmingly sanitation practices, a total of 46 bio-security practices were chosen & evaluated. The bio-security score & percentage of sanitation practices extended from 3-25, ad 6.5% – 54.3% in that order. The implementation level was "Good" for 5 farms & "Poor" for 14 farms. Fin-ally, 12 bio-security practices were considered for the estimation of animal physiology management. The bio-security score ranged from 1-5 and percentage extended from 8.3% - 41.7% and the adoption score was evaluated as "Poor" for all the 21 cattle-farms included in the work.

Traffic control system

The traffic-control component of bio-security practices with high adoption levels (> 90%) were included; no vehicles frequently move off-property, go-to-property, sale yard, abattoir &/or show & then return, no equipment used for different activities, no sharing of equipment & machinery with other farms, no more than one (>1) main entry point to the farm, locating animal entry areas away from the rest of the storage, not grazing resting pastures recent spread with wastes, work from young to old animal, separation of material for young and old animals and when entry animals the lorry & truck didn't enter the stable. The least implemented measures (less than 20%) were, no driveway, transfer information including animal health records for all new animals, outgoing animals moved off the farm with information on animals health status, keeping records of cattle movements, presence of entry restriction sign post, use own vehicle to transport visitors, record presence to the routine, maintaining and monitoring heath records for individual animals, use own vehicle for animal movements, no purchase of replacement animals is done and availability of visitors logbook. The respective range of the traffic-control component for dairy-farms was 12 to 21 and 16.94 ± 2.4 with a maximum score of 35 points.

Table 4: Level of bio-security practices of the traffic-control bio-security component.

Biosecurity practices	**Yes (%)**	**No (%)**
Not infested with wild animals	10 (50)	10 (50)
Presence of parking lot	9 (45)	11 (55)
No driveway	3 (15)	17 (85)
No additions to the herd	8 (40)	12 (60)
Source animals directly from the herd of origin	10 (50)	10 (50)
Transfer information including animal health status records for all new animals	0 (0)	20 (100)
Outgoing animals moved off the farm with information on animals health status	0 (0)	20 (100)
Keeping records of livestock (cattle) movements	0 (0)	20 (100)
Have and follow a movement plan	11 (55)	9 (45)
Closing gates & seeing visitors by the appointment	9 (45)	11 (55)
No Exchange of production material (drinkers, feeders, buckets, and tools) between farm	19 (95)	1 (5)
No vehicles frequently move-off property, or show & then return	20 (100)	0 (0)
No equipments used for the different works	20 (100)	0 (0)
Not allowing frequent visits to the farm area	9 (45)	11 (55)
No sharing of equipments & machinery with other farms area	20 (100)	0 (0)
Notify non-professional visitors, professional visitors and drivers of permitted areas of access to	7 (35)	13 (65)

them and transport vehicles prior entry		
No more than one (>1) or more main gate in the farm	19 (95)	1 (5)
Presence of entry restriction sign post	1 (5)	19 (95)
Use own vehicle to transport visitors	0 (0)	20 (100)
Record presence to the routine	0 (0)	20 (100)
Locating animal loading sections	20 (100)	0 (0)
Maintaining and monitoring heath records for individual animals	0 (0)	20 (100)
Management of sick animals after healthy ones	17 (85)	3 (15)
Not grazing resting pastures presently spread with the waste	20 (100)	0 (0)
Use own vehicle for animal movements	0 (0)	20 (100)
Work from young to old animal	19 (95)	1 (5)
Separation of material for young and old animals	19 (95)	1 (5)
When loading cattle's the lorry &/or truck did not enter in the stables	20 (100)	0 (0)
No purchase of replacement animals is done	1 (5)	19 (95)
Nonprofessional visitors are not allowed to enter into farm	8 (40)	12 (60)
Availability of visitors logbook	0 (0)	20 (100)
Visitors do not have direct access point to the stables or barns	10 (50)	10 (50)
Absence of the freely moving cats & dogs	9 (45)	11 (55)
Presence of permanent rodent control	15 (75)	5 (25)
Presence of own feed and milk collection trucks	6 (30)	14 (70)
Total score of the traffic-control bio-security practices	35	
Minimum – Maximum biosecurity score of dairy-farms	12-21	
Mean ± Standard deviation biosecurity score of dairy-farms	16.94 ± 2.4	

Isolation

More than 90% of farmers disclosed or applied isolation bio-security measures such as no-pasture area, fence off-dead-animal pits & garbage-tips, fencing-off stock access to water courses, no maintain contact of pre-weaned calves with the older cattle, maintain no contact of dry cows with lactating cows, no mixing of different species, separate calves & young stock from the older animals. Bio-security practices of the isolation component with the least adoption levels were (< 20%) included; farm located > 501 m from the main road, farm located > 501 m from residential area, pre-sence of maternity pen and calving takes place in a separated calving box or maternity pen. The range, mean and standards deviation of isolation score of biosecurity component for the dairy-farms was 11 to 27 and 19.24 ± 3.91 respectively with a maximum score of 32 points.

Table 5: Ratio of bio-security practices of the isolation bio-security component.

Biosecurity practices	**Yes (%)**	**No (%)**
Not infested with wild animals	10 (50)	10 (50)
Presence of parking lot	9 (45)	11 (55)
No driveway	3 (15)	17 (85)
No additions to the herd	8 (40)	12 (60)
Source animals directly from the herd of origin	10 (50)	10 (50)
Transfer information including animal health status records for all new animals	0 (0)	20 (100)
Outgoing animals moved off the farm with information on animals health status	0 (0)	20 (100)
Keeping records of cattle movements	0 (0)	20 (100)
Have and follow a movement plan	11 (55)	9 (45)
Closing gates & seeing visitors by the appointment	9 (45)	11 (55)
No Exchange of production material (drinkers, feeders, buckets, and tools) between farm	19 (95)	1 (5)
No vehicles are frequently move off property, or show & then return	20 (100)	0 (0)
No equipments used for different activities	20 (100)	0 (0)
Not allowing frequent visits to the farm	9 (45)	11 (55)
No sharing of equipments & machinery with other farms	20 (100)	0 (0)
Notify non-professional visitors, professional visitors and drivers of permitted areas of access to them and transport vehicles prior entry	7 (35)	13 (65)
No more than one (>1) or more main gate in the farm	19 (95)	1 (5)
Presence of entry restriction sign post	1 (5)	19 (95)

Use own vehicle to transport visitors	0 (0)	20 (100)
Record presence to the routine	0 (0)	20 (100)
Locating of the animal entry areas	20 (100)	0 (0)
Maintaining and monitoring heath records for individual animals	0 (0)	20 (100)
Management of sick animals after healthy ones	17 (85)	3 (15)
No grazing of the resting pastures presently spread with the waste	20 (100)	0 (0)
Use own vehicle for animal movements	0 (0)	20 (100)
Work from young to old animal	19 (95)	1 (5)
Separation of material for young and old animals	19 (95)	1 (5)
When passing animals the lorry &/or truck did not enter the stables	20 (100)	0 (0)
No purchase of replacement of the animals is done	1 (5)	19 (95)
Nonprofessional visitors are not allowed to enter into farm	8 (40)	12 (60)
Availability of visitors logbook	0 (0)	20 (100)
Visitors do not have direct access point to the stables or barns	10 (50)	10 (50)
Absence of freely moving cats and/or dogs on the farm	9 (45)	11 (55)
Presence of permanent rodent control	15 (75)	5 (25)
Presence of own feed and milk collection trucks	6 (30)	14 (70)
Total score of the traffic-control bio-security practices	35	
Minimum – Maximum biosecurity score of dairy-farms	12-21	
Mean ± Standard deviation biosecurity score of dairy-farms	16.94 ± 2.4	

Sanitation

No found higher adoption levels of the sanitary bio-security measures (greater than 90%). The least implemented measures (less than 21%) were asking visitors to wash their hands before and after contact with your livestock (5%), presence of protective clothing for visitors, encourage 'come clean (0%), go clean' practices for visitors (0%), ensuring visitors cleaning and disinfection after visits (0%), if lent, clean down equipment and vehicles before use on farm (5%), provide clean down equipment or facilities for visitors to clean boots and equipment's (5%), clean vehicles and equipment prior to moving from one farm to the other, provision of protective clothing for visitors (0%), have written instructions for cleaning and disinfecting different types of equipment (0%), have written sanitation, disinfection procedures and schedules for all animal holding areas/facilities (0%), specific cleaning and sanitizing protocols for higher-risk practices (e.g. AI & treatment of sick animals) (11%), nonprofessional visitors use farm-specific foot wear (0%), nonprofessional visitors use farm-specific clothing (0%), check for visitors use of a disinfection footbath, professional visitors wear or dressed in herd-specific protective clothing (5%), presence of dis-infection footbaths at the gate (0%), presence of car-wash dip at the gate (0%) and presence of disinfectant footbaths between premises (0%). The range of bio-security score was 3-25 and the mean bio-security score of the farms was 16.64 ± 6.82 for a maximum level of 46 points.

Table 6: Percentage of bio-security practices of the sanitation and hygiene bio-security components.

Biosecurity component	**Yes (%)**	**No (%)**
Location on elevated ground	13 (65)	7 (35)
No evidence of flooding during the wet season	12 (60)	8 (40)
Year round supply of fresh water	11 (55)	9 (45)
Enforce cleaning of vehicles entering the farm	9 (45)	11 (55)
Cleaning of on-farm animal health equipment after each use	7 (35)	13 (65)
Asking visitors to wash their hands before and after contact with your livestock?	1 (5)	19 (95)
Presence of protective clothing for the visitors	0 (0)	20 (100)
Encourage 'come clean, go clean' practices for visitors	0 (0)	20 (100)
Ensuring visitors cleaning and disinfection after visits	0 (0)	20 (100)
If lent, clean down equipment and vehicles before use on farm	1 (5)	19 (95)
Provide clean down equipment or facilities for visitors to clean boots and equipment's	1 (5)	19 (95)
Clean vehicles and equipment prior to moving from one farm to the other	0 (0)	20 (100)
Provision of protective clothing for visitors	0 (0)	20 (100)
Disposal of contaminated and pest damaged stock feed	12 (60)	8 (40)
Routinely clean and/or disinfect housing after removing manure	13 (65)	7 (35)

Cow stalls are clean	13 (65)	7 (35)
Good hygiene of cow from dirt	11 (55)	9 (45)
Presence of control programs for feral-animal, wildlife and weed	15 (75)	5 (25)
Inspect for feeding and drinking equipments for cleanliness	17 (85)	3 (15)
Prevention of stored stock feed contamination by livestock, and domestic animals and other feed types	14 (70)	6 (30)
Regular pest control	16 (80)	4 (20)
Testing water for quality	2 (10)	18 (90)
Visual Inspection of stock feed for contaminants and pest damage etc.	17 (85)	3 (15)
Have written instructions for cleaning and disinfecting different types of equipment	0 (0)	20 (100)
Have written sanitation, disinfection procedures and schedules for all animal holding areas/facilities	0 (0)	20 (100)
Have appropriate and effective cleaning & disinfection materials	4 (20)	16 (80)
Disinfect livestock related equipment between uses	6 (30)	14 (70)
Practice sanitation to minimize contamination of livestock waterers by manure and urine	17 (85)	3 (15)
Specific cleaning and sanitizing protocols for higher-risk practices	2 (10)	18 (90)
Have walls, ceilings and facility parts that are easy to clean and disinfect	11 (55)	9 (45)
Remove and renew bedding on a Regular schedule	6 (30)	14 (70)
Presence of dead-stock disposal protocol	10 (50)	10 (50)
Ensures dead-stock is removed from housing	14 (70)	6 (30)
Dispose of dead stock by burying, composting or pickup by a dead-stock disposal service	17 (85)	3 (15)
Use equipment for a single purpose only	17 (85)	3 (15)
Clean and disinfect cattle barn after abortion	12 (60)	8 (40)
Clean calving box or maternity pen after each calving	9 (45)	11 (55)
Cleaning & disinfecting hands between age groups handling	7 (35)	13 (65)
Cadaver storage facility frequently cleaned & disinfected	15 (75)	5 (25)
Nonprofessional visitors use farm-specific foot wear	0 (0)	20 (100)
Nonprofessional visitors use farm-specific clothing	0 (0)	20 (100)
Check for visitors use of a disinfection footbath	0 (0)	20 (100)
Professional visitors wear or dressed in herd-specific protection clothing	1 (5)	19 (95)
Presence of disinfection footbaths at the gate	0 (0)	20 (100)
Presence of carwash dip at the gate	0 (0)	20 (100)
Presence of disinfectant footbaths between premises	0 (0)	20 (100)
Total score of the isolation bio-security practices	46	
Minimum – Maximum biosecurity score of dairy-farms	3 - 25	
Mean ± Standard deviation biosecurity score of farms	16.64 ± 6.82	

Management of the Animal health

Bio-security measures associated with management of animal health with implementation level of greater than 90% were not present. Besides, animal health management measures with adoption level lower than 20% included testing animals moving onto the farm (0%), presence of accurate disease record (0%), recording of the number of animals that died or we destroyed (0%), documenting of relevant disease management strategies (0%), routine diagnostic testing farm stock (0%), recording the number of animals with disease (0%) and test all purchased animals (0%). The range and mean biosecurity score of the traffic control component for the assessed dairy farms was 0 to 4 and 3.24±1.06, respectively, for a maximum score of 12 points.

Table 7: Level of the bio-security practices of management of cattle health bio-security component.

Biosecurity practice	**Yes (%)**	**No (%)**
Vaccination of the animal	7 (35)	13 (65)
Testing animals moving onto the farm	0 (0)	20 (100)
Presence of accurate disease record	0 (0)	20 (100)
Offering newborn calves more than 2-4 liters of colostrums within 2-12 hours of birth	14 (70)	6 (30)
Recording of the ratio of animals	0 (0)	20 (100)
Documenting of relevant disease management strategies	0 (0)	20 (100)
Routine diagnostic testing farm stock	0 (0)	20 (100)
Following veterinarian-reviewed infectious disease and parasite control program	18 (90)	2 (10)
Routine inspection of farm stock	10 (50)	10 (50)

Vaccination routine of the cattle	16 (80)	4 (20)
Recording the number of animals with disease	0 (0)	20 (100)
Test all purchased animals	0 (0)	20 (100)
Total score of the isolation bio-security practices	12	
Minimum – Maximum biosecurity score of dairy-farms	1 - 5	
Mean ± Standard deviation biosecurity score of farms	3.24 ± 1.06	

Table 8: The bio-security score & bio-security level associated with the bio-security components.

Farm ID	Traffic-control			Isolation			Sanitation			Management of Animal health		
	BS	%	BL	BS	%	BL	BS	%	BL	BS	%	BL
01	12	34.3	Poor	14	43.8	Poor	17	37.0	Poor	4	33.3	Poor
02	15	42.9	Poor	18	56.3	Good	16	34.8	Poor	3	25.0	Poor
03	15	42.9	Poor	19	59.4	Good	16	34.8	Poor	4	33.3	Poor
04	13	37.1	Poor	16	50	Good	3	6.5	Poor	2	16.7	Poor
05	14	40	Poor	12	37.5	Poor	9	19.6	Poor	2	16.7	Poor
06	16	45.7	Poor	11	34.4	Poor	7	15.2	Poor	2	16.7	Poor
07	19	54.3	Good	20	62.5	Good	21	45.7	Poor	3	25.0	Poor
08	21	60	Good	24	75.0	Good	23	50.0	Good	4	33.3	Poor
09	20	57.1	Good	23	71.9	Good	24	52.2	Good	5	41.7	Poor
10	18	51.4	Good	20	62.5	Good	21	45.7	Poor	4	33.3	Poor
11	21	60	Good	22	68.8	Good	22	47.8	Poor	4	33.3	Poor
12	19	54.3	Good	19	59.4	Good	10	21.7	Poor	4	33.3	Poor
13	17	48.6	Poor	19	59.4	Good	14	30.4	Poor	3	25.0	Poor
14	16	45.7	Poor	24	75	Good	23	50.0	Good	3	25.0	Poor
15	18	51.4	Good	27	84.4	Good	25	54.3	Good	5	41.7	Poor
16	16	45.7	Poor	18	56.3	Good	6	13	Poor	1	8.3	Poor
17	16	45.7	Poor	19	59.4	Good	13	28.3	Poor	3	25.0	Poor
18	16	45.7	Poor	20	62.5	Good	25	54.3	Good	2	16.7	Poor
19	18	51.4	Good	20	62.5	Good	16	34.8	Poor	4	33.3	Poor
20	19	54.3	Good	20	62.5	Good	22	47.8	Poor	3	25.0	Poor

Overall, total of 124 bio-security practices were considered to evaluate the bio-security status of study farms. As focused in **Table 9**, the bio-security score of dairy-farms out of 124 ranged from 33 to 74. The ranges of the bio-security score varied from 27. 1% to 61%. From the 21 dairy-farms included in the present study nine (9) farms gained a ranges of score greater than (>) or equal (=) to 51% (ranging from 50.3% to 61%), thus their bio-security compliance was evaluated as "Good". The remaining 12 farms attained a ranges score lower than (<) 51% (varying from 27.1% to 47.4%) & therefore, marked as "Poor".

Table 9: Summary of bio-security level, percentage score, and bio-security status of cattle farms.

ID. No.	Biosecurity score (n = 124)	Percentage	Biosecurity compliance
01	47	37.6	Poor
02	52	41.6	Poor
03	54	43.2	Poor
04	34	27.1	Poor
05	37	29.6	Poor
06	36	28.8	Poor
07	63	50.3	Good
08	72	57.6	Good
09	72	57.6	Good
10	63	50.3	Good
11	69	55.2	Good
12	52	41.6	Poor
13	53	42.4	Poor
14	66	52.8	Good
15	75	60.0	Good

16	41	32.8	Poor
17	51	40.8	Poor
18	63	50.3	Good
19	58	47.4	Poor
20	64	51.2	Good

Table 10: Evaluation of association between respondents demographic & socioeconomic and farm characteristics & bio-security status (*Significant).

Variables	Number	Biosecurity Compliance		Fishers exact value	*p*-value
		Good (%)	Poor (%)		
Gender					
Male	14	6 (42.9)	8 (57.1)	0.09	1.000
Female	6	3 (50.0)	3 (50.0)		
Age (years)					
31 - 45	8	2 (25.0)	6 (75.0)	2.15	0.197
>45	12	7 (58.3)	5 (41.7)		
Marital status					
Married (1)	17	9 (52.9)	8 (47.1)	2.89	0.218
Not married (2)	3	0 (0.0)	3 (100.0)		
Education Level					
Secondary and lower	5	3 (60.0)	2 (40.0)	0.61	0.617
Higher education	15	6 (40.0)	9 (60.0)		
Occupation					
Civil servant	3	1 (33.3)	2 (66.7)	0.90	0.835
Trader	6	2 (33.3)	4 (66.7)		
Others	11	6 (54.5)	5 (45.5)		
Experience (years)					
One to ten (1-10)	12	5 (41.7)	7 (58.3)	0.13	0.714
More than ten (>10)	8	4 (50.0)	4 (50.0)		
Previous training management on the dairy farm					
No	17	8 (47.1)	9 (52.9)	0.19	0.660
Yes	3	1 (33.3)	2 (66.7)		
Member of the dairy farm cooperative(s)					
No	19	9 (47.4)	10 (52.6)	0.86	0.353
Yes	1	0 (0.0)	1 (100.0)		
Knowledge of the bio-security					
No	13	5 (38.5)	8 (61.5)	0.64	0.423
Yes	7	4 (57.1)	3 (42.9)		
Farm location					
Harar	10	1 (10.0)	9 (90.0)	9.90	0.005*
Dire Dawa	10	8 (80.0)	2 (20.0)		
Establishment Year (Ethiopian Calendar)					
1991 - 2000	6	3 (50.0)	3 (50.0)	0.09	0.769
>2000	14	6 (42.9)	8 (57.1)		
Farm size (m^2)					
<2000	8	3 (37.5)	5 (62.5)	0.30	0.582
>2000	12	6 (50.0)	6 (50.0)		
Number of animals (herd size)					
<100	13	4 (30.8)	9 (69.2)	3.04	0.081
100 – 150	7	5 (71.4)	2 (28.6)		
Cattle Breed					
Holstein fresian	13	7 (53.9)	6 (46.1)	1.17	0.279
Mixed breed	7	2 (28.6)	5 (71.4)		

Factors with Overall Bio-security Measures

Several demographic and sociodemographic characteristics as well as farm features were evaluated for their conglomerate with the overall bio-security adoption level using Fishers exact test. Among those characteristics only location the farm (Fishers exact value = 9.91; $p < 0.005$) was statistically significantly associated with the level of bio-security measure. From ten (10) dairy farms located in Harar town, only one (11%) was evaluated to have "Good" bio-security implementation level. Furthermore, from ten (10) study dairy farms of Dire Dawa town, eight one (81%) were examined to have "Good" bio-security adoption level.

DISCUSSION:

The current work, a comparatively small sample size was used. An important factor was that the experiment list was created by the scientists at each farm, rather than sending a questionnaire to the farms. The researchers believe that more reliable data on bio-security practices can be obtained by conducting farm visits, but this requires more time and resources than mailing questionnaires. Moreover, it was not always easier to get producers' permission to visit their farms. According to this studies, out of 50 dairy farmers only 20 farmers, willing and participated and 6 farmers were not willing for different reason. The study provides significant information's on the demography and socio-economic features of farm owners, farm characteristics, and awareness on disease prevention and bio-security aspects of BPs in dairy farms and assessed for their conglomerate with the overall bio-security adoption level using Fishers exact test.

Among those features, only location of the farm (Fishers exact value = 9.91; $p<0.005$) was statistically significantly conglomerated with the level of bio-security measure, this will be, due to culture, climate, & a variation in the training & technical support between regions. From ten (10) cattle farms located in Harar town, only one (11%) was examined to have "Good" bio-security implementation level and on the other hand, from ten (10) cattle study dairy farms of Dire Dawa town, eight one (81%) were evaluated to have "Good" bio-security adoption level. In the work there was nothing found regarding the effects of education in implementation of bio-security? However, others study reported that the important role of research in ensuring bio-security practices (Robertson, 2019 and Wolff *et al*., 2017).

Despite lower uptake of bio-security practices, in the work dairy farmers considering biosecurity as important. On this work only 15% participant got sources of information on bio-security from veterinarian which's in contrast to (Gunn *et al.,* 2008 and Derks *et al.,* 2012;) that veterinarians have been isolated as one of the most important and the most reliable & credible sources of information for farmers on bio-security. Among 21 dairy cattle producers in harar & dire dawa, the larger believed that bio-security (Control) was more cost-effective (Cheaper method) (101%, n = 21) and more time-efficient (Low time consuming) (86%, n = 18) than treating disease on-farm, which are the same & even more implemented. Some farmers (46%, n=10) also believed that benefits (Very importance) could be joined by implementing even a small number of bio-security measures. The interview revealed that the larger are not aware (65%, n = 13) of bio-security which is in contrast to (Mee *et al.,* 2012), & the larger highlighted awareness of bio-security exist and 45% informed for bio-security measures, (14%, n =3) were veterinarians, followed by Internet (11%) and Professional (11%) in contrast focysed by (Collineau and Stärk, 2017) as information channels for bio-security measures were primarily private veterinarians (93%, n=52) followed by articles/professsional press (77%, n = 43). On this work, the larger highlighted that awareness of bio-security does not find but its implementation at farm area was also poor the same as (Mee *et al.,* 2012) but there is sta-tistical significant difference between study areas (location), at Dire Dawa it is implemented as good enough but in Harar poor. This study provided a baseline assessment of bio-security practices on dairy cattle farms in Harar & Dire Dawa towns of Ethiopia. In the current work only one factor associated or affected bio-security status, which was study area this due to accessibility to different facility, climate, culture, & a diversity in the training and technical support between regions , which are the similar focused by the Sayers *et al*. (2013).

Traffic Bio-security

High adoption levels (> 90%), included no vehicles frequently move-off wealth, go to property, abattoir sale yard, &/or show & then return, no equipment used

for different purposes, no sharing of equipment & machinery with other farms, no more than one (>1) main entry point to the farm, locating animal loading areas away from the rest of the stock, not grazing resting pastures presently spread waste, work from young to old animal, separation of material for young & old animals and when loading animals the lorry or truck did n't enter the stable. Having an insect &/or rodent control plan 15 (75%) were more implemented than (Can & Altuğ, 2014) which was (46%). Presence of entry restriction sign post 1 (5%), use own vehicle to transport visitors 0 (0%), keeping records of livestock movements 0 (0%), outgoing animals moved-off the farm with information 0 (0%), transfer information including animal health, records for all new animals 0 (0%), 40% no additions to the herd and 60% add to the herd on animals health status. 51% visitors do not have direct access point to the stables or barns. Closing gates & seeing newers by appointment 9 (45%) and 11 (55%) are not, this results different with (Damiaans *et al*., 2020), reporting (64%) access to the stables was regulated by a closed gate and a requirement for visitors to announce themselves before entering. Traffic components biosecurity were found the second mostly implemented by status as there were 11 participant poor statuses and 9 (Nine) participants received good status.

Don't sharing of equipments & machinery with other farms 100% and No vehicles frequently move-off property, go to property, abattoir or show and then re-turn 100% performed. Presence of permanent rodent control 15 (75%) better than around 64%.

Sanitation Bio-security

In the current study none of the cultivars provided protection clothing for visitors which less than (Can and Altug, 2014) reported 32 %, & Less than 40% (Noremark *et al*. 2010) 33% of the cultivars provided protective clothing for visitors and Less than 41% of the producers reported that they provide protective clothing for visitors. Measures based on farm-specific clothing & boots were not well implemented by most visitors (5%). Professional visitors wear or dressed in herd-specific defensive clothing and19 (95%) are not. Measures regarding farm-specific clothing and boots were not well implemented by most visitors (5%) professional visitors wear or dressed in herd-specific protective clothing and 19 (95%) are not, which are the same to (Damiaans *et al.,*2019). Regarding sanitation, the implementation status by farmers were found poor by 15 farmers and only five of them got good status, thus hygiene was the 2nd least implemented bio-security components.

Management of Cattle Health

Seven (35%) vaccination of cattle before being introduced into the herd and 13 (65) are not again most cultivars implement routine immunization of cattle 16 (81%) which are contrary to veal farm (Damiaans *et al.,* 2019). Management of the health was the least implemented of all bio-security components recorded as all farm was found "Poor "status.

Isolation Bio-security

Separate calves & young stock from older animals 19 (95%), no mixing of different species 19(95%), fence off dead animal pits and garbage tips 19(95%) and fencing off stock access to water courses 19 (95%).

Maintain no contact of pre-weaned calves with older cattle, maintain no contact of dry cows with lactating cows, absence of pasture contact with others cattle 17 (85%), presence of adequately maintained boundary fence around the farm 17(85%) and no pasture area 18 (90%). Eleven of twenty (55%) farmers thought they isolate sick animals and nine (45%) farmers couldn't applied isolation, in contrast to reported none of farmers isolate sick animals so direct and indirect was contact possible to the herd. It is re-ported that most producers did not isolate cattle's moved from another farm (Can and Altuğ, 2014). Only a few producers were aware of the newly purchased animals' disease history. 60% of producers introduced new cattle's directly into the herd without prior isolation which is approximately the similar reported by Noremark *et al.* (2010). On farms there is not a written plan for implementation of biosecurity measures whish's same reported by (Milanovic, 2019). Purchase replacement cattle's from herd with known health status was 12 (60)% which was better than 20% reported by (Damiaans *et al*., 2019). Isolation components of biosecurity was recorded better implementation as there were only three farmers found poor status and the others 17 participant was good by status.

CONCLUSION:

Although the study provides important informations on the demography and socio-economic characteristics of farm owners, farm features, awareness on disease control & bio-security aspects in dairy farms, larger & more comprehensive studies are needed for future, especially, those of Harar as there were only one farm from ten to have good biosecurity status. At the farm, we noticed that there was no biosecurity plan, so farmers should be advised or trained to have bio-security plan. Implementing routine blood or other diagnostic disease screening at purchase, maintaining a closed herd/flock. Farmers should have written plan for implementation of bio-security measures for safety of their business, animal's welfare and public health. We found the least working biosecurity was the health management part so that farmer advised to develop, implement and maintaining good farm management practices as which is better allow biosecurity plan to operate effectively and provide animals with an environment that would be conducive to good health and maximum production. There was nothing about training as well as study done on dairy farm biosecurity in Ethiopia so the concerned policy makers should prioritize biosecurity issues on animals farm especially dairy farm and reach farmers either through training or different regulatory measures. Documenting the implementation of on-farm bio-security measures was beneficial in providing baseline data to monitor 'bio-security uptake' by farmers, and in establishing further sociological and demographic studies that identify training requirements with in farming communities, based on this study, especially those farmers in Harar should be documented.

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CONFLICTS OF INTEREST:

The author (s) declares that there is no potential conflict of interest.

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