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The status of cattle brucellosis in Ethiopia: A review

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Abstract

Brucellosis is an infectious bacterial disease caused by member of the genus Brucella. Bovine Brucellosis is an important disease of cattle, which has zoonotic importance with substantial economic losses. Risk factors that can predispose to brucellosis include Animal factors, Pathogen factors, environmental factors, managemental factors and occupational risk factors. Hence, knowledge of brucellosis occurrence in traditional livestock husbandry practice has considerable importance in reducing the economic and public health impacts of the disease. The possible sources of infections include all infected tissues, aborted fetus, vaginal discharges, cultures and potentially contaminated materials. The pathogenesis of the diseases lies on the presence of the bacteria, in the cells and employing various methods to survive in the phagocytic cells. The disease can be transmitted from infected host to susceptible animals in direct and indirect contacts. However, the most common mode of transmission is sexual contact. Various methods are employed for the diagnosis of brucellosis including microscopic examination, culture methods, serological and molecular biology. In Ethiopia, Brucella sero prevalence with in extensive cattle rearing system is lower than that of intensive systems. The most rational approach for control of *B. abortus* infection is by vaccinating young female animals. To deal with diseases like brucellosis, the public in general and high-risk groups in particular should be made aware of the zoonotic and economic importance of brucellosis through veterinary extension education.

Keywords: Brucellosis; Cattle; Complement Fixation Test; Ethiopia; Public Health; Rose Bengal Test; Sero- Prevalence

1. Introduction

Ethiopia possesses the largest livestock population in Africa. An estimate indicates that the country is home for about 59.5 million cattle, 30.7 million sheep and 30.2 million goats [1]. However, the contribution of the livestock sector to the national economy has been reported to be small compared to its potential. One of the main causes of the mismatch between herd population size and production output from livestock in Ethiopia is undoubtedly the widespread occurrence of huge number of infectious diseases, which drastically reduce animal production [2].

Brucellosis is an infectious disease of domestic and wild animals with serious zoonotic implication in humans. It is considered as the most wide spread zoonoses next to rabies [3]. It is caused by bacteria of the *Brucella* genus.. Six species (*B. abortus, B. melitensis, B. suis, B. ovis, B. canis, B. neotomae)* containing several biotypes are responsible for the natural infection of a number of animal species, including cattle, small ruminants, pigs, rodents and carnivores, as well as humans and other mammals [4].

Bovine brucellosis is mainly caused by *Brucella abortus*; to a lesser extent by *B. melitensis* and occasionally by *B. suis*. Clinically, it is characterized by abortion and retained fetal membrane (RFM) in cows and orchitis and epididymitis in bulls [5]. Sources of infection include aborted fetuses, fetal membranes, vaginal discharges and milk from infected cows. The most common route of transmission in cattle is through direct contact with an aborting cow and the aborted fetus

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or by indirect contact with contaminated fomites. Ingestion of contaminated pasture, feed, fodder and water may also play a secondary role [6].

The economic and public health impact of bucellosis remains of particular concern in developing countries [7]. The disease can affect almost all domestic species and cross transmission can occur between cattle, sheep, goat, camel and other species [8]. Several closely related species of the genus Brucella have been recognized, namely *B. abortus*, *B. melitensis*, *B. suis*, *B. ovis*, *B. canis*, *B. neotomae*, *B. pinnipedialis*, *B.ceti*, *B. microti*, and *B. inopinata*9 and small ruminants infected by ingestion of contaminated feed or water and the consequences of the infection are determined by the virulence of the bacteria, resistance and reproductive status of the host [9].

In animals, abortion is typically one of the clinical signs of pregnant females, and orchitis and epididymitis are typical clinical signs of the male. Excretion of the organisms in uterine discharges and in milk is common [10].

It is an economically important disease of livestock causing reproductive wastage through infertility, delayed heat, loss of calves, reduced meat and milk production, culling and economic losses from international trade bans [11].

Brucellosis is considered as neglected zoonotic disease by the World Health Organization (WHO) and has been identified as having the highest public health burden. Millions of individuals are at risk worldwide, especially in countries where infection in animals has not been brought under control and standards of hygiene in animal husbandry are low [12]. Materials excreted from the female genital tract are the main supply of organisms for transmission to other animals and man [13].

The disease is transmitted to man mainly by direct contact with infected livestock or through consumption of raw or uncooked animal products [14]. *B. melitensis* (biovars 1, 2 or 3) is the main causative agent of caprine and ovine brucellosis and it is highly pathogenic for humans causing udulant or Malta fever followed by *B. suis, B. abortus* and *B. canis* in human [15].

The epidemiology of brucellosis in livestock and humans as well as appropriate preventive measures is not well understood in developing countries like Ethiopia [16]. The disease spreads from one herd to another due to movement of infected animals. Hence, lack of biosecurity measures play a great role in the increment of the prevalence of brucellosis [17].

Therefore, the objective of this paper is to review the status of Cattle Brucellosis in Ethiopia.

2. Literature review

2.1. Etiology

Brucellae are Gram-negative, facultative intracellular bacteria that can infect many species of animals, including humans. Ten species are recognized within the genus *Brucella*. There are six 'classical' species, *B abortus, B melitensis, B suis, B ovis, B canis* and *B neotomae*, and another four species have been recognized more recently [13**]. **The species of *Brucella* and their principal animal hosts are *Brucella abortus* (cattle) *Brucella melitensis* (goat*), Brucella suis* (pig) *and Brucella ovis* (sheep) [14].

Non-bovine animals, and humans, can also contract the disease, which in turn play a significant role in its persistence and transmission*.* *Brucella abortus* infecting cattle has seven recognized biovars, the most reported of which are biovars 1, 2, 3, 4, and 9, with biovar 1 being the most prevalent in Latin America. The distribution of biovars could be important in ascertaining the source of some infections [15].

2.2. Pathogenesis

Brucella species are facultative intracellular pathogens and establish infection by invading macrophages and evading macrophage-induced host protection mechanisms [18]. These characteristics contribute to clinical signs and therapeutic considerations, including the difficulty in both diagnosis and treatment. Following exposure in humans, the organisms travel along the lymphatic pathways; focal disease is most commonly identified in the reticulo-endothelial tissues such as the liver and spleen. In chronic infections, organisms typically localize in joints, especially large joints such as the sacroiliac or lumbar vertebral joints. Pulmonary disease is a less common form of brucellosis [19].

2.3. Epidemiology of the Disease

2.3.1. Geographic distribution

Brucellosis is a highly worldwide contagious bacterial disease affecting both animal and human. *Brucella abortus* is found worldwide in cattle-raising regions, except in Japan, Canada, and some European countries. Australia, New Zealand, and Israel are among few countries where it has been eradicated. Eradication of disease from domesticated herds is nearly complete in the USA. *B abortus* can be found in wildlife hosts in some regions, including the Greater Yellowstone Area of North America [20].

Nowadays the disease is rare in many industrialized/developed nations because of routine screening of domestic livestock and animal vaccination programs. This disease, however, is a leading cause of zoonotic infections in the countries of the Eastern Mediterranean Region and a disease of economic importance [21].

Bovine brucellosis is one of the infectious diseases and has been reported from several parts of Ethiopia, the seroprevalence of bovine brucellosis in cattle is under traditional extensive husbandry [22]. In Borena zone of oromia region, the highest seroprevalence (50%) was documented using ELISA [18].

2.3.2. Occurrence and prevalence

In global terms, the majority of human and animal brucellosis is found in sub-Saharan Africa with large pastoral communities has been recorded at herd level, within-herd level and individual animal level .The persistent disease was observed in most countries in the Sahel, with Ethiopia, Chad, Tanzania, Nigeria, Uganda, Kenya, Zimbabwe and Somalia reporting brucellosis in humans attributed to domestic cattle, camels, goats and sheep calculated an estimated 22seroprevalence of 16.2% with in cattle in sub-Saharan African [21].

In Ethiopia, most research done on brucellosis has been focused on intensive dairy cattle herds in urban and peri-urban areas. In 1987, the World Organization for Animal Health (OIE) reported a prevalence of 20%; the prevalence was higher around large towns than in rural areas. Since the first report of brucellosis in the 1970's in Ethiopia, the disease has been noted as one of the important livestock diseases in the country [23]. A large number of articles have been published reporting individual seroprevalence ranging from 1.1% to 22.6% in intensive management systems [21] and 0.1–15.2% in extensive management system [24]. In zebu cattle of the central highlands, a prevalence of 4.2% was reported [25]. Another study from Addis Ababa, Ethiopia found a prevalence of 10% [26]. A study conducted on smallholder farmers of central Ethiopia (Wuchale Jida district) reported a prevalence rate of 11% [27].

In cattle under extensive management systems, studies conducted in different regions of Ethiopia between 2003 and 2005 reported individual-level prevalence rates of 0.8% and 3.2% and herd-level prevalence of 2.9% and 42.3% respectively [28]. The overall sero prevalence of bovine brucellosis in pastoral and agro pastoral regions of East Showa Zone, Oromia Regional State, was 11.2% by the Rose Bengal Plate Test (RBPT). This report was within the range 10 to 15% that was estimated for any assumed brucellosis seroprevalence for East Africa [29].

According to study of bovine Brucellosis in cattle under traditional production system in North- West Ethiopia Benishangul-gumuz, among the 1,152 cattle screened for *B abortus* antibodies, 14 (1.2%) tested positive by RBPT. Of these, 11 animals (79 %;) were confirmed positive by complement fixation test (CFT), giving an apparent seroprevalence of 1.0% in the study area [30].

2.3.3. Source of infection and mode of transmission

Brucellosis occurs worldwide in domestic and game animals and it is one of the major drug neglected disease [16]. It creates a serious economic problem for the intensive and extensive animal production system of the tropics. Its occurrence is increasing in developing countries in an aggravating manner, which depends on the policy of many developing countries of importing exotic high production breeds without having the required veterinary infrastructure and the appropriate level of development of socioeconomic situation of the animal holder [21].

Furthermore, the increasing towards intensification of animal production favors the spread and transmission of the infection [16]. Susceptibility to infection depends on age, breed and pregnancy status. Younger animals are relatively resistant. Sexually mature animals are much more susceptible to infection, regardless of gender [31]. The main sources of infection for cattle are fetuses, fetal fluids and vaginal discharges. Transmission through gastrointestinal tract is also common following ingestion of contaminated pasture, feed, fodder or water. Moreover, cows customarily lick fetuses and newborn calves; all of which may contain a large number of organisms and constitute a very important source of infection [21].

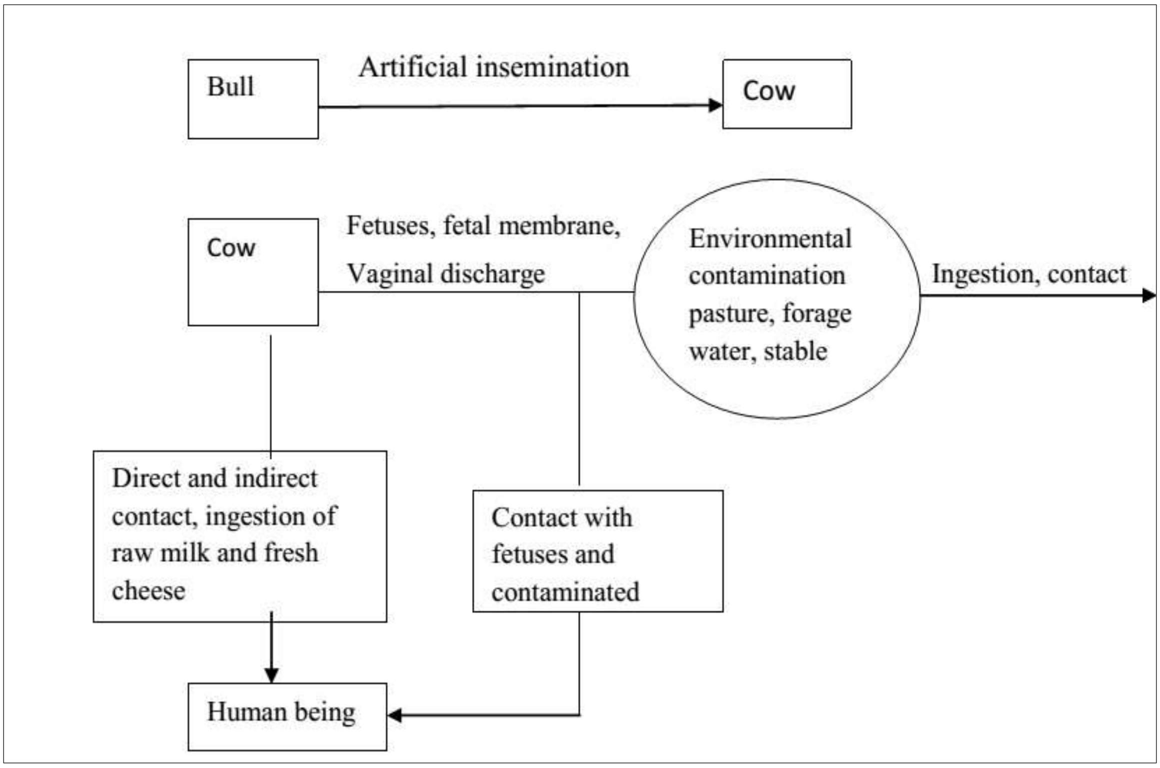

Figure 1 Mode of transmission of bovine brucellosis (B. abortus) [5].

2.3.4. Clinical signs in animals

The incubation period varies between 14 and 120 days. Primary clinical manifestations of brucellosis among livestock are related to the reproductive tract. In highly susceptible non vaccinated pregnant cow, abortion occurs after the 5 months of pregnancy; in bull orchitis and epididymitis are cardinal signs [21].

Retention of placenta and metritis are common sequels to abortion. Females usually abort only once, presumably due to acquired immunity. In general, abortion with retention of the placenta and the resultant metritis may cause prolonged calving interval and permanent infertility [31].

In cattle, *B abortus* causes abortions, stillbirths and weak calves. The placenta may be retained and lactation may be decreased. Epididymitis, seminal vesiculitis, orchitis and testicular abscesses are sometimes seen in bulls. Infertility occurs occasionally in both sexes, due to metritis or orchitis/epididymitis. Hygromas, particularly on the leg joints, are a common symptom in some tropical countries. Arthritis can develop after long-term infections. Systemic signs do not usually occur in uncomplicated infections, and deaths are rare except in the fetus or newborn. Infections in non-pregnant females are usually asymptomatic, but pregnant adult females infected with *B abortus* develop placentitis, which normally causes abortion between the fifth and ninth month of pregnancy. Even in the absence of abortion, there is heavy shedding of bacteria through the placenta, fetal fluids and vaginal exudates. The mammary gland and regional lymph nodes can also be infected and bacteria can be excreted in milk [32].

2.4. Risk Factors of Cattle Brucellosis

2.4.1. Animal factors

Susceptibility of cattle to *B.abortus* infection is influenced by the age, sex and reproductive status of the individual animal. Sexually mature pregnant cattle are more susceptible to infection with the organism than sexually immature cattle of either sex. Susceptibility increases as stage of gestation increases [16].

2.4.2. Pathogen factors

Brucella abortus is intracellular pathogen which is able to survive and replicate within phagocytic cells. It can persist on fetal tissues and soil or vegetation for 21-81-days depending on the month, temperature, and exposure to sunlight. *B. abortus* field strain persisted up to 43-days in oil and vegetation at naturally contaminated birth or abortion sites [33].

The organisms are able to survive within host leukocytes and may utilize both neutrophils and macrophages for protection from humoral and cellular bactericidal mechanism during the period of haematogenous spread. The inability of the leukocytes to effectively kill virulent *B. abortus* at the primary site of infection is a key factor in the dissemination to regional lymph nodes and other sites such as recticuloendothelial system and organs such as the uterus and udder. The congregation of a large number of mixed ruminants at water points facilitates disease spread [34].

2.4.3. Environmental and climatic factors

Brucella may retain infectivity for several months in water, aborted fetuses and fetal membranes, feces and liquid manure, wool, hay, on buildings, equipment and clothes. The survival of the organism in the environment plays a great role in the epidemiology of the disease [35].

Brucella is also able to withstand drying particularly in the presence of extraneous organic material and will remain viable in dust and soil [33].

Temperature, humidity and pH influence the organism's ability to survive in the environment. Brucella is sensitive to direct sunlight, disinfectant and pasteurization [34].

2.4.4. Management risk factors

The spread of the disease from one herd to another and from one area to another is always due to the movement of infected animals from an infected herd into a non-infected susceptible herd. Hence, lack of strict movement control of animal from one area to another, lack of proper hygienic practices and good husbandry management play a great role in the increment of the prevalence of brucellosis [35].

2.4.5. Occupational risk factors

People who work with animals or with infected blood are at higher risk of brucellosis. Examples include: Laboratory workers, veterinarians, dairy farmers, ranchers, slaughterhouse workers, hunters, microbiologists and farmer and also those handling artificial insemination, abattoir and slaughterhouse personnel working in endemic areas are at risk. Brucellae are considered as potential bio weapons [36].

Figure 2 Risk factors for Brucella infection in animals **[36].**

2.5. Diagnosis of Cattle Brucellosis

2.5.1. Bacteriological detection methods

Direct microscopic examination

Microscopic examination of stained smears can be useful for a presumptive diagnosis, particularly if the direct examination supported by other tests occasionally, bacteria can be recovered from the cerebrospinal fluid, urine or tissues. *Brucella* spp. can be isolated on a variety of plain media, or selective media such as Farrell's medium. *Brucella abortus* is highly infectious to humans and therefore, samples should be collected and handled with all appropriate precautions. A variety of samples can be collected for culture and microscopic examination. Milk samples and vaginal swabs are particularly useful for diagnosis in live cows. Milk samples for culture should contain milk from all four quarters. In addition*, B. abortus* can often be isolated from the secretions of non-lactating udders. This organism can also be cultured from aborted fetuses (stomach contents, spleen and lung) or the placenta [20].

Cultural isolation of brucella organism

Isolation of the organism is considered the golden standard diagnostic method for brucellosis since it is specific and allows biotyping of the isolate, which is relevant under an epidemiological point of view. *Brucella Spp*. is classified as a Biosafety level 3 organism, whose manipulation should be performed in biosafety level-3 laboratories. Importantly, brucellosis is one of the most common accidental laboratory infections, particularly in research laboratories [16].

All Brucella strains are relatively slow growing, and because the specimens from which isolations best attempted are frequently heavily contaminated, the use of a selective medium, e.g. Farrell's medium is advocated [9]. Incubation normally continues for 72-hours, but a negative diagnosis can only be made after weeklong incubation. Specimens which may be used for *B. abortus* isolation include: fetal stomach fluid, spleen, liver, placenta, lochia, milk (especially colostrum or milk within a week of calving), semen and lymph nodes supramammary (chronic and latent infections) and retropharyngeal (early infections) are preferred, but iliac, prescapular and parotid may be used. If serological reactions are thought to be caused by *S19* vaccine strain then it is important to collect prescapular lymph nodes as well. All *B. abortus* isolates should be forwarded to laboratories capable of bio typing [37].

B. Spp. colonies are elevated, transparent, and convex, with intact borders, smooth, and a brilliant surface. The colonies have a honey color under transmitted light. Optimal temperature for culture is 37 °C, but the organism can grow under temperatures ranging from 20 °C to 40 °C, whereas optimal pH ranges from 6.6 to 7.4. Some Brucella spp. requires CO2 for growth. Typical colonies appear 2 to 30 days of incubation, but a culture can only be considered negative when there are no colonies appears 2 to 3 weeks of incubation [38].

2.5.2. Serological tests

Several commercial serological tests are available for humans and animals [21]. The Rose Bengal test (RBT) has been recommended as a suitable screening test at the national or local level for diagnosis of brucellosis in [38]. Enzyme-linked immunoassays (ELISA) and the fluorescent polarization assay (FPA) have recently been added as prescribed tests. They are simple, but robust, tests, which can be conducted with a minimum of equipment and are therefore suitable for smaller laboratories. Further serological tests (e.g. the Combs' test, the serum or plate agglutination test and the immune-capture test) are available, and have specific advantages and disadvantages [39].

2.5.3. Molecular techniques

Molecular techniques are important tools for diagnosis and epidemiologic studies, providing relevant information for identification of species and biotypes of *Brucella spp*. allowing differentiation between virulent and vaccine strains [38]. Molecular detection can be done directly on clinical samples without previous isolation of the organism. These techniques can be used to complement results obtained from phenotypic tests [21].

Molecular technologies like PCR are a new approach and applied in many diagnostic works to overcome limitation and difficulties in bacterial culture and serological assays. PCR shows high sensitivity, specificity and overcame the extraneous intervention of mimicry antibodies from sources other than actual infection [26].

PCR and/its variants, based on the amplification of specific genomic sequences of the genus, species or even biotypes of *Brucella spp*., are the most broadly used molecular technique for brucellosis diagnosis [21].

Real-time PCR is more rapid and more sensitive than conventional PCR. It does not require post-amplification handling of PCR products, thereby reducing the risk of laboratory contamination and false positive results. Real-time PCR assays have been recently described in order to test Brucella cells [40].

2.6. Treatment of Brucellosis

Brucellosis is one of the drug-neglected diseases and treatment of brucellosis in domestic animals is still disputed. The treatment recommended by the World Health Organization for acute brucellosis in adults is rifampicin 600 to 900 mg and doxycycline 200 mg daily for a minimum of 6 weeks; some still claim that the long-established combination of intramuscular streptomycin with an oral tetracycline gives fewer relapses. Antibiotics are usually the mainstay of treatment; long-term treatment may be required. Some forms of localized disease, such as endocarditis, may require surgery [21].

2.7. Prevention and Control of Cattle Brucellosis

Mass vaccination is the mainstay of brucellosis control in livestock, but should be combined with other measures that limit the spread of the pathogen, allow identification of animals and increase community participation [38].

Mass vaccination of livestock against brucellosis in Mongolia was noted to be cost effective and resulted in net economic benefit, if interventions costs were shared between the different beneficiaries based on an inter sectorial economic assessment. The presented trans-sectorial analysis is applicable to other zoonoses and environmental threats to public health and contributes to the perception that interventions in the livestock sector can control disease transmission to humans [16].

In Ethiopia as the source of human brucellosis is direct or indirect exposure to infected animals or their products, prevention must focus on various strategies that will mitigate infection risks. To our knowledge, there have been no national programs proposed for prevention and control of brucellosis in Ethiopia. Similarly, at regional levels, no strategy is in place to control brucellosis. This is largely a result of lack of facilities and budget to run such a program. Moreover, many responsible bodies may not recognize the significance of brucellosis given the contradictory and sometimes low prevalence data. However, now, it is crucial to define geographical extent of the problem and then allocate resources and funds to initiate prevention and control strategies in Ethiopia and other countries with similar economic situations [41].

2.8. Zoonotic Implication of Brucellosis

Brucella abortus, B melitensis and *B suis* are highly pathogenic for humans [32]. Brucellosis remains the most common zoonotic disease in the world, with more than 500,000 new cases reported annually [42] ; the actual number of cases, including undetected and unreported cases, is believed to be considerably higher [43].Brucellosis is often a neglected disease despite being endemic with high zoonotic potential in many countries [35]. The prevalence of human brucellosis differs between areas and has been reported to vary with standards of personal and environmental hygiene, animal husbandry practices, and species of the causative agent and local methods of food processing [21].

The Brucellosis 2003 International Research Conference estimated that 500,000 human infections occur per year worldwide. The majority of reported human brucellosis cases are caused by *B melitensis*, *B abortus*, and *B suis*, in occurrence order, novel and atypical *Brucella* are also being investigated [43].

As compared to study of animal brucellosis, study of human brucellosis in Ethiopia is sparse with even less information on risk factors for human infection. For instance, out of 56 cases with fever of unknown origin two (3.6%) were reported to be positive for *B. abortus* antibodies by RBPT and CFT [44]. A study conducted in traditional pastoral communities using *B. abortus* antigen revealed that 34.1% patients with febrile illness from Borena, 29.4% patients from Hammer, and 3% patients from Metema areas were tested positive using *Brucella* IgM/IgG lateral flow assay [21].

Humans can be infected by ingestion of unpasteurized cheese or milk, by direct transmission through contact with infected animals or by handling specimens containing *Brucella* spp. in laboratory. It also transmitted to human by the consumption of raw dairy products and by direct contact with the skin or mucosa during parturition and abortion. Cattle are natural hosts for *Brucella abortus*, and sheep *(Ovis aries*) and goats (*Capra hircus*) for *B melitensis* and *B ovis*, respectively. Humans are susceptible to *both B abortus* and *B melitensis,* the latter being most frequently reported in humans [38].

The most common signs and symptoms of human brucellosis are fever, asthenia, myalgia, arthralgia, sweats, lymphadenopathy, hepatomegaly and splenomegaly. Oste-oarticular manifestations (peripheral arthritis, sacroiliitis, spondylitis) are the most common forms of localized disease [21].

2.9. Economic Losses Associated with Animal Brucellosis

Bovine brucellosis causes huge losses to the dairy Industry. Economic impact can include direct (e.g. reduced milk yield, increased mortality) and indirect (e.g. vaccination, culling) costs. Direct impacts may further be classified as visible (e.g. abortion, repeat breeding), invisible (e.g. lower fertility), additional costs (e.g. treatment, vaccination) and revenue forgone (e.g. distress selling) [36].

Endemic brucellosis in low-income countries of sub-Saharan Africa and South Asia has multiple economic implications across agriculture and public health and broader socio-economic development sectors. Efforts to control the disease in low-income countries must take a different approach. Simply replicating past successes in brucellosis control and eradication in high-income countries will not work. Low-income countries have at least a ten-fold higher burden of infectious disease from a wide variety of pathogens [45].

The assessment of the economic aspects of brucellosis is higher in low-income countries of Africa and Asia. The tools and approaches for assessing and control programs are of relevance to low-income countries [46].

When brucellosis is detected in a herd, flock, region, or country, international veterinary regulations impose restrictions on animal movements and trade, which result in huge economic losses. The economic losses as well as its zoonotic importance are the reasons why programs to control or eradicate brucellosis in cattle [47]. In Ethiopia, information on losses specifically through brucellosis in the different types of production systems is sparse, except for [48] who reported an annual loss from brucellosis estimated to be 88,941.96 Ethiopian Birr ($5231 equivalent) among 193 cattle, largely due to reduced milk production and abortions (Chaffa State Farm, Wollo).

The status of cattle brucellosis in Ethiopia

The review conducted in the east Africa, Ethiopia. Ethiopia is believed to have largest Livestock population in Africa, with the livestock population 59.5 million cattle, 30.7 million sheep and 30.2 million goats [1]. The country has diverse agro ecological zones, which have contributed to the evolution of different agricultural production systems. Animal husbandry forms an integral part of agricultural production in almost all ecological zones of the country. Ethiopia has several institutionally owned commercial dairy farms, mostly situated in and around Addis Ababa and in some regional towns. These farms have been the focus of most of Brucella surveys, potentially producing a bias in reported findings [16].

These prevalence reports have been systematically reviewed as intensive and extensive management systems of various regions in Ethiopia. According to the available data, Brucella sero prevalence with in extensive cattle rearing system is lower than that of intensive systems.

Table 1 Prevalence of Bovine brucellosis in different parts of Ethiopia

Study area	Test used	Prevalence (%)	Reference
Tselemti, Tigray	RBPT/CFT	4.80	[49]
Tigray Region	CFT	7.7	[51]
Alage, Oromia	c-ELISA	2.2	[50]
Shinile,Somali region	CFT	6.6	[24]
Amhara Region	CFT	4.63	[52]
Benshangul Gumuz	RBPT/CFT	1.2/1	[30]
Sidama Zone, SNNP	CFT	2.46	[53]
Borena Zone	CFT	4.7	[24]
Peri-urban dairy farm	CFT	1.9	[54]
Breeding Farm	CFT	1.5	[54]
Commercial farm	CFT	2.4	[54]
Becho, Oromia	RBPTI-ELISA	3.39/1.04	[55]
Debrezeit, Central Ethiopia	RBPT/CFT	3.3/2	[56]
Adadle, Somali	I-ELISA	1.5	[57]

List of abbreviations

CFT Complement Fixation Test

CSA Central Statistics Agency

I-ELISA Indirect Enzyme Linked Immunosorbent Assay

OIE Office of International des Epizooties

RBPT Rose Bengal Plate Test

WHO World Health Organization

3. Conclusion and recommendations

Brucellosis is worldwide and has high prevalence in different areas of Ethiopia. Brucellosis affects both animals and humans, has a very high economic and public health impact. Its impact on public health is related to the infected animal species from which human transmission occurs. The disease transmits from infected animals to human beings through several routes. It is special hazard to occupational groups. It causes considerable losses in cattle because of abortion and reduction in milk yield. Even though the disease is prevalent in Ethiopia, few reports in human are available. This may be due to absence of appropriate diagnostic facilities.

Based on the above conclusion the following recommendations are forwarded;

- Public education on the transmission and source of infection of the disease need to be under taken.
- The necessary precautions should be taken to reduce occupational risks.
- Pasteurization of milk should be widely practiced to prevent human infection.
- Isolation of aborted animals and proper disposal of aborted fetuses and fetal membranes, preferably, by incineration.
- The isolation of calving animals' in separate calving Replacement stock should be purchased from herd known to be free of brucellosis
- Strict movement control of animal from one area to another in order to prevent the spread and transmission of the disease from infected cattle to the non-infected ones.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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