Int.J.Curr.Res.Aca.Rev.2021; 9(08): 23-31

International Journal of Current Research and Academic Review

ISSN: 2347-3215 (Online) Volume 9 Number 08 (August-2021)

Journal homepage: http://www.ijcrar.com

doi: https://doi.org/10.20546/ijcrar.2021.908.004

Epidemiology of Contagious Bovine Pleuropneumonia and its Economic Impact in Ethiopia

Juhar Tesfaye[1*] and Fekadu Gutema[2]

[1]*Ethiopian Institute of Agricultural Research, Werer Agricultural Research Center, Animal Health Research Case Team, Ethiopia*
[2]*Ethiopian Institute of Agricultural Research, Holeta Agricultural Research Center, Animal Health Research Case Team, Ethiopia*

**Corresponding author*

Abstract

Livestock production is constrained by many animal diseases including contagious bovine pleuropneumonia in Ethiopia. It is a contagious disease of cattle which causes much economic losses to the country. The causative agent is *Mycoplasma mycoides subsp. mycoides small colony* (Mmm SC). It is characterized by respiratory signs such as difficulty in breathing, increased respiratory rate, coughing and nasal discharges. However, it has similar clinical signs with severe pneumonia and cannot be diagnosed only using clinical signs. On the post mortem, it is diagnosed by the presence of marbling, adhesion, yellowish fluid accumulation and sequestrate. Moreover, serological techniques, molecular and microbiological tests should be used to confirm the disease. The present review was conducted to highlights on the spread and financial losses of the disease in Ethiopia. The distribution of outbreaks, seroprevalence studies in Ethiopia and the direct and indirect economic losses were reviewed. Contagious bovine pleuropneumonia has worldwide distribution and endemic in Africa including Ethiopia. Currently different studies reported the impact of the contagious bovine pleuropneumonia in different regions of the country with high prevalence. Based on its effect on the country, it is the second rank of livestock disease next to foot and mouth disease in Ethiopia. The disease has direct and indirect economic impacts which account about 8.96 USD and 2.08 Euro losses per year respectively. Therefore, appropriate preventive and control measures such as vaccination, movement restriction and quarantine should be implemented with coordination of both the regional and federal government of Ethiopia.

Article Info

Accepted: 18 July 2021
Available Online: 20 August 2021

Keywords

Contagious bovine pleuropneumonia, Economic impact, Epidemiology, Ethiopia.

Introduction

Agricultural commodities in general and Livestock in particular provide a livelihood for the majority of communities in Ethiopia (Ayele *et al.*, 2003), and have higher contribution for the national and agricultural gross domestic products (GDP) (Leta and Mesele, 2014). Therefore, improvement of the livestock sector will play a major role for the development of the country in general and for the livelihood of the community in particular. Among the livestock species that are found in Ethiopia, cattle are the most import one (Metaferia *et al.*, 2011). Cattle are used as a working animal and source of milk, meat, manure, cash income and have sociocultural value especially for the pastoral communities of Ethiopia (Ulfina *et al.,* 2005; Melaku, 2011; Tonamo, 2016).

According to recent estimation, Ethiopia has 61.6 Million cattle population (CSA, 2020). Even though Ethiopia has large number of cattle, the income derived from this sector couldn't bear significant role for the journey of the country to avoid poverty. This can be due to many reasons and animal diseases are the most important constraints. There are numerous diseases of cattle that affect productivity and production of the sector in Ethiopia. CBPP is one of the most economically important cattle diseases with high infection and mortality rates. The effect of these diseases could be exacerbated by famine, overcrowding at watering and feeding places and high susceptibility of animals (World Bank, 2001).

Contagious bovine pleuropneumonia(CBPP) is a disease of cattle caused by *Mycoplasma mycoides subsp. mycoides small colony* (Mmm SC). Inappetance, increased body temperature and respiratory problems are the characteristic manifestations of the disease in cattle (OIE, 2014). It is principally transmitted by inhalation of infective droplets and Outbreaks tend to be more extensive in stressed animals with overcrowding, transport and starvation (Radiostits *et al.,* 2007). Factors such as extremes of age, stress and comorbidities may exacerbate to the severe form of the disease. It is considered to be a disease of economic importance because of its high mortality rate, production loss, increased control cost, loss of working ability, reduced productivity and loss of income due to international trade ban (Tambi *et al.,* 2006; Radiostits *et al.,* 2007). As a result, OIE declared it as one of the most economically important, notifiable and trans-boundary animal diseases (TAD) (FAO, 2002). The disease is enzootic in Africa (FAO, 2002; Amanfu, 2009; Wade *et al.,* 2015).

In majority of African countries including Ethiopia, control of CBPP is based only on vaccination and chemotherapies. But other continents use early diagnosis, movement restriction or quarantine and stamping out strategy to control the disease (Radiostits *et al.,* 2007; OIE, 2009). Moreover, the disease persists even if the cattle are vaccinated. This is associated with ineffective vaccination, inadequate vaccination coverage, unrestricted cattle movement and lack of disease surveillance strategy (Gedlu, 2004).Since 1992/93 there was annual blanket vaccination of CBPP jointly with render pest eradication campaign in Ethiopia. This kept the disease at a relatively lower prevalence. However, after render pest has been eradicated the vaccination against CBPP was interrupted and as a result CBPP has been re- emerged and caused major losses due to higher number of outbreaks and cattle death (MOA, 2003; Admassu *et al.,* 2015).

Currently in Ethiopia many research works have been conducted since on CBPP and reported seroprevalence of 0.4%-55% (Kassaye and Molla, 2013; Alemayehu *et al.,* 2015; Teklu *et al.,* 2015; Ebisa *et al.,* 2015; Atnafie *et al.,* 2015; Abde *et al.,* 2017; Geresu *et al.,* 2017). The presence of cattle movement due to transhumance, pastoralism and trade favours the spread of the disease (Alhaji and Babalobi, 2015). Furthermore stress factors like overcrowding of animals in watering and feeding points contributes a lot for the spread of CBPP (Radiostits *et al.,* 2007).

Animal diseases in general and CBPP in particular, impacts animal production and health through direct losses and indirect losses. Direct losses include mortality losses and morbidity losses, while indirect losses are the cost of controlling, managing the disease in herds, its effect on trade and socio-economic losses (Tambi *et al.,* 2006). High losses on the agricultural sector of Ethiopia have been caused by CBPP annually. As estimated by Abdela and Yune (2017), the country losses over 8.96 million us dollar per year.

Moreover, as indicated in the 2015/20 strategic livestock Roadmaps for growth and transformation based on its impact on livelihood of farmers, livestock markets and value chains and intensive system of production, CBPP is the 2nd most important prioritized trans- boundary animal diseases next to FMD and has denied the country's access to international markets and makes it vulnerable to trade bans (Solomon *et al.,* 2020; Admassu *et al.,* 2015). The presence of unrestricted movement of animals especially in the extensive production system user of the country worsens the problem. The present review contained and highlighted the magnitude and economic impact of CBPP in Ethiopia, and therefore appropriate measures such as annual vaccination, movement restriction and good husbandry practices should be applied for the prevention and control of CBPP in Ethiopia.

Overview of Contagious Bovine Pleuropneumonia

It is a disease of cattle which is highly contagious, transboundary and economically important. It is characterized by respiratory problems like dyspnea, polypnea, coughing and grunting. It is pathologically described by its pathognomonic lesions like marbling and sequestrate of the lung in chronic cases (OIE, 2009).

Etiology of the Disease

Mycoplasma mycoides subspecies *mycoides Small Colony* (MmmSC) is a causative agent of CBPP. It blongs to the genus mycoplasma which belongs to the family mycoplasmataceae. Mycoplasmas are host specific and have no cell wall. Therefore, they are resistant to antibiotics of the beta lactamase group, such as penicillin. It lives extra-cellular but close to the host cells. There are groups of mycoplasmas "*Mycoplasma mycoides"* cluster which includes MmmSC, *Mycoplasma mycoides subsp. Mycoides large colony* type (MmmLC), *Mycoplasma capricolum subsp. Capricolum*, *Mycoplasma capricolum subsp. Capripneumonae* (Mccp), *Mycoplasma mycoides subsp. Capri* and *Mycoplasma sp. Bovine group7* (Mtui-Malamsha, 2009)]. These groups of mycoplasmas share phenotypic and genotypic characteristic and have a property of cross reaction. MmmSC and *Mycoplasma sp. bovine group 7* cause CBPP and bovine arthritis and bovine mastitis in cattle respectively (OIE, 2018).

Mycoplasma mycoides subspecies mycoides Small Colony is susceptible to environmental factors such as temperature and pH. It can be inactivated by extreme temperature, pH and routinely used disinfectants not more than 3 minutes and on average it can survive up to 14 days in favourable environment but only 3 days in hot areas outside the host. Therefore, the transmission of the agent from the infected animal to the susceptible one requires close contact. But when there is favorable condition of high humidity the agent can be moved longer distance with the aerosol and causes disease (OIE, 2014).

Clinical Signs

Incubation period of CBPP may differ based on different factors but generally infected animals may start to show signs within 1to 4 months (Dupuy *et al.,* 2012). Usually, animals show the acute, sub-acute and chronic forms of the disease. In the acute form, initial manifestations of the disease are mild to moderate respiratory signs: increased body temperature, anorexia, coughing, having abdominal pain and increased respiratory rate. Labored respiration, grunting and dyspnea, and elbow abduction may be seen while the infection is continuing(Swai *et al.,* 2013; Almaw *et al.,* 2016). Depending on the severity of lung infection, dull sounds by percussion and reputations, rales and pleuritic friction rub sounds by auscultation may be noticed. This form may evolve to chronic form (FAO, 2002).Symptoms of sub-acute form of the disease are similar to that of the acute form but it is mild. The sub-acute form often progress to chronic form and occurs in about 40-50% of infected animals. Intermittent fever, loss of milk production, abortion, loss of appetite and weight loss are the clinical manifestations of chronic CBPP but the signs regresses (Admassu *et al.,* 2015).

Postmortem Lesions

Assessment of gross pathological lesions is most important sources of information for disease diagnosis (Provvido *et al.,* 2018). Postmortem lesions of the lung and associated structures are suggestive characteristic for CBPP and often unilateral most commonly the diaphragmatic lobe. The predominant gross change is pleural adhesion (Swai *et al.,* 2013), hepatization and marbled appearance. Widening of interlobular septa with fibrin, Oedematous enlargement, haemorhages on associated lymph nodes in the chest, yellowish fluid accumulation(up to 30 litres) and pleurisyare additional lesions that can be observed (Provvido *et al.*, 2018). Sequestraecan be seen in chronically infected and or recovered animals (lungers). MmmSC can survive within these sequestra for months or longer. Therefore the carrier animals may shed the agent during stress times and may act as a source of infection for susceptible animals (OIE, 2009).

Diagnostic Techniques

Isolation of the organism

The causal organism of CBPP can be identified from samples taken either from live animals or immediately after killing. Lung tissue, lymph nodes and synovial fluids are samples taken during postmortem whereas nasal swabs, blood and broncho-alveolar lavage can be taken from live animals. Pleural fluid can be taken both at biopsy and necropsy. Generally, samples should be taken aseptically and the samples should be collected from lesions at the interface between diseased and normal tissue during postmortem. MmmSC needs appropriate media to grow (OIE, 2009). During culture the lung sample (co_2) should be diluted in medium containing antibiotics to minimize other bacterial growth. Candle jar should be used to ensure better conditions for mmmSC growth. The characteristic morphology of mmmSC is fried egg appearance with dense center on solid medium and fragile filament like in liquid medium within 2 to 4 days (OIE, 2014).

Biochemical tests: MmmSC is sensitive to digitonin, does not produce "film and spots", ferments glucose, reduces tetrazolium salts (aerobically or anaerobically), does not hydrolyse arginine, has no phosphatase activity, and has no or weak proteolytic properties. For these tests, special media have been developed that include the same basic ingredients (heart-infusion broth, horse serum, 25% yeast extract solution, 0.2% DNA solution), to which is added 1% of a 50% glucose solution for glucose hydrolysis, 4% of a 38% arginine HCl solution for arginine hydrolysis, and 1% of a 2% triphenyltetrazolium chloride solution for tetrazolium reduction, plus a pH indicator (e.g. phenol red). (Note: a pH indicator should not be added to a medium containing triphenyltetrazolium chloride.) For demonstration of proteolysis, growth is carried out on casein agar and/or coagulated serum agar (OIE, 2008; European Commission, 2001).

Serological tests

Serological tests are important diagnostic techniques for contagious bovine pleuropneumonia especially for herd level screening. The CFT and ELISA are recommended for screening and eradication programs. C- ELISA has higher specificity and almost equal sensitivity with CFT (OIE, 2014). As compared to postmortem examination, (C-ELISA may miss acute cases and CFT may miss chronic cases so the validity of serological tests should be checked with post mortem lesions and bacteriological examinations (Muuka *et al.,* 2011; OIE, 2014).

Epidemiology

Geographical Distribution

Contagious bovine pleuropneumonia was restricted to the alpine region of Europe, where it first described, until 16^{th} century. Then it spread to the south of the continent due to wars, trade imports and unrestricted animal movements. CBPP was reached worldwide distribution in the 19^{th} century (Dupuy *et al.,* 2012). The disease spread to the Australia and United States of America (USA) in the second half of the 19th century and at the beginning of the 20^{th} century the disease spread from Australia to Asia (Dupuy *et al.,* 2012; Penrith, 2014). Then CBPP spreads to Africa in 20^{th} century and now it is endemic in Africa but it is believed to be eradicated from Europe (Dupuy *et al.,* 2012). CBPP were controlled in few countries when it is benefited from a render pest control program. Again it was spread in Africa at the end of 20^{th} century as it re-emerged in countries that had eliminated the disease in the past (FAO, 2016). The presence of strict sanitary measures applied in Botswana contributed for the eradication of the disease in the country for the second time. In the rest of the continent, CBPP continued to spread gradually to various countries. In 2015, CBPP was considered present in all countries of the sub-Saharan Africa (Thiaucourt, 2015). CBPP is endemic in most pastoral areas of West, Central, south and East Africa, with at least 24 countries (45%) including Ethiopia regularly reporting outbreaks every year (FAO, 2016; Thiaucourt, 2015).

Distribution of CBPP in Ethiopia

Contagious bovine pleuropneumonia is the endemic and prevalent in Ethiopia (Molla *et al.*, 2021). Many reports in the country indicated that it is highly distributed in all regions of the country. MOA (2002) reported that several epidemics of CBPP have been occurred in different areas of Ethiopia. The report shows 587 outbreaks, 16,806 cases and 3,262 deaths. Different seroprevalence studies in different regions of the country revealed that CBPP is posing a major threat with higher seroprevalence to cattle in many parts of the country thereby causing considerable economic losses through morbidity and mortality and warranting for serious attention (Admassu *et al.*, 2015). As reported by (Gedlu, 2004) in Somale region, CBPP herd sero-prevalence was 100% in Mieso district followed by 75% in Qabribeyah and 71.4% in Afdem. Atnafie *et al.,* (2015) reported 7.8% and 5.9% seroprevalence in Bishoftu abattoir and export oriented feed lots around Adama, respectively, Mersha (2017)reported 14.6% seroprevalence in East Wollega and West Shoa, Teklue *et al.,* (2015) reported 11.9% seroprevalence in southern zone of Tigray region, Alemayehu *et al.*, (2015) reported 0.4% seroprevalencein Borena pastoral, Kassaye and Molla (2013) reported 4% seroprevalence in and around export quarantine Adama town and Ebisa *et al.,* (2015) reported (31.8%) in Amaro district of SNNP of Ethiopia (Table 1).Recent study in northern zone of Gonder reported that animal level seroprevalence of 12.92% (Molla *et al.*, 2021).

Morbidity and Mortality

The morbidity and mortality rates for CBPP are highly variable. It is endemic in sub-Saharan Africa and causes important productivity losses due to the high mortality and morbidity rates (Teodoro *et al.*, 2020). Majority of diseased animals may die and or majority of animals may recover in a naïve herd. In general, morbidity and mortality rates of CBPP range from 50% to 80% and 10% to 80% respectively. However, morbidity increases with close confinement or overcrowding, due to the increase in contact and transmission to healthy animals(CFSPH, 2015). The virulence of the strain, host related factors, management factors such as nutrition and secondary complications are factors affecting the severity of the disease. During their initial introduction, African isolates are highly severe than European isolates and causes high mortality to the herd. However, the number of deaths will decrease and chronically infected animals can increase after the disease become established (Teodoro *et al.,* 2020; Amanfu, 2009).

Risk Factors of CBPP

Contagious bovine pleuropneumonia is a multifactorial disease, where factors associated with the host, factors associated with the agent and factors associated with the environment are the determinants for the occurrence of infectious diseases (Thiaucourt, 2015).

Host related factors

Among zebu, some breeds are remarkably resistant to CBPP like Somba, the breed of coastal lagoons of Benin and the small Côte d'Ivoire breed. The Maasai breed of Tanganyika is equally resistant (80-85%) of them recover without treatment whereas the European breeds and their crosses are more susceptible (Radiostits *et al.,* 2007.In the natural disease the susceptibility of animals related to age has three phases: young animals have low susceptibility which develops only minor lesions of tendons and joints but not the severe pulmonary form; animals greater than 1year are moderately susceptible and a final phase of full susceptibility which explains the choice of cattle over two years of age. Age of the animal is directly associated with the disease (Almaw *et al.,* 2016).

Pathogen related factors

Mycoplasma mycoides subspecies mycoides Small Colony is sensitive to all environment influences; do not ordinarily survive outside the animal body for more than a few hours(Mamo and Beshah, 2017). But it secretes different virulence factors like, genes of encoding surface proteins, enzymes and transport proteins responsible for the production of H_2O_2 and the capsule which is thought to have toxic effect on the animal. African strains cause severe diseases than Europeans as described by multi locus sequence analysis of MmmSC (Dupuy *et al.,* 2012; Radiostits *et al.,* 2007; OIE, 2009).

Management related factors

The occurrence and incidence of contagious bovine pleuropneumonia is influenced by management related factors. The major factors include knowledge of the disease by farmers, veterinarians and livestock field officers, the infrastructures of veterinary laboratory, disease surveillance and monitoring system, vaccination, government emphasis to control programs and desires of cattle owner and traders to control (Mamo and Beshah, 2017). These affect epidemiology of the disease and are crucial factors since CBPP is essentially related to the movement of animals. Areas where there is no disease before will become endemic if there is no movement control between them. High density of animals during grazing, overcrowding at watering points, and at night are importantly favorable for disease transmission in endemic areas (Radiostits *et al.,* 2007). The presence of trekking route to and from or through CBPP prevalent areas is the most crucial factor for the spread of the disease. This increases contact of susceptible and infected animals especially in areas where smuggling of cattle is present to the neighboring countries like Sudan (Molla *et al.,* 2021).

Economic Losses Due to Contagious Bovine Pleuropneumonia

Animal diseases in general and CBPP in particular, impacts animal production and health through direct losses and indirect losses. Direct losses include mortality losses and morbidity losses, while indirect costs are the cost of prevention and reduction of the disease and its effect on trade and socio-economic losses (Tambi *et al.,* 2006).

Direct Losses

Direct losses include losses due to morbidity and mortality due to the disease. Reduced meat production, milk production and draft power are considered as direct losses due to morbidity. By adding the complete loss of milk from died animals and reduction in quality and quantity of milk production of diseased cows, we can get the total loss of milk due to the disease (Radiostits *et al.,* 2007). In the former case, the CBPP-specific mortality rate is applied to the proportion of reproductive females that are at risk in order to determine the number of dead cows. Infection of cattle with CBPP can cause animals not to gain weight. They may even lose weight depending upon the severity of the infection.

The loss in beef production was estimated from the number of infected cattle. Infected calves were assumed to lose a daily weight of 0.11 kg while infected adult males and reproductive females were assumed to lose a daily weight of 0.063 kg for a period of 183 days. Due to varying levels of immunity and disease challenge, not all the cattle were assumed to lose weight. In endemic situations 80% of the infected animals will lose weight (Tambi *et al.*, 2006).

Contagious bovine pleuropneumonia has been causing significant economic losses on the agricultural sector and the national economy in Ethiopia. It accounts for a loss of over 8.96 million us dollar per year (Abdela and Yune, 2017). According to Admassu *et al.*, (2015) the annual estimated losses in cattle and cattle products caused by CBPP in Ethiopia reported as Cattle death (no) 10112, Beef (metric tons) 1350, Milk (metric tons) 8500 and Drought power (working days) 1645.

Indirect Costs

Indirect costs of contagious bovine pleuropneumonia include: control costs for vaccination and treatment, socio cultural costs and costs related to international trade bans. These can be associated with the subclinical or chronic nature of the disease (Radiostits *et al.*, 2007; Tambi *et al.*, 2006). Farmers invest considerable resources in the purchase of antibiotics for the control of CBPP, and in some countries affected by even just sporadic CBPP may experience restrictions on free movement or increased transaction costs, such as informal fees for movement permits within national markets.

The indirect costs of control and reduction in the value of livestock because of the presence of CBPP are not well documented but are believed to be significant (Mariner *et al.*, 2019).

Accordingly, Belachew and Jemberu (2003) reported that, Ethiopia has lost a substantial market share and foreign exchange earnings due to frequent trade bans by the Middle East countries. As Tambi *et al.*, (2006) estimated, the cost of control of contagious bovine pleuropneumonia to be 14.8 million euros in Africa and Ethiopia may cost on average 2.08 million euros.

Prevention and Control

In livestock disease control, there are two ways to eliminate infectious animals: removing them through slaughter or treating them. Reducing susceptibility in animals is accomplished by rendering them immune, most often by vaccination. The challenge with this approach is that the majority of the population needs to be rendered immune to interrupt transmission (overall herd immunity). Movement control and quarantine are techniques to isolate populations and prevent contact between infectious animals and susceptible animals. These groups must be kept separate until the infection fades out of the population (Mariner *et al.*, 2019). Since the incubation period of the disease is long it takes long period of time to control contacts between animals. So, movement control should be implemented together with quarantine and vaccination. Vaccination of susceptible animals should be repeated initially and it should be given annually until the evidence of CBPP eradication is confirmed by structured surveillance systems. In addition to repeated vaccination use of quality vaccines should be given emphasis for effective control of contagious diseases. Live attenuated vaccines are used against CBPP control in Africa and only quality certified ones should be used. Furthermore, reduction of infected population is important for the control of CBPP (OIE, 2018).

Recommendations

Contagious bovine pleuropneumonia is a highly contagious and economically important trans-boundary disease of cattle. It is characterized by respiratory signs, anorexia and polypnea clinically and marbling, pleural adhesion and sequestrate pathologically. *Mycoplasma mycoides subsp. mycoides Small Colony*, wall less microorganism is a causative agent of the disease. The disease is widespread all over the world and is endemic in Africa and causes significant impact on the agricultural sector in general and livestock production and productivity in particular. It causes highest outbreaks, morbidity and mortality in Ethiopia. Currently, different reports indicated that the disease is causing losses with seroprevalence reports of over 50% in different zones and districts of Ethiopia. Furthermore, it is prioritized by the livestock production road map of the country as the second most important disease next to foot and mouth disease based on its impacts on different areas and its effect on the international trade. Contagious bovine pleuropneumonia causes loss of milk production, meat production, weight gain, draught power, and causes extra costs for the control of the disease indirectly.

Therefore based on the above conclusion the following recommendations are forwarded.

Appropriate prevention measures such as quarantine, movement restriction and vaccination should be applied

Stakeholders at different stages should effort to the implementation of these control measures.

Farmers and farm owners should practice general disease prevention and control practices such as isolation of new entry animals, good husbandry and purchasing of disease free animals

Routine annual vaccination should be applied for the control and iradication of the disease in endemic areas

References

Abde, A., Lelisa, K., Aklilu, F. and Damena, D. (2017): Contagious Bovine Pleuropneumonia: Serological Prevalence in Derashe District, Southern Ethiopia. *Glob. Vet*., 19 (5): 616-621.

Abdela, N. and Yune, N. (2017): Seroprevalence and Distribution of Contagious Bovine Pleuropneumonia in Ethiopia: Update and Critical Analysis of 20 Years (1996–2016) Reports. *Front.Vet. Sci*., 4:100.

Admassu, B., Shite, A. and Molla, W. (2015): Contagious bovine pleuropneumonia in Ethiopia (A Review). *Acad. J. of Anim. Dis.*, 4 (2): 87-103.

Alemayehu, G., Leta, S., Hailu, B. (2015): Sero-prevalence of contagious bovine pleuropneumonia (CBPP) in bulls originated from Borena pastoral area of Southern Ethiopia. *Trop. Anim. Heal. Prod*., 47 (5):983–7.

Alhaji, N. and Babalobi, O. (2015): Sero-positivity and associated risk factors for contagious bovine pleuropneumonia under two cattle production systems in North Central Nigeria. *Trop. Anim. Health Prod*., 48:311–20.

Almaw, G. Duguma, M., Wubetie, A., Tuli, G., Koran, A. (2016): A contagious bovine pleuropneumonia outbreak on a research farm in Ethiopia, and its dynamics over an eight-month period. *Rev. Sci. Tech. Off. Int. Epiz*., 35 (3): 1-13.

Amanfu, M. (2009): Contagious bovine pleuropneumonia (lung sickness) in Africa. *J. Vet. Res*., 76: 13-17.

Atnafie, B. Goba, H. Sorri, H. Kasaye, S. (2015): Sero-prevalence of contagious bovine pleuropneumonia in abattoirs at Bishoftu and export-oriented feedlots around Adama. *Glo. Vet.*, 15 (3):321–4.

Ayele, S. Assegid, W. Jabbar, M. Ahmed, M. and Belachew, H. (2003): Livestock marketing in Ethiopia: A review of structure, performance and development initiatives. Socio-economics and Policy Research Working Paper 52, ILRI (International Livestock Research Institute), Nairobi, Kenya, Pp, 35.

Belachew, H. and Jemberu, E. (2003): Challenges and opportunities of livestock marketing in Ethiopia. In: Yilma, J. and Getachew G. (eds), Proceedings of the 10th annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, August 2426, 2002, p.27.

Birhanu, T. (2014): Prevalence of the major infectious animal diseases affecting livestock trade industry in Ethiopia. *J. Biol. Agri. Heal.*,4(17):62–76.

Central statistics agency (CSA) (2020): Federal democratic republic of Ethiopia, Agricultural Sample survey.

CFSPH (2015): Center of Food security and public health (CFSPH), contagious bovine pleuropneumonia institute for international cooperation in animal biotechnology, available at:http://www.cfsph.iastate.edu/Contagious_ bovine_ pleuropneumonia, accessed on October 2020.

Daniel, G., Abdurahaman, M., Tuli, G. and Deresa, B. (2016): Contagious bovine pleuropneumonia: seroprevalence and risk factors in Western Oromia, Ethiopia. *J. Vet. Res*., 83 (1):1– 5.

Dupuy, V., Manso-Silva, L., Barbe, V., Thebault, P., Dordet-Frisoni, E., Citti, C., Poumarat, F., Blanchard, A., Breton, M., Pugnet, P. and thiaucourt, F. (2012): Evolutionary History of Contagious Bovine Pleuropneumonia Using Next Generation Sequencing of Mycoplasma mycoides Subsp. mycoides ‘‘Small Colony’’. *PLoS ONE*, 7 (10): e46821. doi: 10.1371/journal.pone.0046821.

Ebisa, T., Hirpa, H. and Aklilu, F. (2015): Study on seroprevalence and risk factors contagious bovine pleuropneumonia in southern nation and nationality people of Ethiopia regional state in Amaro special district. *Sci. Technol. Arts. Res. J.*, 4 (4):106–12.

European commission (2001): Diagnostic techniques of contagious bovine pleuropneumonia. Report of scientific committee of animal health and welfare, October, 2001.

FAO (2002): Food and Agriculture Organization of the United Nations (FAO). Recognizing contagious bovine pleuropneumonia. FAO Animal Manual Health Manual, FAO, Rome, 13: 3-17.

FAO (2016): CBPP Situation in Africa, can contagious bovine pleuropneumonia (CBPP) be eradicated? In: FAO animal health and production (no 19): Proceeding of the FAO-OIE-AU/IBAR-IAEA Consultative group on CBPP – Fifth meeting, Rome, 29 October 2015, Pp: 14-16.

Gedlu, M. (2004): Serological, Clinical and Participatory Epidemiological Survey of Contagious Bovine Pleuropneumonia in Somali Region. MSc Thesis, Addis Ababa University, Ethiopia.

Geresu, M., Kedir, K., Birhanu, D. and Teshome, A. (2017): Sero-epidemiological investigation and risk factors for contagious bovine pleuropneumonia infection of cattle in Dello Mena and Sawena Districts of Bale Zone, South Eastern Ethiopia. *J. Pub. HlthEpidemiol.*, 9 (5): 122-132.

Issa, A. (2004): Epidemiological Study of Contagious Bovine Pleuropneumonia in Borana Pastoral Areas Using Complement Fixation Test and Competitive Enzyme-Linked Immunosorbent Assay. MSc Thesis, Addis Ababa University, Addis ababa.

Kassaye, D., Molla W (2013): Seroprevalence of contagious bovine pleuropneumonia at export quarantine centers in and around Adama, Ethiopia. *Trop. Anim. Heal. Prod*., 45 (1):275–9.

Lemu, D. and Worku, S. (2017): A Sero-Prevalence Study of Contagious Bovine Pleuropneumonia (CBPP) in Bale Zone, Ethiopia. *Academ. J. of Anim. Dis.*,6(3): 83-87.

Leta, S. and Mesele, F. (2014): Spatial analysis of cattle and shoat population in Ethiopia: growth trend, distribution and market access. *Sprin.plus*. 3: 310.

Malicha, G., Alemu, S., Aklilu, F., Abraha, A. (2017): Study of Seroprevalence and Associated Risk Factors of Contagious Bovine Pleuropneumonia in Sidama Zone, Southern Ethiopia. *J. Vet. Sci.Technol.*,8: 471. doi:10.4172/2157-7579.1000471.

Mamo Y, Bitew M, Teklemariam T, Soma M, Gebre D, Abera T, Benti T, and Deneke Y (2018): Contagious Bovine Pleuropneumonia: Seroprevalence and Risk Factors in Gimbo District, Southwest Ethiopia. *Hind. Vet. Med. Int*., Pp, 1-6.

Mamo, Y. and Beshah, A. (2017): Review on Contagious Bovine Pleuropneumonia. *Biomed. Nur*., 3(1):1-18. Available at http://www.sciencepub.net/nurse/nurse030117/01_31551bnj030117_1_18.pdf accessed on30/05/2021.

Mariner, J.; ElIdrissi, A. and Raizman, E. (2019): Control of contagious bovine pleuropneumonia – A policy for coordinated actions. FAO Animal Production and Health Paper no. 180. Rome, FAO. Pp: 52.

Melaku, T. (2011): Oxidization versus tractorization: Options and constraints for Ethiopian framing system*. Int. J. Sustainab. Agric.*,3: 11-20.

Mersha, T. (2017): Epidemiological study on contagious bovine pleuropneumonia and farmers knowledge, attitude and practice towards the disease in selected district of east wollega and west showa zones, western Ethiopia, A Thesis submitted to School of Graduate Studies of Addis Ababa University in partial fulfillment of the requirements for the degree of Master of Veterinary Science in Veterinary epidemiology. Pp 48-62.

Metaferia, F, Cherenet, T, Gelan, A., Abnet, F, Tesfay, A, Ali, J. A. and Gulilat, W. A. (2011): Review to improve estimation of livestock contribution to the national GDP. 79.

MOA (2002): Monthly animal health status report; ministry of agriculture veterinary services, epidemiology Unit. Addis Ababa, Ethiopia.

MOA (2003): Monthly animal health status report; Ministry of Agriculture Veterinary Services, Epidemiology Unit, Addis Ababa, Ethiopia.

Molla, W., Jemberu, W., Mekonnen, S., Tuli, G. and Almaw, G. (2021): Seroprevalence and Risk Factors of Contagious Bovine Pleuropneumonia in Selected Districts of North Gondar Zone, Ethiopia. *Front. Vet. Sci*., 8:142.

Mtui-Malamsha, N. (2009): Contagious Bovine Pleuropneumonia (CBPP) in the Maasai ecosystem of south-western Kenya: Evaluation of seroprevalence, risk factors and vaccine safety and efficacy. *J. Gen. Microbiol*.,14: 97-207.

Muuka, G., Hang'ombe, B., Nalubamba, K., Kabilika, S., Mwambazi, L. and Muma, J. (2011): Comparison of Complement Fixation Test, Competitive ELISA and LppQ ELISA with Postmortem Findings in the Diagnosis of Contagious Bovine Pleuropneumonia (CBPP), *Trop. Anim. Heal. Prod*., 43: 1057-1062.

Negash, W. and Dubie, T. (2020): A seroprevalence study of Contagious Bovine Pleuropneumonia (CBPP) and Assessment of Risk Factors on Indigenous Afar Cattle in Selected Districts of Afar Region, Afar, Ethiopia.

OIE (2018): Contagious bovine pleuropneumonia (infections with *Mycoplasma mycoides subspecies* *mycoides*). OIE terrestrial manual, chapter 3.4.8, pp: 1097-1106.

OIE (2014): Contagious bovine pleuropneumonia. Office International des Epizooties Terrestrial Manual, Pp 1-16.

OIE (2009): Contagious bovine pleuropneumonia. Available at: https://www.oie.int/contagious bovine pleuropneumonia, accessed on November 2019.

OIE (2008): Manual of Diagnostic Tests and Vaccines for Terrestrial Animals (Mammals, birds and bees), 6th ed. Office the International Des Epizooties, Paris. Pp, 712-724. Available at:https://idoc.pub/documents/oie-terrestrial-manual-2008-volume2-2nv8jzgk69lk(accessed on 30 may 2021).

Penrith, M. (2014): Contagious bovine pleuropneumonia (CBPP), livestock health, management and production: high impact diseases, contagious diseases, contagious bovine pleuropneumonia. University of Pretoria, available at: www.afrivip, accessed on October 2019.

Provvido, A., Teodoro, G., Muuka, G., Marruchella, G. and Scacchia, M. (2018): Lung lesion score system in cattle: proposal for contagious bovine pleuropneumonia.

Radiostits, O., Gay, C., Hinchcliff, K. and Constable, D. (2007): Veterinary Medicine. A Text book of Diseases of Cattle, Sheep, Pigs, Goats and Horses. Tenth edition, WB Saunders, London.Pp: 1131-1138.

Swai, E., Mwezimpya, I., Ulicky, E., Mbise, A. and Moshy, W. (2013): An abattoir survey of contagious bovine pleuropneumonia lesions in slaughtered cattle in selected districts in Northern Tanzania. *Asian Pac. J. Trop. Biomed.*, 3 (4): 303-30.

Solomon, G., Hiwot, D., Biruk, A., Azage, T. and Barbara, W. (2020): Importance of livestock diseases identified using participatory epidemiology in the highlands of Ethiopia.*Trop. Anim. Healt Prod.*,52*:*1745–1757.

Tambi, N., Maina, W., and Ndi, C. (2006): An estimation of the economic impact of contagious bovine pleuropneumonia in Africa, *Rev. scienti. ettechn. Offi.inter. des épiz*.,25 (3): 999-1012. available on https://web.oie.int//boutique/extrait/11tambi99910 12.pdf.Accessed on30/05/2021.

Teklue, T., Tesfaye, T., Nirayo, T., Hailu, B., Wayu, S. and Atsbha, T. (2015): Epidemiological status of contagious bovine pleuropneumonia in southern zone of Tigray regions, Northern Ethiopia. *Anim. Vet. Sci*., 3 (1):32–6.

Teodoro, G., Marruchella, G., Provvido, A., Angelo, A., Orsini, G., Giuseppe, P., Sacchini, F., and Scacchia, M. (2020): Contagious Bovine Pleuropneumonia: A Comprehensive Overview. *Vet. Pathol.*, 1-14.

Thiaucourt, F. (2015): Can contagious bovine pleuropneumonia (CBPP) be eradicated? Evolutionary history of CBPP and spread during the past 25 years. How did we fail? FAO Animal production and health proceedings, FAO-OIE-AU/IBAR-IAEA Consultative group on CBPP Fifth meeting, september14-16, Rome.

Tonamo, A. (2016): A review on cattle husbandry practices in Ethiopia. *Intern. J. Livestock Prod.*, 7: 5-11.

Ulfina, G., Zelalem, B., Jemal, D., Gemeda, D., Chala, M., Jiregna, D., Diriba, G., Lemma, G., Workneh, A. and Adam, D. (2005): Survey of cattle production and marketing practices in Danno District, Western Ethiopia, using PRA tools, PRA Report.

Wade, A., Yaya, A., El-Yuguda, A., Unger, H., Nafarnda, D., Ikechukwu, E., and Egwu, G. (2015): The prevalence of contagious bovine pleuropneumonia in Cameroun: A case study of Garoua central Abattoir, Cameroun. *J. Vet. Med. Res.*, 2 (4): 1029-1034.

World Bank (2001): Pastoral area development in Ethiopia: Issues paper and project proposal, 1818 H Street, N.W. Washington, D.C. 20433, U.S.A.

How to cite this article:

Juhar Tesfaye and Fekadu Gutema. 2021. Epidemiology of Contagious Bovine Pleuropneumonia and its Economic Impact in Ethiopia. *Int.J.Curr.Res.Aca.Rev.* 9(08), 23-31. doi: https://doi.org/10.20546/ijcrar.2021.908.004