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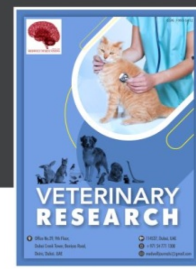

Contagious Bovine Pleuropneumonia (CBPP): Literature Review on Distribution, Sero-Prevalence and Associated Risk Factors Which Plays Major Role in an Economic Loss of this Sector

Tegegn Adugna

Bedele Regional Veterinary Laboratory, Oromia Bureau of Livestock and Fishery, P.O. Box 15, Bedele, Ethiopia

Key words: Contagious Bovine Pleuropneumonia (CBPP), Ethiopia, agro-ecology, prevalence, epizootiology, risk factors

Abstract: Contagious Bovine Pleuropneumonia (CBPP) is highly contagious and infectious respiratory disease of cattle caused by Mycoplasma mycoides mycoides Small Colony type (MmmSC) which is widely spread in Ethiopia regardless of any variation in agro-ecological parameters and found to be threat to cattle health and production. CBPP is an oldest and the noticed disease in Ethiopia. Although, combined blanket vaccination was given with Rinderpest vaccine in the former times it was not eradicated in Ethiopia. Rather the disease is distributed all over the country in various magnitudes of prevalences and made the controlling process very complex. Little is known about the Epizootiology of CBPP in Ethiopia and was thought to be the problem of low land pastoral area in which the adjacent high land do have probability to be exposed, unlike the research result of many literatures which has revealed its outbreak in high lands of Addis Ababa and North showa. In Ethiopia the average physical losses from Contagious Bovine Pleuropneumonia (CBPP) in terms of cattle deaths, traction power, cost of treatment and control is so, magnificent and incalculable both in endemic and epidemic areas that many changes are expected from this sector to save the immense potential loss arising from this problem. As a disease of intensification, animal husbandry and associated cattle movement were incriminated to be the risk factors. In general, small holder farmers of Ethiopia that covers the largest portion of agrarian community was underestimated and not understood because of which no noticeable economic change was seen despite the huge potential of livestock population in the country.

Corresponding Author:
Tegegn Adugna
Bedele Regional Veterinary Laboratory,
Oromia Bureau of Livestock and Fishery,
P.O. Box 15, Bedele, Ethiopia

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INTRODUCTION

In an economic backbone of Ethiopia that largely stems from agricultural sector, the role of livestock is very notable in that it contributes 13-16% of the total Gross Domestic Product (GDP), 30-35% of agricultural Gross Domestic Product (GDP) and more than 85% of farm cash income (Kocho and Geta, 2011). Despite the fact that this magnificent figure is achieved from livestock sector and making the gap of economy very narrow there by alleviating food insecurity, diseases of animals like Contagious Bovine Pleuropneumonia (CBPP) is playing a principal role and remarkably noticed by many scholars for not to achieve the real asset expected from this sector (Lesnoff *et al*., 2002).

Contagious Bovine Pleuropneumonia (CBPP) is an important disease of cattle caused by Mycoplasma mycoides mycoides Small Colony variant (MmmSC) (Radostits *et al*., 2000). It is a respiratory complex disease characterized by high morbidity that ranges from 75- 90% in which domestic ruminants are naturally at risk. Mortality rate seems to vary from 50-90% while the case fatality rate was found to be 50% (Sori, 2005) buffalo and yaks were reported to be susceptible. It is a disease notified by OIE because of its economic importance. CBPP induces lesions of pneumonia and pleurisy in cattle and domestic buffaloes in which mortality may come up to 50% if left untreated (Yaya *et al*., 2008).

According to the 1993 published paper of OIE, FAO and various reports of personal communications, CBPP was present in 23 countries of African of which Eritrea, Ethiopia, Kenya, Somali, Sudan, Tanzania and Uganda are some of the countries quoted (FAO and OIE., 1994). Because of the poor concept and lack of information about epizootiology of CBPP in Ethiopia it has been thought to be a problem of low land pastoral area that does have a high probability to be exposed to the high land. But the outbreak of the recent past in Addis Ababa and North Shewa showed the risk it carries to the dairy industry (Sari, 2005).

Contagious bovine pleuropneumonia is also one of the diseases that are revealed to be the hindering factor of livestock production in Ethiopia as it was seen to be one of the emerging and economically most important diseases in the country. The disease is at an alarming rate in that it is harming the socio-economy of the country in general and of the individual farmer in particular hampering the export standard and potential of the country. Among the exacerbating factors of the impact of CBPP lack of knowledge of the real pathogenesis, vaccine and its shortcomings and the poor diagnostic assays are the principal things which have been cited by many literatures (Ebisa *et al*., 2015; Gedlu, 2006; Sari, 2005).

Mycoplasma mycoides mycoides SC type is highly contagious and transmitted in between animals by aerosol and also available in discharges like saliva, urine, fetal memberanes and uterine discharges. Sequestrum which is encapsulated in the lung lesions of carriers and sub-clinically infected cattle can retain the viable organism for up to two years and the animals shed the organisms when stressed (Rovid, 2012). Cattle movements from one to another, close or repeated contact between cattle are the main route via which the disease transmitted. Sometimes it may spread over a long distance up to 200 m provided that the climatic conditions are favorable (Masiga *et al*., 1996).

Table 1: Cattle population at risk in 4 CBPP affected areas of Ethiopia

Area/administrative zones	Cattle population	Livestock system
Western Ethiopia		
Endemic zones		
Western Wellega (Oromia)	1,005,500	Mixed crop-livesock
Assosa (B. Gumuz)	84,200	Mixed crop-livestock
Epidemic zones		
Part of W. Wellega (Oromia)	272,700	Mixed crop-livestock
North Western Ethiopia		
Endemic zones		
Western Gojjam (Amhara)	1,188,000	Mixed crop-livestock
Awi (Amhara)	470,000	Mixed crop-livestock
North East Ethiopia		
Endemic zones		
Afar zones (Afar)	768,000	Nomads
Epidemic zones		
Southern Tigray (Tigray)	450,000	Mixed crop-livestock
North Wello (Amhara)	620,000	Mixed crop-livestock
North Shoa (Oromia)	1,018,000	Mixed crop-livestock
Eastern Shoa (Oromia)	1,019,000	Mixed crop-livestock
Arsi (Oromia)	2,509,000	Mixed crop-livestock
Southern Ethiopia		
Endemic zones		
Borena (Oromia)	1,419,000	Nomads
South Omo (SNNP)	413,000	Mixed and nomads
Konso SD (SNNP)	70,000	Mixed crop-livestock
Derashe SD (SNNP)	34,000	Mixed crop-livestock
Amaro SD (SNNP)	59,000	Mixed crop-livestock
Epidemic zones		
North Omo (SNNP)	1,715,000	Mixed crop-livestock
Maji (SNNP)	212,000	Mixed and nomadic
Total		
Endemic zones	5,510,700	
Epidemic zones	7,815,000	

Cattle population in the Zones: CSA. (1998) Livestock and poultry and beehives population, November, 1998

A wide range of severity and signs of contagious bovine pleuropneumonia has been quoted with some cattle appear to be resistant (Lesnoff *et al*., 2004). The rate of severity in endemic areas is as follows according the notification of some literatures: 13% of the animals develop the hyper acute form, 20% the acute form and 4% the sub acute form; approximately 21% of the animals are resistant (Sari, 2005). Same result has been seen in epizootic cases (Turner, 1994). The frequency of subclinical forms and severity of respiratory signs are the most prominent features observed in clinical cases (Lesnoff *et al*., 2004).

Large livestock population, poor supply of veterinary service, drought, concentration at watering point, dry grazing grounds combined with reduced resistance are the causes of massive livestock loss than lack of either forage

Table 2: Peasant association level sero-prevalence of CBPP in Amaro spcial woreda, SNNPR, Ethiopia in relation to predisposing factors

Variables/ category	No. of animals tested	No. positive (%)	Prevalence	X^2	p-values
Peasant association					
Jelo	100	7	7	60.950	0.000
Kele	100	28	28		
Globe	100	34	34		
Gamule	100	58	58		
Herd size					
Small	86	17	19.8	14.972	0.001
Medium	141	38	27		
Large	226	73	32.3		
Body condition					
Poor	137	55	40	10.645	0.005
Medium	156	50	32.1		
Good	107	22	20.6		

Ebisa *et al*. (2015)

or water with respect to CBPP. CBPP also retards Genetic improvement and limits working ability of cattle. The economic impacts of CBPP in a number of African countries including Ethiopia were calculated (Tambi and Maina, 2004) (Table1).

Magnificent loss due to death and disease of cattle has been noticed from the report of (Sari, 2005) arising from post vaccinal failure and complications apart from the purchase price of vaccine from the study that had encompassed wide area of the country.

Epidemiology of CBPP: Mycoplasma mycoides subspecies mycoides SC type, the causative agent of CBPP is with two principal clusters the European and Afro-Australian cluster according to the isolate of strains collected over the last 50 years. Moreover, the African isolates are the one seen to surpass that of the European on the basis of degree of virulence (Vilei *et al*., 2000). CBPP is an endemic disease in Africa, Asia, Eastern Europe and the Iberian Peninsula (Radostits *et al*., 1994). Housed, transit and cattle moving on foot are the one estimated to be at risk hence suitable for extension of outbreaks to happen thereby facilitate the disease to spread at ease.

CBPP is characterized by long incubation period, direct contact transmission, possibility of early mycoplamal excretion (about 20 day), during course of the disease and after recovery in "lungers" (up to 2 year). Lack of reliable early screening test to isolate the agent from early carriers and lungers on top of the aforementioned problems necessitate the essence of cattle movement control to limit the spread of disease. Cattle movement is solely incriminated for maintenance and extension of the disease as there is no wild reservoir to make the transmission route complex (Bessin and Connor, 2000) (Table 1). In OIE, 2002 report, CBPP was wide spread in 24 countries in Africa including Ethiopia.

Table 3: Prevalence of CBPP in bulls (Borena, Bale, Arsi origins) at Eastern Ethiopia livestock export industry

Origin	No. examined	Positive result	Prevalence (%)	p-values
Borana	857	61	10.5	0.03
Bale	1432	128	8.9	
Arsi	2019	156	7.7	
Total	4321	345	8	

Mersha (2014)

Table 4: Individual animal level sero-prevalence of CBPP in western part of Oromia, Ethiopia

Districts	No. of animals tested	No. of positive (%)	95%CI	X^2 (p-values)
Bako-Tibbe	100	19 (19)	118-28.06	64.13 (0.001)
Horro	70	4 (5.7)	1.5-14.0	
Gobbu-Sayyo	216	87 (40.3)	33.6-47.1	
Total	386	110 (28.5)	24.04-33.2	

Tesfaye (2016)

Table 5: Animal level sero-prevalence of CBPP in the sampled villages of the three districts at 95%CI

Sites	No. of animals tested	No. of positive (%)	X^2 (p-values)
Ongobo	67	27 (40.2)	73.73 (0.001)
Kejo	51	30 (58.8)	
BARC farm	98	30 (30.6)	
Gitilo	29	2 (6.8)	
Lakku	41	2 (4.8)	
Sadan qixxe	52	5 (9.6)	
Dambi Dima	48	14 (29.01)	
Total	386	110 (28.4)	

Tesfaye (2016)

Table 6: The relative prevalence of CBPP at abattoirs based on associated risk factors

Factors	No. tested	No. of positive	Prevalence (%)	p-values
Origin				0.080
Adama	181	21	11.6	
Bishoftu	118	6	5.08	
Harar	55	3	5.4	
Age				0.640
<4 years	36	2	5.7	
4-9 years	305	24	7.8	
>9 years	43	4	9	
Body condition			0.037	
Poor	11	2	18	
Medium	64	8	12.5	
Good	309	20	6.4	

Atnafie *et al*. (2015)

Review of some of the associated risk factors (environment and host related demographics): Peasant association level sero-prevalence of CBPP in Amaro spcial woreda, SNNPR, Ethiopia in relation to predisposing factors as shown in Table 2. Prevalence of CBPP in bulls (Borena, Bale, Arsi origins) at Eastern Ethiopia livestock export industry in Table 3. Individual animal level sero-prevalence of CBPP in western part of Oromia, Ethiopia Table 4. Table 5 shows the Animal level sero-prevalence of CBPP in the sampled villages of the three districts at 95% CI. The relative prevalence of CBPP at abattoirs based on associated risk factors in Table 6.

Table 7: Direct economic loss due to CBPP post vaccinal reaction in the affected zones

Type of cost/Data used for calculation	Western Wellega	South Omo	Borena
Mortality			
Price of cattle per age/sex at Mendi and Inango markets	ETB 145,030	ETB 89,288.76	ETB 21,160.92
Mortality rate in vaccinated animals per age/sex			
Treatment costs			
The population of affected cattle	ETB 24,665.90	ETB 18,704	ETB 6,897.10
Average cost per treated animal (16.70 per animal)			
Other costs			
Fuel, lubricants and Per diem	ETB 12,354.80	Not available	Not available
Total	ETB 318,351.48		

Table 8: Attack, mortality and case fatality rates due to post vaccinal reaction in the zones investigated

	Areas studied			
Parameters	Western Borena	South Wellega	Omo	Total
Vaccinated population	176,750	37,710	71,788	296,248
Number affected	413	1477	1120	3010
Number died	41	283	173	497
Attack rate (%)	0.23	3.91	1.37	1.02 $x^2 = 4331.47$
Mortality rate (%)	0.023	0.75	0.21	0.17 $x^2 = 994.256$
Case fatality rate (%)	9.9	19.2	15.4	16.5 $x^2 = 21.43$

Sari (2005)

MATERIALS AND METHODS

Diagnosis and diagnostic techniques used for CBPP:
Cultural examination: Samples like nasal swabs, broncho-alveolar washings, pleural fluid obtained by puncture are collected from live animal. Samples taken to necropsy are lung lesions, lymph nodes, pleural and synovial fluid from animals with arthritis. The causal organisms can be isolated culturally from animals during febrile phase or shortly after postmortem from blood, pleural exudates (chest fluid) and/or affected lung tissue and lymph nodes. Because of “fastidious” nature of the agent, samples should be submitted to the laboratory as soon as possible after collection (Walker, 1999).

Biochemical test: Mycoplasma mycoides mycoides small colony type is sensitive to digitonin does not produce “film spots”, ferment glucose, reduces tetrazolium salts (aerobically and anaerobically), does not hydrolyze arginine has no phosphatase activity and has no or weak proteolytic properties (OIE., 2002). It is where immunological tests give uncertain results that biochemical test is preferred.

Serology: To detect latency and chronically infected animals, almost all serological tests are suitable. Complement Fixation Test (CFT) has been prescribed by OIE to undergo a reliable test in an international trade in which interpretation can be held at herd level. The other is competitive ELISA (c-ELISA) which does have equal sensitivity and great specificity. It was seen to be easy to perform than Complement Fixation (CF) test but its performance characteristics has not yet been fully assessed (OIE., 2002).

Control strategies: The options for control of Contagious Bovine Pleuropneumonia (CBPP) include cattle movement control and quarantine, stamping out, test and slaughter, treatment and vaccination with T1 vaccines (Radostits *et al*., 2000). One should be very aware and very equipped with veterinary knowledge and practices not to commit contagious bovine pleuropneumonia post-vaccinal reactions termed Willem’s reaction to happen, hence, it has produced many direct and indirect losses as was seen on Table 7 and 8 (Sari, 2005).

CBPP can disappear from a country with movement control (Newton and Norris, 2000). However, movement control is difficult and often impractical because of need for transhumance, trade, socio-cultural practices and inadequate veterinary personnel (Wanyoike, 1999).

The major control strategy practiced in Ethiopia is vaccination. It was the main control strategy practiced in Ethiopia for the last 30 years in combination with Rinderpest vaccine which has rendered protection and restrained the disease to relatively low level until 1992/93. Currently, CBPP vaccination in Ethiopia is based on targeted and ring vaccination in the face of outbreaks (MOA., 1997).

Economic importance: The economic importance of Contagious Bovine Pleuropneumonia (CBPP), especially, losses due to the chronic disease is difficult to assess. Losses include mortality, loss of weight, reduced working ability, reduced fertility, reduced growth rate and losses caused by control program (due to vaccination campaigns, quarantine and restrictions on cattle trade) (Masiga and Domenech, 1995).

In Ethiopia the average physical losses from CBPP in terms cattle deaths are 25,115 heads (8,372 in endemic areas and 16,743 in epidemic, 1,852 and 13,396 metric tons of beef and milk, respectively). In terms of animal power average of 3,135,000 oxen (farming) days are lost. Ethiopia experiences the largest number of cattle deaths and reduction in cattle products under both endemic and epidemic conditions relative to other African countries, due probably to its large cattle population (Lesnoff, 2004). It should be noted that the economic evaluation of losses due to CBPP has not been performed systematically throughout Africa. Priority should therefore be given to the cost-benefit analysis of control or eradication campaigns (Masiga and Domenech, 1995). The following is the tabular summary of the two main ways via which economic losses are possibly happened directly and indirectly.

RESULTS AND DISCUSSION

Contagious Bovine Pleuropneumonia (CBPP) has been frequently indicated as a disease of cattle in many literatures with various ranges of parameters required for a given animal for its susceptibility. Even though many controversial ideas are there about breed differences with respect to susceptibility, European breeds are the one in which many scholars believe for their susceptibility relative to the native zebu (Bemrew *et al*., 2015).

According to the testimony of Tesfaye (2016) in three selected districts of west Oromia an overall sero-prevalence of 28.5% (out of 386 sera samples examined for the presence of specific antibodies against MmmSC type by c-ELISA) was investigated. Significant variation ($p<0.05$) in sero-prevalence of Mycoplasma antibodies was discovered amongst the districts (40.3, 19 and 5.7% in Gobu Sayyo, Bako Tibbe and Horo districts respectively), with no remarkable variation ($p>0.05$) in animal related risk factors like sex, age, breed and body condition with the serological status of the animal. The same was shown on the research of Tadese (2014) in that site difference is still an important factor and significant for the sero prevalence though the overall sero prevalence (8%) was by far less than Tesfaye. According to the research, conducted by Tolesa *et al*. (2015) in Amaro special woreda of SNNPR Ethiopia an overall sero prevalence of 31.8% was registered and a bit higher than the two. Environment was found the principal risk factor followed by body condition and herd size and again similar with (Tesfaye, 2016) with respect to animal related demographics. According to the investigated of Biruhtesfa *et al*. (2015), (Table 6) the potential predisposing factors like origin and age of animals were not associated significantly ($p>0.05$) with the occurrence of the disease and was in agreement with Tesfaye (2016) and Tolesa *et al*. (2015) who found no significant difference between age groups but different with respect to the origin. And with the overall sero-prevalence of 8.4% which is very nearer to the result of Tadese (2014) who reporte an overall prevalence of 8%.

An overall sero prevalence of 11.9% was registered in southern Tigray by Teklue *et al*. (2015) and was nearly found in agreement with Tadese and Biruhtesfa. According to Teklue *et al*. (2015), age and sex were not seen to be significant ($p>0.05$) predisposing factors for sero-prevalence of CBPP but agro-ecology was found to be very significant ($p<0.05$) and agrees with few of the aforementioned literatures.

In the study conducted in to Somali zones, namely Jijiga and Shinille, the result of an epidemiological survey aimed at assessing the distribution, prevalence and indicative risk factors showed that agro-ecology based sero-prevalence investigation was found signicant (low land excels mid-altitude 39% by 6.7%). Animal husbandry and associated cattle movement were entitled to be the major risk factors (i.e., pastoral area with the most significant sero-prevalence with about 36%) and no remarkable variation in the herd sero-prevalence of transhumance and sedentary management techniques. In nearly all animals showing clinical signs the causative agent Mycoplasma mycoides mycoides SC type was recovered by culturing the lung tissue obtained from this study area (Gizaw, 2004) indicating that the clinical signs are nearly specific.

On the other way round prevalence studies of 56% (1996) in north Omo of western Ethiopia, 39% (2004) in to two Somali zones (Jijiga and Shinille), 28% (2001) in Bodji district of west Wollega, 9.4% (2004) in Borena, 4% (2013) in and around Adama, (66.3, 47.7 and 33.3% Banja, Dangila and Denbecha respectively (1998) in Western Gojjam and Awi zones) (Tesfaye, 2016) are the indicative for the widely distribution of CBPP with various prevalence rates in Ethiopia and growing in magnitude of prevalence.

On top of direct economic loss arising from cattle death and cost of treatment there had been a significant depression of production (mainly milk production), traction power, manure body weight and etc. A direct economic loss amounting to ETB 318,151.48 (Table 7) had resulted.

The principal natural setting in small holders like husbandry practice, feed resources, purpose of keeping the production system and environmental interaction which are the vital factors for production and productivity of livestock are not been properly underway; hence, momentarily resulted in production loss from these huge resource potential (Yitate *et al*., 2000). Lack of marketing standard for livestock and livestock products in case of small holders was the challenge not to generate income and support the livelihood of individuals.

On the other way round, production systems may vary due to factors like climate, human population, disease incidence, level of economic development, research support and government economic policies according to Devendra and Thomas (2002).

CONCLUSION

The impact that Contagious Bovine Pleuropneumonia (CBPP) can impart in an economy of a given country is so, vast and tremendous that it is not advisable to overlook like any of the ordinary routine disease of livestock that can be easily removed by treatment or self cure. In Ethiopia where great majority of cattle management and the production fashion was not technically and scientifically supported and of either semi-intensive or completely extensive that enhance close or repeated contact of cattle, the propagation of CBPP is so simple and the output is very worsening.

As a transboundary animal disease listed by OIE its presence in Ethiopia can produce a magnificent problem on the trade export of the country. Moreover due to the direct effect of this disease on cattle, traction power, milk production, death of cattle, impairments of genetic improvement and weight loss are inevitable to happen. Moreover, the indirect losses like cost of treatment and control are not simple and worth mentioning.

The variation in prevalence registered in different parts of the country may be due to differences in agro-ecology, cattle management, production systems, population density and the type of tests used. It was also seen in some circumstances that the associated risk factors of either environment or animal related demographics described in various data analysis as influential or non-influential can bring about changes in prevalence studies of different literatures.

Moreover the degree of significance of the associated risk factors for the prevalence of the individual or overall sero-prevalence of CBPP can be limited by the quantity and quality of data used for processing the research, talent and devotion of the researcher and season when the research was underway. The fact of the reviewed articles indicated that the disease (CBPP) is widely distributed in different agro-ecological zones of the country without any limitations in parameters and has showed me that the disease is growing in magnitude of prevalence which designated that our country is at an alarming rate in that it has induced me to forward the following recommendations as a professional personnel:

- Controlling and limitation of CBPP via animal movement control and vaccination
- Mass blanket vaccination supported by regular diagnosis, isolation of animals, stamping out of outbreaks
- Endorsing of intensive sero-surveillance in different agro-ecological zones
- Frequent training of veterinary personnel about diagnostic techniques
- Avoiding of re-introduction, close or frequent contact of cattle from neighboring countries or herds suspected of CBPP
- Awareness creation among the society about the nature of CBPP without whom participation controlling process shouldn't be undertaken at ease
- Producing marketing standards for livestock and livestock products for small holder farmers which do have paramount importance for generation of income to support livelihood of individual thereby increase participation of small holders in the disease controlling process

REFERENCES

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

Atnafie, B., H. Goba, H. Sorri and S. Kasaye, 2015. Sero-prevalence of contagious bovine pleuropneumonia in abattoirs at Bishoftu and export oriented feedlots around Adama. Glob. Vet., 15: 321-344.

CSA., 1998. Agricultural sample survey, volume II, report on livestock and livestock characteristics. Central Statistical Agency, Addis Ababa, Ethiopia.

Devendra, C. and D. Thomas, 2002. Crop-animal systems in Asia: Importance of livestock and characterisation of agro-ecological zones. Agric. Syst., 71: 5-15.

Ebisa, T., E. Hirpa and F. Aklilu, 2015. Study on sero-prevalence 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: 106-112.

FAO and OIE., 1994. Animal Health Yearbook. Food and Agriculture Organization of the United Nations, Rome, Italy, Pages: 228.

Gizaw, G.M., 2004. Serological, clinical and participatory epidemiological survey of contagious bovine pleuropneumonia in the Somali region, Ethiopia. M.Sc. Thesis, University of Addis Ababa, Addis Ababa, Ethiopia.

Kocho, T. and E. Geta, 2011. Agro-ecologic mapping of livestock system in smallholder crop-livestock mixed farming of Wolaita and Dawuro districts, Southern Ethiopia. Livestock Res. Rural Dev., Vol. 23, Lesnoff, M., G. Laval, P. Bonnet and A. Workalemahu, 2004. A mathematical model of Contagious Bovine Pleuropneumonia (CBPP) within-herd outbreaks for economic evaluation of local control strategies: An illustration from a mixed crop-livestock system in Ethiopian highlands. Anim. Res., 53: 429-438.

Lesnoff, M., M. Diedhiou, G. Laval, P. Bonnet, A. Workalemahu and D. Kifle, 2002. Demographic parameters of a domestoc cattle herd in a contagious-bovine-pleuropneumonia infected area of Ethiopian highlands. Rev. Elev. Med. Vet. Pays Trop., 55: 139-147.

MOA., 1997. Livestoick development project. Ministry of Agriculture, the Federal Democratic republic of Ethiopia, Addis Ababa, Ethiopia.

Masiga, W.N. and J. Domenech, 1995. Overview and epidemiology of contagious bovine pleuropneumonia in Africa. Rev. Sci. Tech., 14: 611-630.

Masiga, W.N., J. Domenech and R.S. Windsor, 1996. Manifestation and epidemiology of contagious bovine pleuropneumonia in Africa. Rev. Sci. Techn. Off. Int. Epiz., 15: 1283-1308.

Mersha, T., 2016. Sero-prevalence of contagious bovine pleuropneumonia and its potential risk factors in selected sites of Western Oromia, Ethiopia. Ethiopian Vet. J., 20: 31-41.

OIE., 2002. Manual of standards for diagnostic test and vaccines. Office International des Epizooties, Paris, France.

Radostits, O., D.C. Blood and C.C. Gay, 1994. Veterinary Medicine: A Text Book of Disease of Cattle, Sheep, Pigs, Goats and Horse. 8th Edn., Baillere Tindall Publication, London, pp: 1223-1225,1237-12 38.

Radostits, O.M., C.C. Gay, D.C. Blood and K.W. Hinchcliff, 2000. Veterinary Medicine: A Text Book of Disease of Cattle, Sheep, Pigs, Goats and Horses. 10th Edn., Saunders, London, UK., ISBN: 9780-7020-2777-2, Pages: 2065.

Rovid, S.A., 2012. Contagious bovine pleuropneumonia. The Center for Food Security and Public Health, College of Veterinary Medicine, Iowa State University, Ames, Iowa.

Sori, T., 2005. Contagious Bovine Pleuropneumonia (CBPP) post-vaccinal complication in Ethiopia. J. Applied Res. Vet. Med., 3: 344-350.

Teklue, T., T. Tesfay, T. Nirayo, B. Hailu, S. Wayu and T. Atsbha, 2015. Epidemiological status of contagious bovine pleuro pneumonia in southern zone of Tigray regions, northern Ethiopia. Anim. Vet. Sci., 3: 32-36.

Turner, A.W., 1954. Epedemiolocucal characteristics of bovine contagious pleuro-pneumonia. Australian Vet. J., 30: 312-317.

Vilei, E.M., E.M. Abdo, J. Nicolet, A. Botelho, R. Goncalves and J. Frey, 2000. Genomic and antigenic differences between the European and African/Australian clusters of *Mycoplasma mycoides* subsp. mycoides SCThe GenBank accession numbers for the nucleotide sequences determined in this work are: AF165134 for the 3•4 kb HindIII fragment from M. mycoides subsp. mycoides SC strain L2; AF165135 for the analogous locus in strain Afade (containing lppB and IS1634); and AF1651136 for the DNA segment containing lppB [MmymyLC] and ORF6 [MmymyLC] from*M. mycoides*subsp. mycoides LC strain Y-goat. Microbiology, 146: 477-486.

Walker, L.R., 1999. Mollicutes. In: Veterinary Microbiology, Hirsh, D.C. and Y.C. Zee (Eds.). Blackwell Science Inc., Boston, USA., pp: 165-172.

Wanyoike, S.W., 1999. Assessment and mapping of contagious bovine pleuropneumonia in Kenya: Past and present. M.Sc. Thesis, Addis Ababa University, Addis Ababa, Ethiopia.

Yaya, A., L. Manso-Silvan, A. Blanchard and F. Thiaucourt, 2008. Genotyping of *Mycoplasma mycoides* subsp. mycoides SC by multilocus sequence analysis allows molecular epidemiology of contagious bovine pleuropneumonia. Vet. Res., 39: 1-19.

Yitaye, A., A. Tegegne and M.Y. Kurtu, 2000. The livestock production systems in three peasant associations of Awassa Woreda. Proceedings of the 8th Annual Conference of the Endocrine Self-assessment Program, Aug. 24-26. Addis Ababa, Ethiopia, pp: 155-167.