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Review on Economic Impact of Contagious Bovine Pleuropneumonia (CBPP)

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Abstract: Contagious bovine pleuropneumonia (CBPP) caused by Mycoplasma mycoides subsp. mycoides (Mmm) is an economically very important cattle disease in sub-Saharan Africa. The disease causes high morbidity and mortality losses to cattle. CBPP impacts animal health and poverty of livestock-dependent people through decreased animal productivity, reduced food supply and the cost of control measures. CBPP is a barrier to trade in many African countries and this reduces the value of livestock and the income of many value chain stakeholders. The presence of CBPP also poses a constant threat to CBPP-free countries and creates costs in terms of the measures necessary to ensure the exclusion of disease. Control of CBPP is therefore important as a way to salvage the losses and increase the incomes of cattle owners. This review assesses the economic impact of CBPP.

Key words: Contagious Bovine Pleuropneumonia · Disease Control · Economic Impact

INTRODUCTION

Contagious bovine pleuropneumonia (CBPP) is a highly contagious trans-boundary disease of cattle and water buffalo caused by Mycoplasma mycoidesmycoides Small Colony (MmmSC). It occurs in the hyperacute, acute, sub-acute, or chronic form, affecting the lungs and occasionally the joints particularly in calves. Clinically it manifests as fast, difficult or noisy breathing, discharges from the nose and/or mouth and a painful cough which becomes worse on exercise. In the chronic stage, there is weight loss. Death may be sudden in the hyper-acute stage or after prolonged illness in the chronic form [1].

CBPP affects production through mortality and reduced productivity. It also retards genetic improvement and limits the ability of cattle to work. CBPP is reported to be a constraint to cattle production in the arid and semi-arid pastoral areas [2], therefore affecting livelihoods of over a hundred thousand households. However, other cattle systems have remained free from CBPP, its persistence in pastoral areas has been attributed to the nomadic lifestyle of pastoralists which allow for uncontrolled movement of cattle with continuous mixing at grazing fields, watering points and difficulty accessing vaccination services[3].

Economic losses can be significant due to high infectivity and the presence of chronic subclinical carriers. The response to antibiotic treatment can be incomplete, creating chronic carriers; therefore slaughter is generally recommended for infected animals. The presence of CBPP in a herd results in direct losses due to its impact on cattle production, through increased mortalities, reduced milk yield, reduced weight gain and reduced fertility rate and therefore it compromises both household and national food security due to loss of protein and draught power [4]. CBPP also causes indirect losses through additional cost of treatment, preventive vaccination, field diagnostic testing and slaughter of clinical cases, surveillance activities, disruption of trade and the limitation of investment opportunities due to reluctance in adoption of improved breeds [5].

The policy for control of CBPP in most countries relies on mass vaccination of susceptible cattle and enforcement of movement control [6]. Additionally, research on antimicrobial agents for use in treatment of CBPP was recently proposed [7].The implementation of test and slaughter as a control policy is unattractive to cattle producers in sub-Saharan Africa, but the strategy was instrumental for CBPP eradication from Australia[8].

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Likewise, the policy was recently applied in Botswana during an outbreak in Ngamiland district in 1996, although its application resulted in food security challenges to children under 5 years of age who suffered malnutrition [9].

Preventive vaccination of susceptible cattle is recommended as the most appropriate control measure in many countries where CBPP is endemic. It is very difficult to evaluate the losses due to CBPP in many African countries where the disease is enzootic (endemic) because of the lack of proper reporting and economic evaluation. Available data on the impact of the disease is however, limited to incidence rather than the effects on livelihoods. While such data may not be readily available, empirical evidence indicates that the disease occurrence in many sub-Saharan (SSA) countries comprising about 433.9 million people of whom 10% entirely depend on livestock for livelihoods may be significant. In countries where some data has been gathered, losses due to CBPP have been estimated to be very high especially when the disease enters a CBPP free zone or country where cattle are susceptible. As an example, losses due to the reintroduction of CBPP in Tanzania may have caused more than $11 million dollars of direct loss in 1990. The reintroduction of CBPP in Botswana in 1995 led to the slaughter of 320,000 cattle at a cost of US$ 100 million, with further indirect losses estimated at over US$ 400 million. Considering the diversity of apparently important cattle diseases in Africa and the need for Donors and Governments to prioritise investments, it is not surprising that CBPP has received little attention in most countries where it exists because of the enormous costs involved in its control [10]. Therefore, the major objective of this paper is:

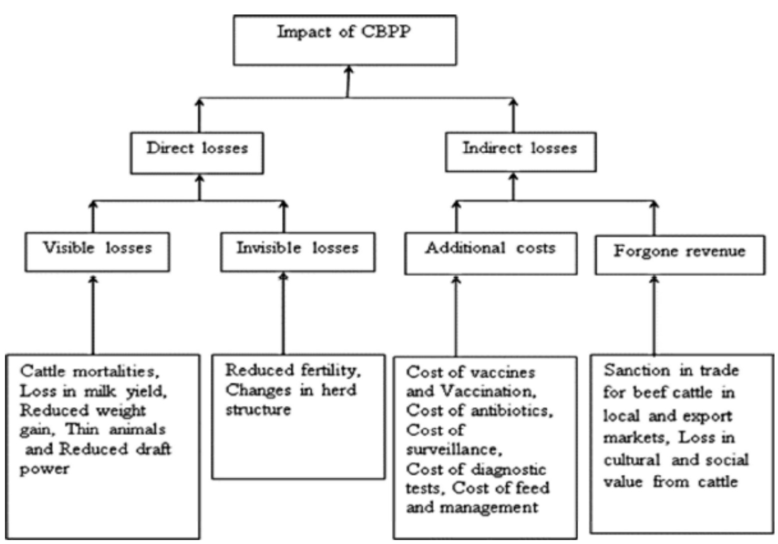
- to review the economic impact of contagious bovine pleuropneumonia(CBPP).

Review on Economic Impact of CBPP: Population at risk: Cattle (both *Bostaurus*and *Bosindicus*) are the main species that are susceptible to CBPP. The domestic buffalo (*Bubalusbubalus*) is also susceptible although the disease is difficult to produce experimentally in this species. The African water buffalo (*Synceruscaffer*), Sheep and goats are resistant to the disease CBPP [11].

Antemortem and Postmortem Findings: Carcass of an animal affected with contagious bovine pleuropneumonia is *condemned* if the disease is associated with fever, inadequate bleeding of carcass, serous infiltration of the brisket and emaciation. Recovered animals showing no generalized signs of the disease are *approved* and the affected organs are condemned [12].

General Impact of CBPP: The framework described by Rushton *et al*. [5] for assessment of disease impact in livestock was adopted for the analysis. According to this framework, diseases impact production through direct output losses due to reduction in yields and changes in herd structure and indirect losses that relates to the cost of control and management and the poor access to markets and limited use of improved technologies.

The direct losses from CBPP which can considered in the analysis included increased mortalities, reduced milk production, reduced live weight gain and reduced fertility rate, while the indirect losses included the cost of controlling and managing the disease in herds. The framework for assessment of CBPP impact is shown in this figure.



Morbidity Losses: According to Elshafey [13] presentation on CBPP, the morbidity increases with close confinement and can reach 100% in susceptible herds.

The direct morbidity losses were the reduction in milk yield, meat production and reduced fertility rate. The loss in milk was estimated from the reduction in milk output from dead cattle that no longer produced milk and reduction due to diseased cattle that did not produce the same quantity of milk when compared to healthy cattle. The losses are based on prevalence estimates for CBPP in pastoral herds which have been predicted through mathematical modelling [14].

Morbidity rates for CBPP vary significantly between herds. Complement fixation test (CFT) results obtained from field surveys differ significantly from one study to another. For example, McDermott *et al.* [15] reported a CBPP CFT seropositive rate of 8.1% in Sudan. Using the standard procedure of the Kenya Veterinary Laboratory and an antigen from the Muguga (Kenya) Veterinary Research Laboratory to test sera, Zessin and Baumann [16] reported an infection rate of 8.3% among cattle in Sudan. Other surveys reveal rates above 25% in Chad, Ethiopia, Guinea and Tanzania [17- 20].

Mortality Losses: It ranges from 30% to 80% based secondary factors. 25% of recovered animals may become CBPP carriers [13].

The mortality losses can estimate by applying the impact of CBPP on mortality rate in each age and sex group of cattle at risk. The output losses due to CBPP mortality was derived from the difference between the number of dead cattle for “with CBPP” scenario and those from “without CBPP” scenario. Outbreaks of CBPP have been associated with various levels of mortality. In endemic situations mortality rates are generally low. However, higher mortality rates are not uncommon. In its acute form, the mortality rate can reach 50%[1]. Mortality rates above 10% have been reported in Guinea [17] and Ethiopia[18]. Rates between 5% and 10% have been reported in Chad and Côte d’Ivoire [17], while rates below 5% have been reported in Tanzania, Uganda, Burkina Faso, Ghana and Mali [17, 20- 22].

Cost of Production Losses: Production losses included mortality losses and losses of milk, beef and draught power through disease morbidity. The production losses due to CBPP can be derived from the difference between the production parameters for “with CBPP” scenario and those from “without CBPP”. The animals considered for calculation of morbidity losses were those with CBPP, did not die but had reduced production. In cross-sectional study and outbreak investigation, if a draught animal is infected with CBPP there is total loss of draught power for at least a full year whether the animal dies or not. Often the hide is not salvaged from dead cattle because the carcass is too emaciated to allow flaying. On average half lactation was lost for every lactating cow that died assuming that lactating cow deaths are evenly distributed between the beginning and the end of lactation. Other production losses were milk and calf losses resulting from death of pregnant cows, abortions and reduced calving rate [14]. Costs associated with outbreak occurrence: These were considered as the cost of ring vaccination and antibiotic treatment, costs of disease reporting, costs of sampling and testing prior to vaccination and costs due to adverse post vaccination reactions including deaths, abortions and treatment of reactors. Ring vaccination occurs when there is an outbreak with or without a preceding annual vaccination in the outbreak herd and up to 30 km radius around the outbreak herd. The cost of ring vaccination was calculated by multiplying the average number of animals vaccinated in ring vaccinations per year by the cost of vaccination of one animal. The cost of treatment was obtained by estimating the number animals treated per year and multiplying by the average cost of treating one animal as derived from the responses of the farmers. Ring vaccination occurs after farmers report the disease to the District Veterinary Office. The cost of reporting the disease was calculated by applying the proportion of households experiencing disease to the proportion of farmers reporting the disease. The product was then multiplied with the cost of reporting per household which can be high due to poor infrastructure and sometimes need for repeated reporting before response. Adverse reactions to vaccination included deaths, abortions and other reactions [23].

Impact of CBPP on International Trade: Increased international trade in livestock and livestock products is also an argument for more support for the veterinary services in the control of CBPP. Despite widespread recognition of the prime importance of livestock for pastoral societies, TADs such as CBPP continue to be an effective brake on marketing opportunities for these often poor communities. The occurrence of such diseases impacts both poor and richer livestock producers by marginalizing them from higher price livestock markets and restricting their capacity for value-added trade [11].

Movement restrictions and local quarantines mean the closure of livestock markets and reduced or no opportunities for sale of live animals and possibly meat and other products. In addition to the measurable economic impact on a national economy, the inability to sell their animal can bring severe hardship to a pastoral family with no other income of sources of support[24].

Total Economic Cost of CBPP: The total economic cost of CBPP (C) can be obtained by summing the value of the direct and indirect production losses (L), expenditures on other activities following disease such as sampling and testing (R), the cost of inputs used to treat disease (T) and the cost of disease prevention measures (P) [25].

$C = (L + R) + T + P$

CBPP Control Cost: Control cost in Cattle Herds: The economic cost of CBPP controlis the sum of output losses (L) and expenditures (E) incurred on treatment or preventive measures taken against CBPP. The expenditures on CBPP are those either for treatment or preventive purposes. Treatment expenditures represent strategies to mitigate the impact of CBPP once an outbreak has occurred, while preventive expenditures are incurred to avoid occurrence of CBPP. Therefore expenditures on CBPP control represented the total value of resources which are used either to reduce or to forestall potential loss from output reductions. The direct costs included expenditure on treatment, vaccination and home slaughter of clinical cases. CBPP induced output losses in a herd were represented by reduced milk yield, increased mortality rate, lowered weight gain and reduced fertility rate. Costs of these output losses can be estimated from their prevailing market prices for different cattle groups by age and sex categories and other cattle products. High expenditures on treatment and prevention of CBPP will result in low output loss and vice versa, but this relationship is non-linear. Minimum costs of CBPP control was determined according to the procedure described by Mclnerney*et al.* [26]. Based on this framework, any additional expenditure on CBPP control above this minimum cost will result in lower reduced output losses because all technically available tools are insufficient.

Economic Modeling of Costs - Benefits for CBPP Control: The estimated herd prevalence of CBPP was multiplied by the number of herds raised within these pastoral areas to estimate the number of cattle herds which were at high risk of infection.

Direct Disease Control Costs

Vaccination Cost: A previous economic analysis for CBPP control in 12 countries within the sub-Saharan Africa region found an average unit cost for vaccination of US$ 0.58 (_0.42).

Costs of vaccinating one animal in current and past CBPP vaccination programs considered variable and attributable fixed costs. The fixed cost items included automatic syringes, camping equipment, cold chain (refrigerators and freezers), vaccination crushes and vehicles. The variable cost items included were CBPP vaccine, vaccination consumable materials, repairs to equipment, vehicles and crushes, vaccination staff allowances, gas and electricity, fuel, vaccination awareness creation campaigns, expected profits for the vaccinating agency and contingencies.

Attributable fixed costs, rather than the full costs of the fixed items, can be calculated using the straight line depreciation method and used in calculating the total cost of vaccination since these items were not just for this vaccination as their lifespan is beyond the vaccination period[4]

Treatment Cost: The cost of antimicrobial treatment was based on the average cost that incurred on treatment of sick animals from their preferred animal health service providers.

Culling Cost: The cost incurred on home slaughter for clinical cases was estimated through summation of data gathered from cattle traders, butchers and brokers on prices of hides and skins at abattoirs, value of meat from a culled cow and the average market prices for cattle purchased for slaughter [4].

CONCLUSION

Contagious bovine pleuropneumonia is a disease that causes high morbidity and mortality losses to cattle. The financial implications of these losses are of great significance to both cattle owners and to the nation. Control of CBPP is therefore important as a way to salvage the losses and increase the incomes of cattle owners. Economic cost can be evaluated in terms of the direct and indirect production losses attributed to morbidity and mortality plus the disease control cost. Production losses comprised of cattle deaths and reductions in beef, milk and draft power.

Therefore, further Study will need to consider other control strategies such as stamping out, movement control, surveillance and quarantine and will need to undertake sensitivity analysis of the different parametersimplementing based on technical and financial feasibility system in areas where CBPP is endemic.

REFERENCES

1. Masiga, W.N., J. Domenech and R.S. Windsor, 1996. Manifestation and epidemiology of contagious bovine pleuropneumonia in Africa. *In* Animal mycoplasmoses and control. Rev. sci. tech. Off. int. Epiz., 15(4): 1283-1308.
2. Kairu-Wanyoike, S.W., S. Kaitibie, N.M. Taylor, G.K. Gitau, C. Heffernan, C. Schnierd, H. Kiara, E. Taracha and D. McKeever, 2013. Exploring farmer preferences for contagious. bovinepleuropneumonia vaccination: a case study of Narok district of Kenya. PREVET, http://dx.doi.org/10.1016 /*j.prevetmed*. 2013.02.013.
3. Amanfu, W., 2009. Contagious bovine pleuropneumonia (lungsickness) in Africa. Onderstepoort, J. Vet. Res., 76: 13-17.
4. Tambi, N.E., W.O. Maina and C. Ndii, 2006. An estimation of the economic impact of contagious bovine pleuropneumonia in Africa. Rev. Sci. Tech., 25: 999-1012.
5. Rushton, J., P.K. Thornton and M.J. Otte, 1999. Methods of economic impact assessment. Rev. Sci. Tech., 18: 315-342.
6. Kairu-Wanyoike, S.W., 2009. Epidemiology and socio-economics of CBPP and its control by vaccination in Narok district of Kenya. University of Reading, UK.
7. Food and Agriculture Organization of the United Nations (FAO), 2007. CBPP control: antibiotics, to the rescue. Report of FAO-OIE-AU/IBAR-IAEA Consultative Group Meeting On CBPP in, Africa. Rome, Italy, Rome: FAO, 6-8 November 2006.
8. Newton, L.G. and R. Norris, 2000. The Eradication of Contagious Bovine Pleuropneumoniafrom Australia.Clearing a Continent.CSIRO publishing, Australia, pp: 15-20.
9. Boonstra, E., M. Lindbaek, B. Fidzani and D. Bruusgard, 2001. Cattle eradication and malnutrition in under fives: a natural experiment in Botswana. Public Health Nutr., 4: 877-882.
10. OIE, 2011. Terrestrial Animal Health Code: Article 1.6.6 - Questionnaireson contagious bovine pleuropneumonia. World Organisation for Ani-mal Health, pp: 54-61.
11. FAO, 2002. Recognizing Contagious Bovine Pleuropneumonia Ani. Heal Manual No. 13 (Rev. 1).
12. FAO, 2001. Manual on meat inspection for developing countries.
13. Elshafey, D., 2012. CBPP presentation. Mycoplasma Department Animal Health Research Institute (AHRI).
14. Onono, J.O., B. Wieland and J. Rushton, 2014. Estimation of impact of contagious bovine pleuropneumonia on pastoralists in Kenya. Prev. Vet. Med. http://dx.doi.org/10.1016/j.prevetmed.2014.03.022.
15. McDermott, J.J., K.A. Deng, T.N. Jayatileka and M.A. El-Jack, 1987.A cross-sectional cattle disease study in Kongor Rural Council, southern Sudan. I. Prevalence estimates and age,sex and breed associations for brucellosis and contagious bovine pleuropneumonia. Prev.vet. Med., 5: 111-123.
16. Zessin, K.H. and M. Baumann, 1985. Analysis of baseline surveillance data on CBPP in the Southern Sudan. Prev. vet. Med., 3: 371-381.
17. Kane, M., 2002. Etude historiquesur la péripneumoniecontagieuse bovine au Burkina Faso, Côte d'Ivoire, Guinee, Mali, Mauritanie, Niger et Sénégal. Consultancy report produced for the African Union Interafrican Bureau for Animal Resources-Pan African Programmefor the Control of Epizootics. AU/IBAR-PACE, Nairobi.
18. Laval, G., 2001. Experiences from CBPP follow-up in Western Wellega, Ethiopia. CBPPdynamics modelling project in Ethiopia. CIRAD/ILRI/MOA/EARO.CBPP regional workshop for Eastern African Countries, 19-21 November, Addis Ababa.
19. Maho, A., 2001. Etude historiquesur la péripneumoniecontagieuse bovine au Tchad. Consultancy report produced for the African Union Interafrican Bureau for Animal Resources-Pan African Programme for the Control of Epizootics. AU/IBAR-PACE, Nairobi.
20. Msami, H.M., 2001. Background information on contagious bovine pleuropneumonia(CBPP) in Tanzania. Consultancy report produced for the African Union InterafricanBureau for Animal Resources-Pan African Programme for the Control of Epizootics. AU/IBAR-PACE, Nairobi.

21. Byekwaso, F. and R. Nyamutale, 2001. Background study on contagious bovine pleuropneumonia (CBPP) in Uganda. Consultancy report produced for the African UnionInterafrican Bureau for Animal Resources-Pan African programme for the Control of Epizootics. AU/IBAR-PACE, Nairobi.
22. Turkson, P.K., 2001. Background information on contagious bovine pleuropneumonia(CBPP) in Ghana. Consultancy report produced for the African Union InterafricanBureau for Animal Resources-Pan African Programme for the Control of Epizootics. AU/IBAR-PACE, Nairobi.
23. Wanyoike, S.W., 1999. Assessment and Mapping of Contagious Bovine Pleuropneumoniain Kenya: Past and Present (MSc dissertation). FreieUniversität Berlin, Berlin.
24. Holleman, C.F., 2002. The socio-economic implications of the livestock ban in Somalia. Famine Early Warning Area Network: Nairobi, Kenya.
25. Bennet, R., 2003. The ‘direct costs’ of livestock disease: the development of a system of models, for the analysis of 30 endemic livestock diseases in Great Britain. J. Agric. Econ., 54: 55-71.
26. Mclnerney, J.P., K.S. Howe and J.A. Schepers, 1992. A framework for the economic analysis of disease in farm livestock. Prev. Vet. Med. 13: 137-154.