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Estimation of economic losses due to haemorrhagic septicaemia in livestock of southern part of India

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Abstract
This paper attempts to estimate the economic losses due to Haemorrhagic septicaemia (HS) in Southern region of India. The study was carried out in Belagavi and Tumakuru Districts of Karnataka covering 4 blocks and 12 villages totally in those districts. Purposive sampling was used for the selection of blocks, villages and livestock farmers. A total of 600 livestock farmers were covered in the 2 districts. The total economic loss was computed with sum of mortality loss, direct milk loss, milk loss due to increased abortion, value of calves lost due to increased abortion, loss in animal draught power, treatment cost and extra labour cost. The results stated that the total annual economic loss because of HS in Karnataka was ₹462.5 crores. Among that mortality loss accounts for 63.9 per cent and treatment cost accounts for 20.7 per cent. This study is coinciding with literature as mortality loss is contributing maximum for economic loss followed by treatment cost. Direct losses contribute maximum of 76.9 per cent and indirect losses contribute 23.1 per cent of economic loss. The study that revealed significant losses due to HS in large ruminants in the Karnataka state.

Keywords: Buffalo, cattle, haemorrhagic septicaemia, economic losses

Introduction
Livestock plays an important role in Indian economy. About 20.5 million people depend upon livestock for their livelihood. Livestock contributed 16% to the income of small farm households as against an average of 14% for all rural households. Livestock provides livelihood to two-third of rural community. It also provides employment to about 8.8 % of the population in India. India has vast livestock resources. Livestock sector contributes 4.11% GDP and 25.6% of total Agriculture GDP [1]. The contribution of agriculture to total national GDP was in a declining phase, whereas the contribution of Livestock sector to the total national GDP was increasing. In spite of the potential offered by livestock, and dairying in particular, the sector is characterized by poor productivity. One reason for poor productivity of livestock is the diseases that afflict the livestock population. Poor livestock health, as a technological constraint, remains one of the principal factors limiting livestock development. In view of limited resources and funds, it is imperative that the scarce resources are used optimally. In this regard, quantifying the financial loss from priority diseases can provide some valuable indication towards the importance of the disease to regional economy and also a measure of benefits to be gained from eliminating the disease.
Haemorrhagic septicaemia is an acute, highly fatal, septicaemic disease of cattle and buffalo caused by *Pasteurella multocida*, and is one of the most important bacterial diseases responsible for approximately 60 per cent of bovine mortality in India and prevalent throughout the country. Around 97 per cent of the HS outbreak reports are in large ruminants (Cattle and buffaloes). In India, in most HS endemic districts, outbreaks do occur throughout the year but epidemics occur during wet seasons. HS has emerged as a disease of great economic importance in India and it features as the second most reported disease in India during the last two decades. In spite of the economic significance of the disease, scant literature is available in Indian context documenting the economic losses caused due to Haemorrhagic septicaemia. The present study aims to address this research gap by estimating the annual economic loss due to HS in Karnataka. It is expected that the findings of the study will aid in optimization of resource allocation decisions for animal disease control in Karnataka.

In estimation of economic losses due to Haemorrhagic septicaemia, values of different parameters associated with disease and its effect on production and reproduction traits could be obtained from sample surveys.

Data and methodology

The study was carried out in the state of Karnataka which is having livestock population of 27,701,896. A combination of purposive and multistage random sampling technique was adopted for the selection of blocks, villages and households. The state has 30 Districts. Two districts, *viz*. Belagavi and Tumakuru, were selected from Karnataka state on the basis of highest livestock population as per the 19th Livestock Census[1/]. In the next stage, 2 blocks were selected from each district, randomly. Three villages were selected from each block and from each village 50 farmers were selected, randomly. Thus, a total of 600 livestock rearing households were covered in the survey from a total of 12 villages in 4 administrative blocks from 2 districts of the state. Primary data were collected through a household survey by personally interviewing the head of selected households with the help of pre-tested questionnaire specifically designed for this study. Data pertaining to the incidence of disease and the economic loss incurred due to the disease were collected from the farmers for period of 1st January 2014 to 31st December 2014.

Analytical framework

The total economic loss due to HS in bovines was worked out as sum of mortality loss (A), direct loss in milk yield (B), losses due to reproductive failure (C), loss in animal draught power (D), cost of treatment of affected animals (E) and labour costs (F). The models used to estimate the different components of economic losses for cattle and buffalo are given as under:

Mortality Loss (A)

This was worked out as the product of number of died animals (separately for calves, young and adult animals) due to HS and their respective market values. Mortality losses were divided as per losses in males (AM) and females (AF). For both males and females, the mortality losses were obtained across different age groups (young and adult animals for males and calves, young and adult breedable animals for females).

A = AF (Mortality loss in females) + AM (Mortality loss in males)

$AF = PF_1 \times D_1 \times V_1 + PF_2 \times D_2 \times V_2 + PF_3 \times D_3 \times V_3$

PF_1 = Female Calves Population

PF_2 = Young Female Population

PF_3 = Breedable Adult Female Population

D_1= Proportion of female calves died.

D_2 = Proportion of young females died.

D_3= Proportion of adult breedable females died

V_1 = Average market value of a female calf

V_2 = Average market value of a young female animal

V_3 = Average market value of an adult breedable female animal.

$AM = PM_1 \times D_4 \times V_4 + PM_2 \times D_5 \times V_5$

PM_1 = Young Male Population

PM_2 = Adult Male Population

D_4 = Proportion of young males died.

D_5 = Proportion of adult males died.

V_4 = Average market value of a young male

V_5 = Average market value of an adult male

Direct Milk Loss (B)

For the proportion of animals in milk in a year, the losses were expressed in terms of reduction in milk yield, which through the price of milk could be directly converted into monetary terms. The loss due to direct decline in milk production was calculated using the formula:

$B = PF_3 \times PL \times C_1 \times D \times ML \times P$

PL = Proportion of adult breedable female animals in-lactation (%)

C_1 = Proportion of in-milk animals infected (%)

D = Average duration of the disease (days)

ML = Milk loss per day per animal (Litre)

P = Price of milk (₹)

Losses due increased abortions (C)

$C = C_1 + C_2$

C_1: Milk Loss due to increased abortion

The disease can cause abortions, particularly in the late pregnancies and leads to increased inter calving period, besides loss of calves. Given the time of abortion (LS months) from conception, and a delay in next oestrus (DE months), the inter calving period gets increased by (LS + DE months) in aborting cases, and the milk loss due to increased abortions was estimated from following equation:

$$C_1 = \left[\frac{12}{ICP} - \frac{12}{ICP + LS + DE}\right] \times PF_3 \times PL \times C_1 \times A \times L \times MY \times P$$

A = Increased abortion rate (%)

L = Average Lactation length (days)

MY = Average per day milk yield (litre)

ICP = Inter-calving period (months)

LS = Stage at which abortion occurred (months)

DE = Delay in next oestrus (months)

C_2: Value of calves lost due to increased abortion

Reduction in the number of calves due to more abortions in animals after infection with a disease caused loss, which was estimated by the formulae.

$$C_2 = \left[\frac{12}{ICP} - \frac{12}{ICP + LS + DE}\right] \times PF_3 \times PL \times C_1 \times A \times VC$$

VC= Average value of new born calves (₹)

Loss in animal draught power (D)

In work animals, HS causes significant loss to the farmers by making them unavailable for ploughing, traction and other draught animal led crop farm works. This loss is worked out using the formulae:

$D = PM_2 \times C_2 \times DW \times HW$

C_2 = Proportion of adult males (> 1.5 ₹) affected (%)

DW = Average duration of disease in adult males (days)

HW = Average hiring charges per day (₹)

Treatment Cost (E)

$E = PA \times PT \times TC$

PT = Total Population

PA = Proportion of animals infected (%)

TC = Average Treatment cost of an infected animal

Extra Labour Cost (F)

This was computed by multiplying the number of diseased animals with the product of duration of disease, per day per animal extra labour hours given in taking care of the animals and the wage rate prevailing in the region.

F = PA x PT x LH x WR x DA
LH = Total no. of labour hours devoted by family members per day per animal
WR = Wage rate prevailing in the region (₹) / 8
DA = Duration of the disease in affected animal (days)

Results and Discussion

The total annual economic loss due to HS in bovines in Karnataka was estimated at ₹ 462.5 crores, which is higher than the previous finding of economic loss due to HS by Singh *et al*. (2014) [3-4] who have reported a total loss of ₹ 3.7 lakhs in central India and also relevant to the earlier finding of Singh *et al* (2014) [3-4] who have reported economic loss of ₹ 5255 crores for whole India. This study of economic loss was differing from the finding of Farooq *et al*. (2007) [2] of 2.17 billion Pakistani rupees [2]. Mortality loss contributed ₹295.8 crores; which is higher than earlier finding of Singh *et al*. (2014) [3-4] who reported mortality loss of ₹351150 in central India[3]. These results are relevant to earlier finding of Singh *et al.* (2014) [3-4] who reported mortality loss was ₹ 4039 crores for whole India. Direct milk loss contributed ₹ 32.5 crores; Milk loss due to increased abortion contributed ₹ 0.034 Crore; Value of calves lost due to increased abortion contributed ₹ 0.25 crore; Animal draught power loss contributed ₹ 27.08 crores; Treatment cost contributed 95.78 crores; and Extra labour cost contributed ₹ 11.05 crores. Thus, the maximum loss of about 64 percent was due to mortality and 36 per cent due to morbidity in bovines which is similar to the earlier findings of Singh *et al*. (2014) [3-4] and Singh *et al.* (2014) [3-4] who reported that mortality and morbidity loss contributed maximum of 92.2 per cent, 76.6 per cent and 7.76 per cent, 23.11 per cent in central India and for the whole of India respectively. Among different components of morbidity losses, the highest loss was due to treatment cost (21%), followed by direct milk loss (7%), drop in work power (6%) extra labour charges (2%). Loss due to abortion was insignificant (0.06%).

Disaggregated analysis across different breeds/species revealed that the total economic losses due to HS in case of crossbred cattle and buffaloes were almost similar (₹ 201 crores and ₹ 203 crores, respectively). Annual economic losses in case of indigenous cattle was relatively lesser at ₹58 crores. Thus, crossbred cattle and buffaloes accounted for the maximum share of total economic losses caused by HS (43.45% and 43.89%, respectively). Indigenous cattle accounted for 12.54 per cent of the total economic loss due to HS. The above finding is differing from the earlier finding of Singh *et al.* (2014) [3-4] who reported buffaloes (₹ 272805) were contributing maximum for economic loss of HS among bovines than crossbred (₹ 61342) and indigenous animals (₹ 37692.5). The finding of Singh *et al*. (2014) [3-4] also states that buffaloes (₹3506 crores) contributed maximum in economic loss than cattle (₹1748 crores) [3].

Among Indigenous animals, maximum contribution of economic loss was by loss in draught power of the animals ₹27.08 crores (46.4%), which was followed by mortality loss ₹16.9 crores (28.9%) and then by Treatment cost ₹ 9.5 crores (16.3%), which is differing from earlier finding of Singh *et al.* (2014) who reported that mortality loss (88.47%) was giving maximum contributing for economic loss [3].

Table 1: Total annual economic loss due to HS (in crores)

Models	Particulars	Indigenous cattle	Crossbred cattle	Buffalo	Total	Percentage (%)
A	Mortality loss	16.9 (28.99%)	151.4 (75.16%)	127.4 (62.9%)	295.8 (63.95%)	63.95
B	Direct Milk loss	3.1 (5.4%)	9.2 (4.57%)	20.1 (9.9%)	32.5 (7.03%)	7.03
C1	Milk loss due to increased abortion	0.00 (0%)	0.0034 (0.02%)	0.00 (0%)	0.0034 (0.007%)	0.007
C2	Value of calves lost due to increased abortion	0.00 (0%)	0.25 (0.13%)	0.00 (0%)	0.25 (0.055%)	0.055
D	Loss in Draught power	27.08 (46.38%)	0.00 (0%)	0.00 (0%)	27.08 (5.85%)	5.855
E	Treatment cost	9.5 (16.3%)	35.4 (17.60%)	50.8 (25.1%)	95.78 (20.71%)	20.70
F	Extra labour cost	1.7 (2.9%)	5.07 (2.52%)	4.2 (2.1%)	11.05 (2.4%)	2.38
	Total	58.39 (12.63%)	201.48 (43.56%)	202.6 (43.8%)	462.5	100

In case of Crossbred animals, maximum contribution of loss was by mortality ₹151.4 crores (75.2%) followed by treatment cost ₹35.4 crores (16.28%). Distribution of economic loss among Buffaloes was maximum for mortality ₹127.4 crores(62.9%) which was followed by treatment cost ₹ 50.8 crores(25.07%) which is similar to earlier finding of Singh *et al*. (2014) [3-4] who reported that mortality loss for crossbred animals (92.51%) and buffaloes (95.69%) contributed maximum for the total economic loss which was followed by Treatment cost. The economic loss per survived animal was ₹41866.17, ₹ 18477.03 and ₹ 30095.98 for Indigenous, Crossbred animals and Buffaloes respectively. The overall economic loss per survived animal was ₹21396 which is similar to the earlier finding of Singh *et al*. (2014) [3-4] who reported that economic loss per survived animal was higher for buffaloes (₹10901) than cattle (₹6816) but the economic loss per survived animal was higher than earlier finding [4].

Conclusion

The present study was carried out to estimate the economic losses due to Haemorrhagic septicaemia in Karnataka. The total annual economic loss because of HS in Karnataka was ₹462.5 crores. Among that mortality loss accounts for 63.9 per cent and treatment cost accounts for 20.7 per cent. Breed wise share of economic loss accounts ₹58.39 crores, ₹201.48 crores and ₹202.6 crores for indigenous (12.63%), crossbred animals (43.6%) and buffaloes (43.8%) respectively. This study is coinciding with literature as mortality loss is contributing maximum for economic loss followed by treatment cost. Direct losses contribute maximum of 76.9 per cent and indirect losses contribute 23.1 per cent of economic loss.

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