



## Bovine Ephemeral Fever in Turkey and Its Economic Effect

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### ABSTRACT

Bovine Ephemeral Fever (BEF) is a viral infection that causes a significant decrease in milk and meat production, infertility in cows and bulls, abortion and a significant economic loss due to its rapid spread in the herd. Partial budgeting method was used in the study to measure the economic impact of vaccine use and non-vaccination use. In line with preventive medicine, it has been determined that if animals are vaccinated regularly, there is an average of \$8.10 vaccination cost per animal, but the average treatment cost of an animal that has not been vaccinated during the epidemic is \$20.2. It was determined in the economic analysis that in addition to the treatment costs, the loss of milk for a dairy cow increased to approximately \$85, for a livestock to \$148 with the loss of condition, but the economic loss increased due to high morbidity. In this context, early diagnosis, detection and monitoring of spreading conditions are as extremely important as vaccination in the fight against BEF infection. It can be said that the economic loss will be minimized with the vaccination and preventive medicine practices to be made by rapid intervention to the disease with the early warning system created by the Ministry of Agriculture and Forestry for this purpose in Turkey.

**Keywords:** Bovine ephemeral fever, Cattle, Turkey.

### ÖZ

### Türkiye’de Üç Gün Hastalığı ve Ekonomik Boyutu

Bovine Ephemeral Fever (BEF), süt ve et üretiminde önemli bir düşüşe, inek ve boğalarda kısırılığa, düşüklere ve sürüde hızla yayılması nedeniyle önemli ekonomik kayıplara neden olan viral bir enfeksiyondür. Çalışmada aşı kullanımının ve aşı kullanmamanın ekonomik etkisini ölçmek için kısmi bütçeleme yöntemi kullanılmıştır. Koruyucu hekimlik doğrultusunda, hayvanlar düzenli aşılanırsa hayvan başına ortalama 8,10 \$ aşı maliyeti olduğu, salgın sırasında aşılanmayan bir hayvanın ortalama tedavi maliyetinin ise 20,2 \$ olduğu belirlendi. Yapılan ekonomik analizde tedavi maliyetlerine ek olarak kondisyon kaybı ile birlikte süt ineği için süt kaybının yaklaşık 85\$, besi hayvanı için 148\$ olduğu, ancak yüksek morbidite nedeniyle ekonomik kaybın arttığı belirlendi. Bu bağlamda BEF enfeksiyonu ile mücadelede aşılama kadar erken teşhis, yayılma koşullarının tespiti ve takibi de son derece önemlidir. Türkiye’de Tarım ve Orman Bakanlığı tarafından bu amaçla oluşturulan erken uyarı sistemi ile hastalığa hızlı müdahale edilerek yapılacak aşılama ve koruyucu hekimlik uygulamaları ile ekonomik kaybın en aza indirileceği söylenebilir.

**Anahtar Kelimeler:** Sığır, Sığır üç gün hastalığı, Türkiye.

### INTRODUCTION

Bovine Ephemeral Fever (BEF), which is an economically important viral disease, was first described in 1906 in South Africa (Öztürk 2012; Pyasi et al. 2021). This is locally referred to as three-day disease since infected animals usually recover after three days (Kirkland 2002; Walker 2009). The causative agent of the disease is Bovine Fever Ephemerosvirus (BEFV), which is in the Ephemerosvirus genus in the Rhabdoviridae family (Nandi and Negi 1999). BEFV was isolated from bovine blood in the 1960s and from mosquitoes in the 1970s (Walker and Klement 2015). BEF, apart from the Culicine and Anopheline mosquitoes, especially the stinging flies of the

genus *Anopheles bancroftii* and *Culicoides* are considered as potential biological vectors of the disease, and the disease can also occur with the bites of these flies or the injection of the virus (Alkan et al. 2017). Although the disease first appears sporadically, the morbidity rate reaches 100% at the end of the incubation period (Tonbak et al. 2013a; Abdullah et al. 2020; Pyasi et al. 2021). Animals that survive a BEF outbreak become immune for life and are very rarely reinfected (Tonbak et al. 2013b). It is also reported that the morbidity of the disease is higher in female and premature cattle (Liu et al. 2017).

The clinical symptoms of the disease last 1-3 days and usually heal spontaneously at the end of the 3rd day



(Kirkland 2002; Nandi and Negi 1999). Sudden onset of high fever (the disease rises up to 41-42°C in 12-18 hours), nasal discharge, eye discharge, swelling of the eyelids and general disorders are noted in cattle with BEF (Yeruham et al. 2002). Symptoms are more severe on the 2nd and 3rd days of the illness. Myalgia in the muscles, painful swelling in the joints, tremor, coordination disorder, lameness, lying in the lateral position in some animals, loss of swallowing reflex, apathy towards the environment, emphysema and paralysis occur in advanced stages (Abdullah et al. 2020).

Bovine Ephemeral Fever infections cause a significant decrease in milk production in particular, and complications such as mastitis may occur in some animals, milk yield is not restored in cows that survived the disease, and meat production is decreased in livestock animals. The disease also causes infertility in female cattle and bulls, abortion in pregnant cattle, and a significant economic loss due to its rapid spread in the herd (Nandi and Negi 1999; Yeruham et al. 2002)

Bovine Ephemeral Fever has been reported in more than 40 countries, primarily in Africa, Asia, and countries in the Arabian Peninsula (Em et al. 1997). The first findings regarding the presence of BEF infection in Turkey were reported by Girgin et al. (1986), and it occurs at regular intervals (1999, 2003, 2008, 2012, 2020) especially in the South-East regions of Turkey close to the Syria, Iraq and Iran border (Oğuzoğlu et al. 2013; Tonbak et al. 2013a). Tonbak et al. (2013b) reported in their study that cattle in the eastern, southern, western, Black Sea and Marmara region provinces of Turkey were also affected.

The impact of BEF has been more severe in Turkey due to the increase in the number of animals imported from abroad, the increase in the number of productive breeds produced and global climate changes, and has caused significant economic losses in the livestock sector. Although BEF responds to anti-inflammatory and calcium treatment, these drugs can only reduce the symptoms of lameness and stiffness to a certain extent (Öztürk 2012). The only way to protect against this infection is vaccination.

In this study, it was aimed to determine the economic losses by examining the reflection of vaccinated and unvaccinated cattle with BEF on dairy and fattening enterprises.

## MATERIAL AND METHODS

Ethical approve for this study was conducted the permission of Ardahan Provincial Directorate of Agriculture and Forestry dated 18.08.2021 and numbered E-29486769-325.99-2374077.

Ten veterinarians who practiced clinics in Cukurova Region in June 2020 when the disease emerged and agreed to participate in the survey were interviewed in order to determine the economic loss caused by Bovine Ephemeral Fever, and the data obtained as a result of the interview were calculated and presented in tables.

The cost of the disease was calculated in the study according to two different scenarios.

**Scenario 1.** Estimated cost due to regular vaccination of the enterprise every year was calculated.

**Scenario 2.** The estimated economic loss that may occur as a result of not vaccinating the livestock enterprise was calculated.

Partial budgeting method was used in the study to measure the economic impact of vaccine use and non-vaccination use. Only the expenses required by the partial change were taken into account in the partial budgeting method, and since the other expense items do not change, they were not taken into account in the total cost calculation. The technical and economic parameters and their values are given in Table 1.

**Table 1.** Technical and economic parameters.

Technical Parameters	Mean	Min	Max	Reference
Morbidity (%)	80.0	60.0	90.0	Study finding
Mortality (%)	5.0	0.0	10.0	Study finding
Abort rate (%)	3.0	1.0	6.0	Study finding
Rate of reformed (%)	15.0	10.0	20.0	Study finding
Loss of condition (%)	13.0	10.0	15.0	Study finding
Protection rate of vaccinations (%)	96.5	90	100.0	Study finding
Economic Parameters		Value		
Loss of milk per cow	175.9 kg			Aziz-Boaran et al. (2014)
1-liter raw milk price	0.37 \$			USK (2021)
Price of 1 kg body weight for reformed animal	1.97 \$			ESK (2021)

## RESULTS

Two doses of vaccine are administered to cattle, calves and calves of all ages, 21 days apart, at least one month before the disease season in order to prevent BEF, which is an economically important viral disease. Vaccination's protection rate of 96,5% determined interviews with the veterinarians (Table 1). It is sold in the market as 2 bottles in 5-dose bottles with a dilution bottle and lyophilized. The market value of the vaccine is \$20.23, and the cost of vaccination against infection (scenario 1) is given per animal and per herd of 50 heads in Table 2.

It is seen when Table 2 is examined that if animals are vaccinated regularly in line with preventive medicine, there is an average of \$8.10 per animal, and an approximate cost of \$430 for a livestock farm with 50 heads.

According to the data obtained as a result of the interviews with the veterinarians, the estimated economic loss per animal and a livestock enterprise with 50 heads in the absence of vaccination is given in Table 3.

It is seen when Table 3 is examined that while the treatment cost of an animal that was not vaccinated during the epidemic was \$20.2 on average, this value increased to \$85 with the loss of milk for a dairy cow, and \$148 for a livestock with loss of condition. It has been calculated in Table 3 that these losses increase with the increase in the number of animals and death rate, and the estimated loss in a 50 head dairy farm has increased to \$5.381 and to \$7.902 in a fattening farm.

It was also stated in the interviews with the veterinarian working in the field that the enterprises made an additional cost of approximately \$ 138.7 to combat insecticides when the disease broke out as an epidemic.

**Table 2.** Cost of vaccination (\$) (Scenario 1).

Expense items	Per Animal	50 titles in a pack
Vaccination cost (1st application)	4.05 \$	202.31 \$
Vaccination cost (2nd application)	4.05 \$	202.31 \$
Veterinarian vaccination fee	-----	23.12 \$
Total vaccination costs	8.10 \$	427.74 \$

**Table 3.** The cost of the disease (\$) if the vaccine is not administered (Scenario 2).

Cost items (\$)	per Animal	50 titles in a pack*
a. Treatment cost		
- Anti-inflammatory		
- Vitamin B Complex	20.20 \$	808.0 \$
- Vitamin C	(24.28)**	
- Antibiotic**		
b. Loss of milk	65.08 \$	2.603.2 \$
c. Body weight loss	128.05 \$	5.124.0 \$
d. Loss due to death***	985.00 \$	1.970.0 \$
Total loss		
For a dairy cow (a+b)/for a 50 head dairy business (a+b+d)	85.28 \$	5.381.2 \$
For one livestock (a+c)/for 50 heads (a+c+d)	148.25 \$	7.902.0 \$

\*: Calculated over the morbidity rate (80%),

\*\* : Where necessary (secondary infection),

\*\*\*: Calculated over the reformed animal value.

## DISCUSSION AND CONCLUSION

Bovine Ephemeral Fever (BEF) is a viral disease that can cause significant losses in high-yielding cattle and buffaloes and is characterized by the disappearance of clinical findings in a short period of 3-4 days (Nandi and Negi 1999). The disease manifests itself at certain intervals in many regions with tropical, subtropical and hot climates such as Asia, Africa, Australia and the Middle East (Nandi and Negi 1999; Walker and Klement 2015). BEF can be seen sporadically or in large endemic waves, but the onset and severity of outbreaks cannot be predicted (Sackett et al. 2006). However, it has been reported in studies that the disease is seen especially in extreme heat and after precipitation after drought (Walker 2009). As a matter of fact, it has been reported that the mean temperature of BEF infection has increased by 50% since the 2000s (He et al. 2016). In this context, the spread of BEF depends on the abundance and mobility of the susceptible cattle population and the formation of suitable conditions (suitable climate, air, humidity, temperature, etc.) for the vector to multiply (Sellers 1980).

The disease has been reported to occur at certain intervals (1999, 2003, 2008, 2012) in Turkey, especially in the South-East regions of the country close to the border with Syria, Iraq and Iran (Tonbak et al. 2013a). It was stated in interviews with veterinarians that BEF affected cattle in Şanlıurfa, Diyarbakır, Adıyaman and Adana provinces from mid-May to early October in the southern part of Turkey in 2020, after a long break. Although climatic conditions are among the primary reasons for the infection to be seen in border provinces of Turkey, it can be said that unregistered animal movements from the border are also effective.

Bovine Ephemeral Fever infection in cattle is expressed in a wide spectrum ranging from indistinct clinical findings to death (Abdullah et al. 2020; Öztürk 2012). BEF infection is an inflammation-based disease and is one of the rare viral diseases in which early treatment applications (nonsteroidal anti-inflammatory application) are beneficial (Abaylı 2018). It may show symptoms resembling milk fever (tachycardia, lying down, stiffness, muscle tremors, paralysis, torticollis, loss of swallowing reflex) during the febrile phase due to a temporary decrease in serum Ca amount (Uren et al. 1987). In this context, calcium preparation should be given. Anti-inflammatory agents as well as vitamin B and C preparations can be given to support the animal's immune system and increase its resistance. Isotonic fluids can be given if the patient has dehydration (Abaylı 2018). It was determined in the study that an average treatment cost of \$20.2 was made, depending on the severity of the disease. Antibacterial drugs are ineffective since the infection is of viral origin, however the cost of treatment per animal increases to \$24.3 if certain antibacterial preparations are used against secondary infections with the approval of the veterinarian. However, it should be noted here that the economic loss in the enterprise increases with the sudden and rapid emergence of clinical findings in animals in the enterprise in a short time due to the high morbidity of the disease. As a matter of fact, it was estimated in the study conducted that 40 animals became ill and a cost of 808\$ could occur to the enterprise when the disease was calculated over 80% morbidity in a 50-headed enterprise.

The economic effects of bovine ephemeral fever can be significant, the virus is more severe in cows with high milk yield, especially during the lactation period or in high-condition beef cattle (St George 1988). For this reason, it may lead to a decrease in milk production in dairy enterprises and loss of condition in fattening enterprises (Aziz-Boaron et al. 2017). The sales value of the livestock decreases depending on the body weight loss and clinical symptoms of the disease in the interviews with veterinarians. In this context, livestock sold at the value of reformed animals negatively affect the profitability of the enterprise. It was determined in this study that the loss in case of infection for a livestock increased to \$148.

The most important effect of the disease on dairy enterprises is the decrease in milk production. It has been reported in studies that milk production has decreased by 45-70%, and this rate could even reach 90%, but it has reached only 85% of its previous yields 2-3 weeks after infection (Davis et al. 1984; Nandi and Negi 1999, Newton and Wheatley 1970). It can be said that abortion cases are also effective in the decrease in milk production. As a matter of fact, the rate of abortion due to infection was found to be 3% (0-6%) in the interviews. Similar to the findings of this study, Uren et al. (1987) reported that infection causes abortion at a rate of 5.1% and it is seen especially in the eighth or ninth months of pregnancy. In

this case, it can be said that it will also cause calf loss in addition to one-year milk production in cows. It has been reported in a recent study that the virus causes an average of 175.9 kg of milk loss (Aziz-Boaron et al. 2017).

Weight loss due to BEF infection was reported as 20% in a study conducted in Australia (Sackett et al. 2006). The average body weight loss in cattle in the region was determined as 13% in interviews with veterinarians and it was calculated in the analysis that an average of \$128 body weight loss in beef cattle.

The average mortality rate in the region was 5%, and the rate of culling due to disease was 15% in interviews with veterinarians. Similar to this finding, it reported a mortality rate of 2.0% and 8.6% in 1990 and 1999, respectively (Yeruham et al. 2002). On the other hand, Tonbak et al. (2013b) and Walker and Klement (2015) reported unlike this finding that mortality rates by disease or culling were 10-20%. It has been reported in the studies conducted that deaths are due to complications such as pneumonia, coma-toxication, paralysis, loss of reflexes, and dehydration (Abaylı 2018). As a matter of the fact, it was reported in interviews with veterinarians that animals generally occur due to respiratory difficulties.

Although the death rate in BEF outbreaks has increased recently, the overall mortality rate is low. The death of valuable breeding animals, decrease in milk quality and yield, abortion, temporary infertility in bulls, loss of condition in beef cattle, treatment costs are the main economic losses caused by BEF (Uren 1987; Walker 2013). As a matter of fact, it was reported in a study conducted in Israel that there was an average loss of \$280 for a lactating cow, and the loss due to the BEF epidemic in the 1970s exceeded \$200 million (Walker 2009). It has been stated that the economic loss in Australia can reach 100-200 million dollars during severe BEF epidemics (Walker 2013).

Bovine Fever Ephemerovirus infection has been reported to result in persistent immunity (Mackerras et al. 1940; Nandi and Negi 1999; Walker and Klement 2015). That's why researchers made an effort to produce a vaccine. To date, 4 types of BEF vaccines have been developed (live-attenuated vaccines, inactivated vaccines, sub-unit G protein-based vaccines and recombinant vaccines), and live-attenuated, inactivated and subunit vaccines are used the most in the field (Walker and Klement 2015). In a 1985 study, it was reported that the protection rate of the vaccine was 99.99% when Quil A (a purified saponin derivative) was added to the attenuated BEF vaccine. A different study reported that an oil emulsion BEF vaccine developed and tested in Taiwan showed 100% protection (Hsieh et al. 2006). In our study, the protection rate of the vaccines used in parallel with the literature was determined as  $\geq 96\%$ .

In conclusion, early diagnosis, detection and monitoring of spreading conditions are extremely important in the fight against BEF infection, which causes significant economic losses in the dairy and livestock industry as it causes many yield losses and deaths. In this context, studies are carried out to predict the disease with fly traps set up in many regions of the country to combat vectorial diseases by the Ministry of Agriculture and Forestry. In this respect, it can be said that the economic loss will be minimized with the early warning system and the vaccination and preventive medicine practices to be made by rapid intervention to the disease in the coming years.

## CONFLICTS OF INTEREST

The authors report no conflicts of interest.

## ACKNOWLEDGMENTS

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## AUTHOR CONTRIBUTIONS

Idea / Concept: CA, PAD  
Supervision / Consultancy: CA, PAD  
Data Collection and / or Processing: CA, PAD  
Analysis and / or Interpretation: CA, PAD  
Writing the Article: CA, PAD  
Critical Review: CA, PAD

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