

PRODUCTION AND ECONOMIC LOSSES DUE TO SOME COMMON INFECTIOUS DISEASES OF BUFFALOES IN KASHMORE

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DOI: <https://doi.org/10.5281/zenodo.17212746>

Keywords

Infectious diseases, economic losses, prevalence, Kashmore, Buffalo, production performance

Article History

Received on 28 May 2025

Accepted on 30 July 2025

Published on 28 August 2025

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Abstract

Different infectious diseases in buffaloes, such as mastitis, foot and mouth disease (FMD), and hemorrhagic septicemia (HS), affect production and economic losses in dairy farms. A cross-sectional study was conducted to determine the production and economic losses due to infectious diseases of buffaloes in the district of Kashmore. Three Talukas (Kashmore, Kandhkot and Tangwani) randomly selected 50 respondents from each taluka (n=150) farmers and got the information on questionnaires proforma. According to sociodemographic data showed that 61% of farmers knew most of the infectious diseases in the taluka Kashmore, mostly respondents (60%), were farmers. 48% of farmers have eight years above experience in livestock rearing, most of the farmers were male (86.66%) rearing the livestock. Data regarding the monthly income of the respondents 40% has above 40000 Rs. During the survey, the data revealed that 90% of buffaloes were infected with mastitis, 45% of animals were infected with FMD whereas 60% of animals were infected with HS. The highest prevalence percentage due to Mastitis (96%), FMD (85%) and HS (64%) in taluka Tangwani, mostly highest prevalence percentage of mastitis was recorded in all three taluka of district Kashmore, Highest prevalence were recorded in females (82.04%) of lactating buffaloes (65.68%) under the age of (>3 years), whereas in male (17.95%) highest prevalence were recorded in male calves (12.72%). The highest (49.54%) morbidity percentage was recorded for mastitis, followed by FMD (33.97%) and HS (16.47%), whereas the highest mortality (52.27%) percentage was recorded in HS disease, followed by FMD (9.09%). The total economic losses due to infectious diseases in buffaloes in three talukas during period of study were estimated to be Rs. 1389300/- due to mastitis, 2109700 due to FMD and 90513300 due to HS Among these, the highest losses were due to mortality of calves (75%), followed by milk losses (18.54%), Medicine cost charges (3.95%) and veterinarian services charges (2.04%). Thus, above mentions infectious diseases seem to be the major problems in buffaloes in the study area.

INTRODUCTION

The agriculture-based economy accounts for 60% GDP revenue of Pakistan and 55.5 of % GDP of the Livestock industry in the country. Total milk production is 66 percent (24.2 million tonnes) in the world, and 78.41% (30 million tonnes) of the total milk production and 32.7 million buffalo are reared

Shah Bandar (Sindh), there is a home tract for the Kundi breed of buffalo. The cost of producing milk is significantly higher in urban and peri-urban areas than it is in rural areas (Ashfaq et al., 2014).

Dairy farmers face several challenges due to animal diseases because they not only reduce production but also impact on their ability to make profits. Morbidity losses due to infectious disease may have a significant impact on dairy farmers' income. In animals, morbidity-related diseases are responsible for low and high production losses. Compared to mortality, these losses are more significant economically (Ashfaq et al., 2015). Mostly diseases prevalent due to management in developing countries due to a lack of hygienic controls, public health measures, and awareness programs for animal health (Farouk et al., 2017; Hassan et al., 2020).

Various infectious diseases, including foot and mouth disease (FMD), haemoglobinuria, bovine viral diarrhoea (BVD), hemorrhagic septicemia (HS), brucellosis, mastitis, bovine tuberculosis and black quarter, influence production and economic losses (Bilal et al., 2006). Likewise, parasites, i.e., ticks, lice, and flies, are reducing the yield of buffalo and cattle. Due to mismanagement and nutritional deficiency, every animal suffers from infectious disease and significantly reducing milk and meat production (Jakhani et al., 2019).

Mastitis causes significant financial losses because of mismanagement in dairy farms and decreases in milk production and potential health hazard to human health (Ashfaq et al., 2014). Short-term and long-term product losses are caused by morbidity brought on by diseases. In terms of economic importance, these losses exceed mortality (Dutta et al., 2011). Annual losses from mastitis are approximately \$ 184 per animal. It results in production losses such as milk that is dismissed, a decrease in milk yield, premature animal culling, and replacements. Clinical mastitis

for meat and milk purposes in Pakistan. Mostly buffalo are reared for the source of milk in urban and rural areas of Sindh province (Khan et al., 2021). The average household has 3-4 cattle or buffalo and 4-6 sheep or goats and gets 36-40% income from them. On the banks of the Indus River from Kashmore to

can result in a quarter-level milk loss of 10% or more due to the affected animal quarters; subclinical mastitis reduces milk output by about two-thirds. It was reported that 18.72% and 21.08% of clinical mastitis are present in farm animals. It also provides risk for infectious diseases like streptococcal sore throat, leptospirosis, tuberculosis, and brucellosis spread from animals to humans and resulting in economic losses.

Hemorrhagic septicemia is caused by *Pasteurella multocida*, and it is a highly contagious disease. The disease has a significant negative effect on livestock production in Asia, notably in Pakistan, where it results in significant financial losses. According to the report, Pakistan has a 49% frequency against H.S. (Farouk et al., 2017). The buffalo calves in Pakistan had a 100% and 31.48% morbidity and mortality rate, respectively (Khan et al., 2020). Singh et al. (2014) reported a loss of 287.81 lacs per year on average because of HS in cattle in India. The most prevalent serotypes of FMD in Pakistan are O (72%), Asia-I (26%) and A (4.68%), causing a loss of PKR. 8.00 billion/year to farmers (Hassan et al., 2019; Pinior et al., 2019).

The recommended livestock production procedures are crucial for lucrative animal production. Due to improper management, a lack of food, inadequate deworming and vaccination programs, insufficient breeding practices, a high incidence of diseases, high mortality rates, limited capital and financial resources, and a lack of treatment, all of which contribute to low profitability and a weak marketing infrastructure at the farm level. There is no published data; therefore, this study has been designed to record the epidemiological prevalence of various diseases and economic losses in the Kashmore district, Sindh, Pakistan.

MATERIALS AND METHODS

Active surveillance data was conducted for the prevalence and economic losses occurring due to different infectious diseases in buffalo in the district of Kashmore in the year 2022. District Kashmore is in

the upper region of the province of Sindh, Pakistan (Fig. 1). Kashmore district is subdivided into three talukas: viz, Kashmore, Kandhkot, Tangwani, and 41 union councils.

Figure 1: Map of the Sindh province showing the district of Kashmore, Pakistan



The epidemiological data were collected from 150 farmers, randomly selected from the three talukas, Kashmore, Kandhkot, and Tangwani district, Kashmore. The data was collected by visiting/farms and interviewing the key respondents of the study area. The participatory rural appraisal (PRA) approach was used by interviewing the key respondents. Farmers were asked questions in a face-to-face manner while visiting the survey area (Siyal et al., 2021). The mortality, and morbidity due to infectious diseases were calculated using following formula:

$$\begin{aligned} \text{Prevalence \%} &= \frac{\text{No of positive animals}}{\text{No of animals examined}} \times 100 \\ \text{Morbidity \%} &= \frac{\text{Total no of affected animals}}{\text{Total no of animals at farms}} \times 100 \end{aligned}$$

In addition, the economic losses occurring due to infectious diseases and the total losses were computed by adding medicine costs, service charges, mortality rate, and other management issues due to a severe drop in milk production, potential health risks for

questionnaire proforma consisted of two sections. The first section was related to demographic data, and the second was related to prevalence and economic losses due to infectious diseases. The prevalence of commonly occurring diseases in buffaloes of the district Kashmore, like mastitis, hemorrhagic septicemia, and foot and mouth disease. The data was subjected to statistical analysis and prevalence,

$$\begin{aligned} \text{Mortality \%} &= \frac{\text{Total no of died animals}}{\text{Total no of animals at farms}} \times 100 \end{aligned}$$

other animals and human beings, and increased cost of treatment and culling processes, are tremendous. The economic losses were calculated using the following formula, and the collected data were tabulated and analyzed by using SPSS software.

$$\text{Economical losses\%} = \frac{\text{Total economic losses due to particular diseases}}{\text{Total economic losses due to all disease}} \times 10$$

RESULTS

Demographic information about farmers

The information regarding sociodemographic data of the study population is very important to determine the relevance of the respondents in the present study, their approach, and practices in the related area. A total of 150 respondents were investigated in selected areas of the Kashmore district, were present in Table 1, where 61% of farmers have knowledge about most of the infectious diseases in the Taluka Kashmore, 28% of farmers in the Taluka Kandhkot and 10.66%

of farmers have knowledge about diseases belonging to the Tangwani taluka. Most of the respondents are farmers (60%), other occupations are landlords (14.66%) and 25 % were government servants in different departments. The table further described that 48% of farmers have eight years above experience in livestock rearing, 26.66% have five-to-eight-year experience and 25.33% have two to five years of experience. In addition to that, the table also showed that majority of the farmers were male (86.66%) and 13.33% were females rearing the livestock. Data regarding the monthly income of the respondents 40% has above 40000 Rs. 33.33% are below 20000, whereas 26.66% have 20000-40000.

Table 1: Sociodemographic characteristics information of livestock farmers (N=150) participants in their practices in the district of Kashmore

Variables	Category	Number	%
Taluka (Knowledge about diseases)	Kashmore	92	61.33%
	Kandhkot	42	28%
	Tangwani	16	10.66
Farmers occupations	Farmers	90	60%
	Landlord	22	14.66%
	Government Servant	38	25.33
Experience in livestock rearing (in years)	2-5 years	38	25.33
	5-8 years	40	26.66
	8 years above	72	48
Age of Farmers	25-35 years	30	20%
	36-46 years	110	73.33
	Above 46 years	10	6.66
Gender	Male	130	86.66
	Female	20	13.33
Monthly income (in rupees)	Below 20000	50	33.33
	20000-40000	40	26.66
	Above 40000	60	40

Overall prevalence percentage of infectious diseases in the district of Kashmore

Figure 1 shows the overall prevalence percentage of infectious diseases in the district of Kashmore. During the survey, the data revealed that 90% of buffaloes were infected with mastitis, 5% of animals were infected with foot and mouth Disease (FMD), whereas 60% of animals were infected with hemorrhagic septicemia (HS) in the district of Kashmore.

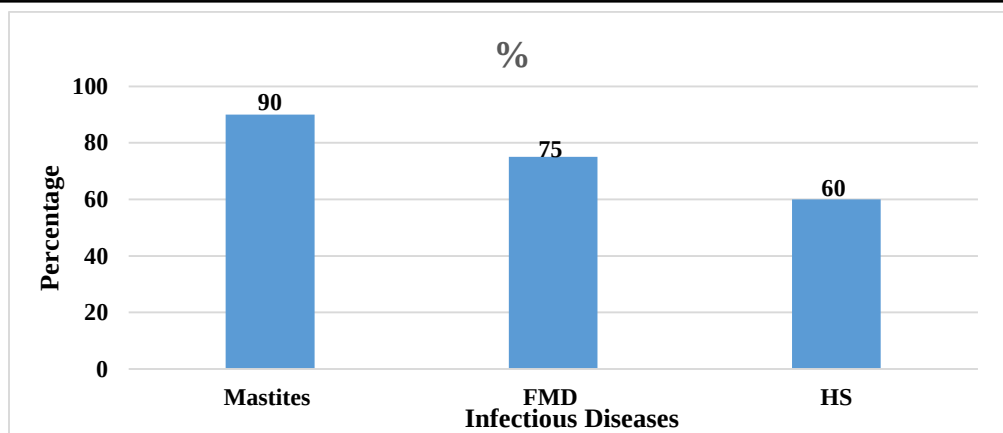


Figure 1. Overall prevalence percentage of infectious diseases in the district of Kashmir

Taluka-wise prevalence of infectious diseases in the district of Kashmir

Figure 2 shows the prevalence percentage of infectious diseases in three talukas of district Kashmir. It was recorded that highest prevalence percentage was recorded in mastitis (96%), FMD (85%) and HS (64%) in Taluka Tangwani, whereas 92%, 73% and

60% prevalence were recorded in mastitis, FMD and HS respectively in Taluka Kandhkot. The lowest prevalence percentage were recorded in Kashmir Taluka, 82% mastitis, 67% FMD and 56% HS were recorded.

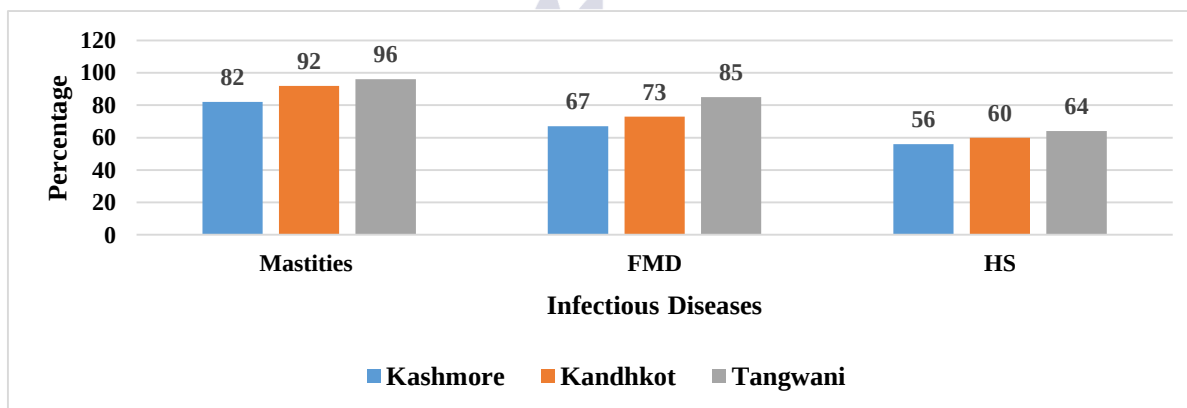


Figure 2: Taluka-wise prevalence of infectious diseases in the district of Kashmir

Gender and age-wise prevalence percentage of infectious diseases in buffaloes in the district of Kashmir

Table 2 indicates the gender and age-wise prevalence percentage of infectious diseases in buffalo in district

Kashmir. highest prevalence was recorded in females (82.04%) of lactating buffaloes (65.68%) under the age of (>3 years), whereas in males (17.95%) highest prevalence was recorded in male calves (12.72%).

Table 2: Gender and age-wise prevalence percentage of infectious diseases of buffalo in the district of Kashmir

Variables	Taluka	Taluka	Taluka	
Gender and age-wise	Kashmore	Kandhkot	Tangwani	Sum (%)
Male				158 (17.95%)
Male calves (<1 year)	42	32	38	112 (12.72%)
Bull (1-4 years)	22	10	14	46
Females				722 (82.04%)
Females calves (<1 year)	18	14	10	42
Heifers (1-3years)	36	38	28	102
Lactating buffaloes (>3 years)	180	146	252	578 (65.68%)
Total	298	240	342	880

Morbidity and mortality percentage of infectious diseases in the district of Kashmir

Figure 3 indicates the morbidity and mortality percentage of infectious diseases in buffalo district Kashmir, highest (49.54%) morbidity percentage was recorded for mastitis, followed by FMD (33.97%) and HS (16.47%), whereas the highest mortality (52.27%) was recorded in HS disease, followed by FMD (9.09%) in the study area.

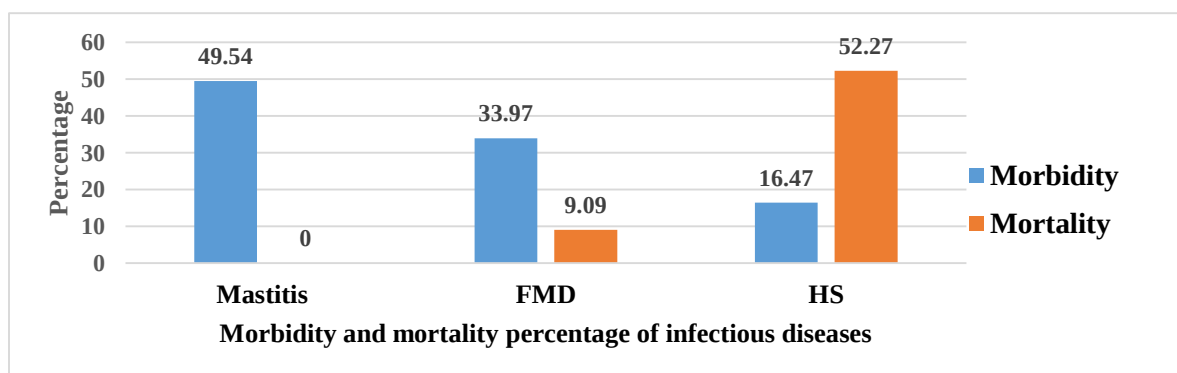


Figure 3: Morbidity and mortality percentage of infectious diseases in the district of Kashmir

Economic losses due to mastitis in the Talukas of district of Kashmir

Table 3 shows the economic losses due to mastitis in the district of Kashmir. A loss of PKR 1389300 was recorded due to mastitis in the study area. The data revealed that highest economic loss of PKR is 518100, followed by PKR. 485100 was recorded by Taluka Kashmir and Tangwani. While the lowest PKR is 435600 from Taluka Kandhkot.

Table 3: Economic losses due to mastitis in the Talukas of district, Kashmir

Names of Talukas	No. respondents response	Cost of veterinary services (PKR)	Cost of medicine (PKR)	Milk losses (PKR)	Total losses (PKR)
Kashmore	52	47100	94,200	376800	518100
Kandhkot	48	39600	79200	316800	435600
Tangwani	50	44100	88200	33600	485100
Total	150	126300	252600	1010400	1389300

*Average veterinarian service charges per animal during mastitis = Rs. 300/- **Average medicine costs per animal during mastitis =Rs. 600/-, *Average milk loss per buffalo (4 kg) during mastitis = Rs. 800/-

Economic losses due to HS in the Talukas of district Kashmir

Table 4 presents the total economic losses resulting from the HS disease in selected areas of Kashmir District during the study period. Total losses of PKR.

9051300 was recorded due to HS in the district of Kashmir. The data revealed that the highest economic loss was PKR. 7227000 was recorded in Taluka Kashmir, while the lowest PKR 462900 was recorded in Taluka Kandhkot

Table 4: Economic losses due to HS in the Talukas district of Kashmir

Names of Talukas	No. respondents response	Mortality losses (PKR)	Cost of veterinary services (PKR)	Cost of Medicine (PKR)	Milk losses (PKR)	Total losses (PKR)
Kashmore	52	7095000	12000	24000	96000	7227000
Kandhkot	48	255000	18900	37800	151200	462900
Tangwani	50	1170000	17400	34800	139200	1361400
Total	150	8520000	48300	96600	386400	9051300

Average veterinarian service charges per animal during mastitis = Rs. 300/- **Average medicine costs per animal during mastitis =Rs. 600/-, *Average milk loss per buffalo (4 kg) during mastitis = Rs. 800/-

Economic losses due to FMD in the Talukas of district Kashmir

Table 5 shows the total economic losses due to the FMD in selected areas of the district of Kashmir. Total estimated losses of Rs. 2109700 were recorded

in the district of Kashmir during the study period. The highest economic loss due to FMD (Rs. 951300) was recorded in Taluka Tangwani, while the lowest value (Rs. 515500) was recorded in Taluka Kashmir.

Table 5: Economic losses due to FMD in the Talukas of district Kashmir

Names of Talukas	No. respondents response	Mortality losses (PKR)	Cost of veterinary services (PKR)	Cost of Medicine (PKR)	Milk losses (PKR)	Total losses (PKR)
Kashmore	52	255000	2400	45300	191200	515500
Kandhkot	48	405000	20100	40200	177600	642900
Tangwani	50	540000	36300	75000	300000	951300
Total	150	1200000	58800	160500	660500	2109700

*Average veterinarian service charges per animal during mastitis = Rs. 300/- **Average medicine cost per animal during for mastitis =Rs. 600/-, *Average milk loss per buffalo (4 kg) during mastitis = Rs. 800/-

DISCUSSION

The sociodemographic information was collected to determine the relevance and representativeness of the respondents in the present study. The data revealed that 61% of farmers in Taluka Kashmir had knowledge about most infectious diseases, compared with 28% in Taluka Kandhkot and only 10.66% in Taluka Tangwani. Most respondents were farmers

(60%), followed by landlords (14.66%), while 25% were government servants in different departments. Regarding experience, 48% of farmers had more than eight years of livestock-rearing experience, 26.66% had five to eight years, and 25.33% had two to five years of experience. Most of the respondents were male (86.66%), while females accounted for 13.33%.

In terms of income, 40% of the respondents reported earnings above PKR 40,000 per month, 33.33% earned below PKR 20000, and 26.66% earned between PKR 20000 and 40000. These results agree with Haleem et al. (2018), who also reported poor awareness of livestock diseases among farmers in Khyber Pakhtunkhwa (KP). In their study, only 4.6% of farmers were aware of major infectious diseases, including mastitis, FMD, HS, and tuberculosis, reflecting low levels of education and poor disease management practices. This highlights the urgent need to strengthen farmer education strategies, particularly in rural areas, to improve livestock health management, cleanliness, sanitation, and parasite control.

Similar demographic trends were observed by Coetzee et al. (2010), who reported that most livestock farmers were male, middle-aged, and engaged in small-scale farming. Aulakh et al. (2011) also noted that most respondents had education only up to high school level (38.5%), with fewer reaching graduation (3.5%). These findings are consistent with Verma et al. (2016), who reported that most respondents were small or marginal farmers, while Heydari et al. (2015) found that education, herd size, and sources of information significantly influenced knowledge of livestock management practices.

The present study recorded an overall prevalence of infectious diseases in District Kashmir of 90% for mastitis, 45% for FMD, and 60% for HS. These findings are consistent with Bilal et al. (2004), who reported high mastitis prevalence in buffaloes in rural areas. Higher prevalence in rural areas may be attributed to larger herd sizes, poor management, and milking by hired laborers rather than owners, as observed by Srinivasa et al. (2013).

Gender- and age-wise prevalence showed that female buffaloes were more affected (82.04%) compared with males (17.95%). Lactating buffaloes older than three years had the highest prevalence (65.68%), while male calves accounted for 12.72%. These findings agree with Derara Derara et al. (2020), who also reported higher disease prevalence in females than males. Similar observations were made by Iqbal et al. (2011) in Punjab, Pakistan, and by Mohammed Hussen (2001) in Ethiopia, who attributed higher susceptibility in females to hormonal influences

(estrogen, prolactin, and progesterone), making them more vulnerable to infections (Hornok et al., 2010).

Regarding morbidity and mortality patterns, mastitis had the highest morbidity, followed by FMD and HS. In contrast, HS showed the highest mortality, followed by FMD. These findings are consistent with Kumar et al. (2011), who reported that infectious disease outbreaks in large ruminants in Asia often cause high mortality and morbidity. Ali et al. (2011) also reported morbidity and mortality rates of 95.25% and 21.19%, respectively, in HS outbreaks among cattle and buffaloes. The high mortality is likely due to the acute and peracute nature of HS, caused by *Pasteurella multocida*, which often leaves little time for treatment. Environmental factors, particularly hot and humid weather, also contribute to outbreaks of HS, FMD, and blackleg (Veen et al., 2015). Heat stress, scarcity of fodder, and poor management practices further increase the risk of disease spread.

The present study estimated the economic losses associated with major livestock diseases, including mastitis, hemorrhagic septicemia (HS), and foot and mouth disease (FMD), in District Kashmir. For mastitis, the total estimated loss was PKR 1,389,300 across the three talukas. Among them, Taluka Kashmir reported the highest losses (PKR 518,100), followed by Tangwani (PKR 485,100) and Kandhkot (PKR 435,600). These losses were mainly attributed to milk losses (PKR 1,010,400), which represented the major share, while veterinary services (PKR 126,300) and medicine costs (PKR 252,600) contributed comparatively less. These findings agree with earlier studies that highlighted milk production loss as the primary component of mastitis-related economic burden.

For HS, the overall economic loss was estimated at PKR 9,051,300. Taluka Kashmir contributed the highest share (PKR 7,227,000), followed by Tangwani (PKR 1,361,400), while Kandhkot incurred the lowest losses (PKR 462,900). Mortality accounted for most of the economic impact, whereas costs of veterinary services, medicines, and milk losses were comparatively minor. Similar observations were reported by Khan et al. (2020), who emphasized that HS outbreaks are primarily associated with high mortality, causing significant financial losses.

For FMD, the total losses recorded in the district were PKR 2,109,700. Among the talukas, Tangwani bore

the highest losses (PKR 951,300), followed by Kandhkot (PKR 642,900) and Kashmore (PKR 515,500). Milk losses (PKR 660,500) constituted the largest component, followed by medicine costs (PKR 160,500) and veterinary services (PKR 58,800). These results are consistent with previous reports that identified reduced milk yield as the major contributor to FMD-associated economic losses (Shrivastava et al., 2013).

Overall, the results confirm that mastitis and FMD are predominantly associated with morbidity-related losses (mainly reduced milk yield), while HS is primarily characterized by mortality-related losses. This aligns with earlier findings from Khan et al. (2017), who also reported that diseases like HS and black quarter cause heavy mortality losses, while mastitis and FMD mainly cause production losses.

Conclusions

It was concluded that most farmers knew about infectious diseases. The majority were landlords with more than eight years of livestock-rearing experience, mainly male farmers aged between 36 and 46 years, and many respondents earned above PKR 40,000 per month.

Among infectious diseases, mastitis showed the highest prevalence in the study area, with Tangwani Taluka recording the greatest burden. Female buffaloes were more affected compared to males, and animals above three years of age were the most susceptible.

Mastitis accounted for the highest morbidity, while haemorrhagic septicaemia (HS) was associated with the highest mortality in the study area. Economic losses were greatest due to mastitis, mainly from milk production losses, whereas HS resulted in the highest mortality-related losses across the three talukas of District Kashmore.

References

Ali, M. A., Ahmad, M., Muhammad, K., & Anjum, A. A. (2011). Prevalence of sub clinical mastitis in dairy buffaloes of Punjab, Pakistan. *Journal of Animal and Plant Sciences*, 21(3), 477-480.

- Ashfaq, M., Muhammad, G., Shamsheer-ul-Haq, A.R. (2014). Effects of livestock diseases on dairy production and in-comes in district Faisalabad, Punjab, Pakistan. *Pakistan Strategy Support Program-International Food Policy Research Institute Working Paper*, 23.
- Ashfaq, M., Razzaq, A., Muhammad, G. (2015). Economic analysis of dairy animal diseases in Punjab: a case study of Faisalabad district. *Journal of Animal and Plant Sciences*, 25.
- Aulakh, G.S., Rajbir, S., Yadav, J.S. (2011). A study on adoption of recommended feeding practices by the buffalo owners of Punjab. *Indian Journal of Animal Sciences*, 81: 631-633.
- Bilal, M.Q., Suleman, M., Raziq, A. (2006). Buffalo: black gold of Pakistan. *Livestock Research for Rural Development*, 18: 140-151.
- Coetzee, J. F., Nutsch, A. L., Barbur, L. A., & Bradburn, R. M. (2010). A survey of castration methods and associated livestock management practices performed by bovine veterinarians in the United States. *BMC Veterinary Research*, 6, 1-19.
- Derara, D., Gutata, J., Zerihun, B., Dawit, B., Kantiba W. & Kabeta, W. (2020). Prevalence and associated risk factors of lice in small ruminants in and around Ambo District, *Global Scientific Journal*, 8(7): 1295-1303.
- Dutta, J., Rathore, B.S., Mullick, S.G., Singh, R. Sharma, G.C. (2011) Epidemiological studies on occurrence of Hamemorrhagic Septicaemia in India. *Indian Veterinary Journal*, 67: 893-899.
- Farouk, U.M., Bale, J.O.O., Kwaga, J.K.P., Abdullahi, U.S., Ibrahim, S., Madobi, I.S. (2017). Preliminary study on brucellosis in cattle in Jigawa state Nigeria. In Proceedings of the 54th Annual Congress of the Nigerian Veterinary Medical Association, Printed by University Press Limited Zaria, Kaduna State, Nigeria, 66-71.

- Farouk, U.M., Bale, J.O.O., Kwaga, J.K.P., Abdullahi, U.S., Ibrahim, S., Madobi, I.S. (2017). Preliminary study on brucellosis in cattle in Jigawa state Nigeria. In Proceedings of the 54th Annual Congress of the Nigerian Veterinary Medical Association, Printed by University Press Limited Zaria, Kaduna State, Nigeria, 66-71.
- Haleem, S., Niaz, S., Qureshi, N. A., Ullah, R., Alsaied, M. S., Alqahtani, A. S., & Shahat, A. A. (2018). Incidence, risk factors, and epidemiology of cystic echinococcosis: a complex socioecological emerging infectious disease in Khyber Pakhtunkhwa, Province of Pakistan. *BioMed research international*, 2018.
- Hassan, N.M., Farag, T.K., Abu El Ezz, N.M., Abou-Zeina, H.A. (2019). Prevalence assessment of gastrointestinal parasitic infections among goats in Giza Governorate, Egypt. *Bulletin of the National Research Centre*, 43: 1-7.
- Heydari, M., Rahman, M., & Gupta, R. (2015). Kinetic study and thermal decomposition behavior of lignite coal. *International Journal of Chemical Engineering*, 2015.
- Hornok, S., Hofmann-Lehmann, R., de Mera, I.G., Repasi, A., Gonczi, E., Tanczos, B., Farkas, R., Lutz, H. & de la Fuente, J., (2010). Survey on blood-sucking lice (Phthiraptera: Anoplura) of ruminants and pigs with molecular detection of *Anaplasma* and *Rickettsia* spp. *Veterinary Parasitology*, 174 (34), 355-358.
- Iqbal, M., Ajmal, M., Choudhry, A.H. & Kazam, A.R. (2011). Studies on the ectoparasites infesting experimental livestock and poultry of West Pakistan Agricultural University, Lyallpur. Proc. 23rd Pak. Sci. Conf., J14.
- Jakhrani, S. A., Ujjan, J. A., Jakhrani, M. A., Dayo, F. Z., & Mazari, H. (2019). Investigation of different biochemical parameters in three economical important fish species captured from ponds of district Kashmore, Sindh, Pakistan. *International Network for Natural Sciences*, 14(4), 387-392.
- Khan, A., Saleemi, M. K., Khan, M. Z., Gul, S. T., Irfan, M., & Qamar, M. S. (2020). Hemorrhagic Septicemia in Buffalo (*Bubalus bubalis*) Calves Under Sub-Tropical Conditions in Pakistan. *Pakistan Journal of Zoology*, 43(2).
- Khan, M. U., Ahmad, M., Sultan, M., Sohoo, I., Ghimire, P. C., Zahid, A. & Yousaf, M. (2021). Biogas production potential from livestock manure in Pakistan. *Sustainability*, 13(12), 6751.
- Khan, U. D., Khan, A., Gul, S. T., Saleemi, M. K., & Du, X. X. (2020). Seroprevalence of brucellosis in cattle (*Bos taurus*) kept in peri urban areas of Pakistan. *Agrobiological Records*, 1, 6-10.
- Khan, Z. U., Khan, S., Ahmad, N., & Raziq, A. (2017). Investigation of mortality incidence and managerial practices in buffalo calves at commercial dairy farms in Peshawar City. *Journal of Agricultural and Biological Science*, 2(3), 16-22.
- Kumar, R., Singh, J. B., & Chaudhary, G. (2011). Pre-Acute Haemorrhagic Septicaemia in a Cow and its Clinico-Therapeutic Management. *Intas Polivet*, 12(1), 22-23.
- Mohammad Hussien, (2001). Study on skin diseases of small ruminant in central Ethiopia, DVM thesis, FVM, Addis Abeba University, Debre Zeit.
- Pinior, B., Garcia, S., Minviel, J.J., & Raboisson, D. (2019). Epidemiological factors and mitigation measures influencing production losses in cattle due to bovine viral diarrhoea virus infection: A meta-analysis. *Transboundary and Emerging Diseases*, 66: 2426-2439.
- Siyal, M., Leghari, R. A., Soomro, S. A., & Arain, M. B. (2021). Control strategies of mastitis/udder problems in the dairy farms of Hyderabad. *University of Sindh Journal of Animal Sciences (USJAS)*, 5(3).
- Shrivastava, M., Nanavati, S., Yadav, D. S., & Mishra, A. K. (2013). Studies on incidences and causes of buffalo calf mortality in Malwa region of Madhya Pradesh. *Int. J. Agric. Sci. Vet. Med*, 1(2), 69-72.

- Singh, B., Prasad, S., Verma, M.R., & Sinha, D.K. (2014). Estimation of economic losses due to haemorrhagic septicaemia in cattle and buffaloes in India. *Agricultural Economics Research Review*, 27: 271-279.
- Veen. V., Mohammed, A.K. (2015). Traditional Ruminant production in the Sub humid Zone of Nigeria 2005; 41:233-238.
- Verma, A.P., Ansari, M.A., Ranjan, R., Bhatt, A., Raghuvanshi, R., Patel, D. (2016). Farmers' Attitude towards E-Choupal: A Critical Investigation in Gonda District of Uttar Pradesh. *Int. J. Agri. Sci.*, 8(49): 2076-2078.

