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The Economic Impact of Protozoan Infections on Livestock Productivity

Dr. Angeline Felicia Bora C.
M.V.Sc., Veterinary Parasitology,
Veterinary Practitioner,
Puducherry 605001, India
***Corresponding Author:** angelinefeliciabora@gmail.com
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Abstract:

The protozoan infections are one of the important parasitic diseases affecting livestock, its production and economic sustainability of livestock farming. The protozoan diseases which affect livestock includes theileriosis, babesiosis, trypanosomosis, coccidiosis. The clinical signs like reduced feed intake, reduced growth, decrease in milk production, reduced reproduction efficiency and losses due to veterinary care. The degree of losses varies according to species of parasite, host susceptibility, management practices, environment, diagnostic methods and treatment. In tropical and sub-tropical conditions, the economic losses are significant because vector borne diseases often coincide with nutritional stress, inadequate veterinary infrastructure and limited preventive measures. The indirect losses include reduced market value, replacement of dead animals, trade restrictions and reduced farm profit. This article emphasizes on major protozoan diseases of livestock, its economic impact, factors responsible for financial losses and various measures to combat its burden. The early diagnosis of infection, treatment, control of vector, improved animal husbandry, assessment of economic losses at farm level are essential for sustainable livestock production.

Keywords: Protozoan diseases, theileriosis, babesiosis, coccidiosis, animal health, economic impact

Introduction:

Livestock are reared for milk, meat, hide, manure and other valuable products. Its production plays a crucial role in rural livelihoods, food security and agricultural development. In developing countries like India, infectious diseases continue to constrain the productivity and profit of livestock enterprises. Among various infectious diseases, protozoans are important because it persist with animal population and cause substantial losses when morbidity is more. Protozoa are single celled, microscopic, eukaryotic organisms which parasitize livestock and affects normal physiological functions. The mode of transmission includes

tick bite, biting flies, contaminated food and water, congenital. The economic importance of protozoan infection includes treating affected animals, production of less milk or meat, reduced growth and in case of severe infections, mortality occurs. The sub clinical diseases cause reduced production and feed efficiency. The assessment of protozoan diseases was mainly carried out by mortality rate which eventually underestimates the obvious productivity losses. (Shaw 2009).

Major Protozoan Diseases Affecting Livestock:

- **Theileriosis:**

  In tropical regions, theileriosis caused by *Theileria annulata, Theileria oreintalis* threatens cattle production and shows clinical signs like fever, enlarged lymphnode, anemia, respiratory distress and death. The economic consequences include reduced milk yield, treatment cost, mortality.

- **Babesiosis:**

  Babesiosis caused by *Babesia bovis* and *Babesia bigemina* is a tick-borne disease of cattle and shows clinical signs such as fever, haemolytic anaemia, haemoglobinuria (Coffee coloured urine), weakness and death. The economic losses includes reduced milk production, poor growth, treatment costs, mortality. The carrier animals and persistent infection complicate the control measures.(Bock et al., 2004).

- **Trypanosomosis:**

  Surra caused by *Trypanosoma evansi* affects livestock and other domestic animals in Asia, Africa and other countries. The clinical signs of disease include anaemia, progressive weakness, weight loss, reproductive problem. The annual losses from surra at approximately US$671.1 million, with milk-yield and reproductive losses contributing substantially to the estimated burden (Ravindran et al., 2019).

- **Coccidiosis:**

  Coccidiosis is caused by *Eimeria zuernii* affects cattle. Acute infection causes haemorrhagic diarrhoea in calves, Faeces streaked with blood at first then to frank blood, Severe case tenesmus, straining and prolapse of rectum. Anemia, weakness, emaciation and coughing accompanied with dysentery. Animal's rear quarters may look as they had been smeared with red paint. Bedding provides warmth and moisture for sporulation of oocyst at subzero temperature. At winter, cold stapled and yarded animals suffer severe outbreak called Winter coccidiosis.

- **Toxoplasmosis:**

  Toxoplasma gondii affects sheep and goats because infection during pregnancy can lead to embryonic loss, abortion, stillbirths and weak offspring. The disease also can be transmitted through contaminated environments and certain food products. Its economic impact is therefore associated with reproductive losses, flock replacement costs and food-safety management (Dubey, 2009).

Major Economic Losses of Protozoan Infections:

- **Reduced Milk Production:**

  Protozoan diseases may reduce milk yield through fever, anaemia, anorexia, tissue damage and metabolic stress. In dairy production, a slight decline in daily milk output can result in substantial overall financial losses when a large number of animals are affected. These losses may be more pronounced when infections occur during early lactation, a period when high-yielding animals have elevated nutritional requirements.

- **Reduced Meat Production and Growth Rate:**

  Protozoal infections can adversely affect body-weight gain by decreasing feed intake, disrupting nutrient absorption and reducing feed conversion efficiency. Coccidiosis is particularly significant, as intestinal damage caused by the parasites impairs normal digestion and nutrient uptake. Similarly, blood-borne protozoan parasites may lead to persistent weakness and stunted growth. Consequently, infected animals often require greater feed inputs and a prolonged rearing period to attain the target market weight, thereby increasing production expenses and delaying the recovery of investment.

- **Mortality:**

  Acute protozoan diseases may result in substantial mortality among susceptible livestock, especially when diagnosis and therapeutic intervention are delayed. The death of a breeding animal, such as a cow, buffalo, sheep or goat, leads to economic losses that extend beyond its immediate market price. These losses include the forfeiture of future milk production, offspring, reproductive capacity and the financial resources invested in rearing the animal. Furthermore, purchasing replacement stock requires considerable expenditure and newly acquired animals may take several months or even years to attain full productive capacity. Consequently, livestock mortality can have particularly devastating economic consequences for smallholder farmers, whose livelihoods often depend heavily on a limited number of animals.

- **Reproductive Inefficiency:**

  Protozoan infections can adversely affect reproductive performance by disrupting fertility, conception, the maintenance of pregnancy and the survival of offspring. Such infections may lead to abortions, stillbirths, the birth of weak neonates, delayed conception and prolonged calving intervals.

  These reproductive complications decrease the number of offspring available for sale and increase the expenses associated with maintaining animals that are not producing economically. In extensive livestock production systems, reproductive losses may go undetected for extended periods due to limited individual animal monitoring, further aggravating the economic burden on farmers.

Increased Management and Veterinary Expenditure:

The management of protozoan infections requires considerable expenditure on diagnostic procedures, veterinary services, medications, supportive care, vaccination where available, and additional labour. Further costs may arise from implementing quarantine measures, restricting animal movement, and maintaining appropriate cleaning and disinfection practices on farms.

Moreover, improper drug administration or repeated treatments can increase financial burdens and contribute to the development of drug resistance, therapeutic failure, and drug residues in livestock products. Therefore, effective and economically sustainable disease management should rely on accurate diagnosis, professional veterinary advice, and treatment protocols appropriate to the local epidemiological conditions.

Market And Trade Losses:

Livestock affected by protozoan diseases may fetch lower market prices due to poor body condition, anaemia, and noticeable clinical manifestations. Disease outbreaks and animal mortality can interfere with livestock transportation and marketing, while certain infections may necessitate enhanced surveillance and compliance with additional trade regulations. Furthermore, infected farms may face declining consumer confidence and increased expenditure on biosecurity measures and regulatory compliance. The resulting economic consequences may extend beyond individual livestock enterprises, affecting animal traders, processing industries, and other stakeholders throughout the livestock supply chain.

Strategies For Reducing Economic Losses:

- **Early Diagnosis and Surveillance:**

  Protozoan infections can be diagnosed using various techniques like clinical assessment, microscopic examination of blood smears and faecal samples, serological assays, and molecular diagnostic methods. Polymerase chain reaction (PCR) techniques are particularly valuable for identifying infections with low parasite burdens and differentiating between closely related protozoan species. Prompt and accurate diagnosis facilitates timely therapeutic intervention, thereby helping to minimise disease-associated productivity losses in livestock (Kumar et al., 2016).

- **Integrated Vector Management:**

  Routine surveillance of ticks and biting flies, the judicious application of approved acaricides and insecticides, effective pasture management, and the provision of suitable housing can help minimise livestock exposure to disease vectors. Vector control strategies should be tailored to local ecological conditions while prioritising animal welfare, environmental protection, and measures to prevent the development of resistance to chemical agents.

- **Improved Nutrition and Farm Hygiene:**

  Providing a nutritionally balanced diet, ensuring access to clean drinking water, maintaining

appropriate stocking densities, using dry bedding, managing manure effectively, and implementing regular cleaning practices can strengthen livestock health and reduce exposure to parasites transmitted through contaminated environments. Particular attention should be given to young animals, as they are often more vulnerable to protozoan infections that can result in significant clinical disease.

- **Economic Monitoring and Farm Records:**

Farmers should maintain comprehensive records of disease occurrence, mortality, veterinary costs, milk production, growth performance, reproductive efficiency, and treatment outcomes. Such documentation facilitates the identification of recurring disease patterns, enables the assessment of production-related losses, and helps evaluate the economic effectiveness of preventive measures.

An integrated disease management approach is particularly essential for controlling coccidiosis, as improved husbandry practices, vaccination, and chemoprophylaxis offer complementary advantages, although each has certain limitations (Blake et al., 2021). Similarly, the combined implementation of disease surveillance, vector control, appropriate therapeutic interventions, and targeted preventive strategies can enhance livestock productivity while minimizing recurrent disease management costs.

Future Directions and Perspectives:

- **Advanced diagnostics and disease surveillance:** Future research should focus on developing rapid, accurate, and affordable diagnostic methods, alongside digital surveillance systems, to facilitate early detection, continuous monitoring, and effective tracking of protozoan infections in livestock.
- **Climate change and disease distribution:** Future studies should explore how variations in temperature, rainfall patterns, humidity, and vector distribution affect the spread and transmission of protozoan parasites, as well as their resulting economic impact on livestock production and farmers' livelihoods.
- **Innovative prevention and control strategies:** Future research should assess the effectiveness and economic feasibility of vaccination, targeted antiparasitic therapies, vector management, improved hygiene practices, and integrated parasite control approaches across diverse livestock production systems.
- **Genetic improvement and host resistance:** Future studies should focus on identifying genetic markers and livestock breeds that exhibit greater resistance or tolerance to protozoan infections, thereby facilitating selective breeding programmes aimed at enhancing disease resilience, animal health, and overall productivity.

- **Precision livestock farming and artificial intelligence:** Future research should explore the integration of wearable sensors, automated health-monitoring systems, machine learning, and predictive analytics to enable the early identification of protozoan infections, assess potential productivity losses, and facilitate timely, evidence-based interventions in livestock production.
- **Evidence-based policies and economic decision-making:** Future research should focus on developing region-specific economic models and decision-support frameworks to facilitate informed investment in disease surveillance, preventive healthcare, veterinary services, and farmer awareness programmes, thereby minimizing economic losses and promoting sustainable livestock production.

Conclusion:

Protozoal infections pose a major challenge to livestock productivity and the long-term economic viability of animal husbandry. Their adverse effects include reduced milk production, impaired growth, reproductive disorders, increased mortality, higher veterinary costs, and disruptions in livestock marketing. These impacts are especially pronounced in tropical and subtropical regions, where the prevalence of vector-borne diseases, exposure to environmental sources of infection, and inadequate access to veterinary healthcare often occur concurrently.

Successful management of protozoan infections necessitates prompt diagnosis, timely and appropriate treatment, comprehensive vector control measures, adequate nutrition, improved hygienic practices, vaccination where available, and continuous evaluation of farm productivity. Ultimately, the prevention of protozoan diseases extends beyond veterinary healthcare, representing a strategic economic investment in enhancing livestock production, ensuring food security, and promoting the long-term sustainability of rural livelihoods.

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