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Optimal Control Model Analysis for Fasciola hepatica Parasite in Human-Cattle Interactions

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Abstract : Fasciola hepatica is a trematode parasite that infects both animals and humans, leading to fasciolosis. This disease is globally prevalent and is associated with significant economic losses and health issues. This study presents a mathematical analysis of the transmission dynamics of Fasciola hepatica epidemics to understand disease spread and identify effective prevention and control measures for cattle and human populations. It offers valuable insights into the effective management of Fasciola hepatica and the reduction of its impact on both cattle and human populations. The optimal control model is evaluated using Pontryagin's maximum principle. Numerical simulations demonstrated that all implemented control strategies significantly reduced infections in both cattle and humans. The numerical simulation results show that all control measures, including public health education, treatment of infected cattle and humans, and the use of chemical molluscicides for snail removal, contributed significantly to the reduction of Fasciola hepatica infections in both cattle and human populations. Integrated control measures lead to an immediate and significant decrease in the infected cattle and human populations. This decline continues over time, demonstrating the effectiveness of the integrated interventions in reducing the spread of the disease. Furthermore, the study emphasized the crucial role of maximizing the treatment measures for infected cattle, highlighting the importance of treating infected cattle in managing Fasciola hepatica.

Keywords : cattle population, Fasciola hepatica, forward bifurcation, human population, optimal control
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