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MATHEMATICAL ANALYSIS OF A DISEASED PREY- PREDATOR SYSTEM WITH HARVESTING OF PREY

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Susceptible prey modelling is important to understand the transmission of infectious diseases, such as COVID-19, SARS, ebola, and dengue, among populations of organisms. Studying the dynamics and the behaviour of the ecological interactions among the species of susceptible prey-predator system assists in decision-making by making projections regarding important issues such as intervention induced changes in the spread of disease. In this study, a continuous-time prey-predator system with susceptible prey, infected prey, and predator populations is considered assuming that the predator is not acquiring infections. An existing mathematical model has been modified in order to study the dynamics of a diseased prey-predator system with the harvesting of the prey. The existence and uniqueness of the solutions to the modified model have been proved. Locally, asymptotic stability of the vanishing equilibrium point, disease and predator-free equilibrium point, predator-free equilibrium point, and the co-existent equilibrium point is proved under some conditions. Those conditions are $c > 1$ for vanishing equilibrium point, $c < 1$ and $ak(1-c) < e$ for disease and predator-free equilibrium point, $f\hat{y} < d$ and $k(1-c) < (2\hat{x} + ak\hat{y})$ for predator-free equilibrium point, and $k(1-c) < (2x^* + aky^*)$ and $ax^* < (bz^* + e)$ for co-existent equilibrium point. Here a, b, c, d, e, f, and k are constants and x,y and z are variables in the system. Moreover, it is shown that the prey and predator populations can survive in the ecological system even if the disease still exists in the populations.

Keywords: Ecological system, Equilibrium, Prey-Predator, Susceptible Prey Modelling, Stability