ABSTRAK

Penelitian ini membahas analisis kestabilan dan bifurkasi model matematika penyebaran rabies pada populasi hewan. Model yang digunakan merupakan modifikasi model epidemi SIR (*Susceptible–Infected–Recovered*) menjadi model epidemi SIV (*Susceptible–Infected–Vaccinated*) dengan mempertimbangkan kelahiran, vaksinasi, kehilangan imunitas, kematian alami, dan kematian akibat infeksi. Analisis dilakukan dengan menentukan titik ekuilibrium bebas rabies dan endemik serta menghitung bilangan reproduksi dasar (R_0) menggunakan metode *Next Generation Matrix*. Hasil analisis menunjukkan bahwa jika $R_0 < 1$, maka titik ekuilibrium bebas rabies bersifat stabil asimtotik sehingga rabies akan menghilang atau punah dari populasi. Sebaliknya, jika $R_0 > 1$, maka titik ekuilibrium endemik bersifat stabil asimtotik sehingga rabies tetap bertahan dan menyebar dalam populasi. Analisis bifurkasi menunjukkan terjadinya bifurkasi *transcritical* pada $R_0 = 1$ yang menandai perubahan kestabilan sistem. Simulasi numerik dilakukan untuk mendukung hasil analisis teoritis dengan menggunakan perangkat lunak *Python*.

Kata kunci: *rabies, model SIV, kestabilan, bifurkasi, bilangan reproduksi dasar*

ABSTRACT

This study examines the stability and bifurcation analysis of a mathematical model for the spread of rabies in an animal population. The model used is a modification of the SIR (Susceptible–Infected–Recovered) epidemiological model into the SIV (Susceptible–Infected–Vaccinated) model by incorporating birth, vaccination, loss of immunity, natural death, and disease-induced death. The analysis is carried out by determining the disease-free and endemic equilibrium points and by calculating the basic reproduction number (R_0) using the Next Generation Matrix method. The results show that when $R_0 < 1$, the disease-free equilibrium point is asymptotically stable, indicating that rabies will disappear from the population. Conversely, when $R_0 > 1$, the endemic equilibrium point is asymptotically stable, meaning that rabies persists and continues to spread within the population. The bifurcation analysis reveals the occurrence of a transcritical bifurcation at $R_0 = 1$, which marks a change in the stability of the system. Numerical simulations are performed to support the theoretical analysis using Python software.

Keywords: *rabies, SIV model, stability, bifurcation, basic reproduction number*