ABSTRACT

OPTIMAL CONTROL MODEL OF DENGUE HEMORRHAGIC FEVER SPREAD WITH PREVENTION, LARVICIDES, AND INSECTICIDES

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This thesis discusses the stability analysis of the dengue hemorrhagic fever spread model and optimal control. The model consists of eight subpopulations, namely susceptible individuals, exposed individuals, infected individuals, recovered individuals, aquatic phase mosquitoes, susceptible mosquitoes, exposed mosquitoes, and infected mosquitoes. In determining local and global stability of the system, the Routh-Hurwitz stability criteria and Lyapunov methods were used. The stability analysis results obtained two equilibrium points, namely non-endemic and endemic equilibrium points. Furthermore, the optimal control problem is solved using the Pontryagin Minimum Principle. The controls given are preventive, larvicide, and insecticide. The results of the optimal control analysis show that the dengue hemorrhagic fever spread model is controlled. In this thesis, a numerical simulation is given using assumed data on the initial value of each variable and parameter values sourced from the following studies, Bekoe (2017) and Khan & Fatmawati (2021). The basic reproduction number in the model is 5,3772. Since $\Re_0 > 1$, the dengue hemorrhagic fever spread model is asymptotically stable at the endemic equilibrium point, meaning that dengue fever remains in a population. The simulation results show that the given control can minimize the number of dengue hemorrhagic fever transmissions. The provision of control with a combination of the three controls is more effective in controlling the level of dengue hemorrhagic fever spread than only using a combination of the two controls so that the provision of optimal control simultaneously can reduce the spread of dengue hemorrhagic fever.

Keyword: dengue hemorrhagic fever, Lyapunov method, stability analysis, optimal control, Pontryagin Minimum Principle.