**Title: Mathematical Models for the Transmission Dynamics of Fowl Pox Disease with Seasonality and Control Measures**

**Supervisors**

1) Prof. J.Y.T. Mugisha: Department of Mathematics, Makerere University
2) Dr. Fred Mayambala: Department of Mathematics, Makerere University
3) Prof. John Kitayimbwa: DVC, Uganda Christian University

**Abstract**

Fowlpox disease poses a real threat to domestic birds, especially the chickens and turkeys in Uganda and the world, despite the tremendous efforts to avert the transmission. The disease prevalence varies depending on climate change, vector dynamics, vaccination, good management, and hygienic practices. This is primarily due to seasonal variations that affect mosquito populations and fowlpox virus concentrations in the environment. However, the effects of seasonality on disease dynamics are not fully understood. Therefore, a deterministic mathematical model was formulated and used to determine the impact of seasonality. In addition, the probability of a fowlpox outbreak for the stochastic model derived from the deterministic model was determined, and optimal control strategies for disease extinction were explored. The next-generation method was used to compute the basic reproduction number Ro. The model exhibits backward bifurcation when ***Ro <1***, which implies the persistence of the disease in poultry birds. However, for ***Ro >1***, a stochastic model using the continuous-time Markov chain (CTMC) was derived and used to determine the probability of disease outbreak. Results showed that the probability of disease extinction is high when infected mosquitoes introduce the infection, and the probability of disease outbreak is high with infection originating from infected chicken and the concentration of the virus in the environment. Results also showed that host-vector and environmental transmission routes have a high probability of disease outbreaks. The results also showed that the time-average approach overestimates the disease risk and underestimates the disease risk as the amplitude of the mosquito seasonal oscillation was varied from 0.3 to 0.8 as ***Ro*** was plotted against varying parameters of *Lambda (*recruitment rate of mosquitoes*)*. In addition, it was illustrated that for the linear operator approach, ***Ro <1*** when varied with ***eta*** (decay rate of the fowlpox virus). In addition, results demonstrated that environmental decontamination yields

better control results than insecticide spraying, though the measure does not eliminate fowl pox disease in chickens. However, the application of both control measures produces much better results.