Effect Analysis of Climate Change on the Reproduction of Mosquitoes and Infection Rate Sensitivity for SI/SIR Epidemical Model in the Case of Malaria Disease

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***Abstract*—The purpose of this study is to improve the current methodology SI/SIR by introducing the sensitivity of infection rate to climate change variables such as temperature and humidity to reproduce infection by anophelines gambaie. The improvement provides a satisfactory model, where the number of mosquitoes is controlled by the time and seasons, which change the malaria reaction. Rwanda weather facilitates the lodgment of these vectors where the variation of temperature is ranged between 10 and 29°C and humidity is in the range of 30% – 97%. With climate change, distress the change into the number of mosquitoes is complex to change, this makes the reaction of the infection rate to respond proportionally to the change of mosquito and it is effective for the population at risk of malaria to respond to this change, especially in some season where the infection rate can be more than 0.2. Furthermore, analysis and comparison are made, where the infection rate as a time-dependent variable, demonstrate a significant result where the explanation of the result has the meaning of the climate change variables. The result provided by the new model proves the importance of the focus mostly on infection rate sensitivity.**

***Index Terms*—climate change, variables, seasonal, humidity, temperature, approach, mosquito, anopheline gambaie, malaria disease, population, human, SI/SIR model, infection rate, sensitivity**

I. INTRODUCTION AND BACKGROUND

The world has been and is still facing the presence of Malaria disease, which is among the high placed problem of the world. This disease has been discovered in 1880 [1], its studies have been conducted and there have been many new discoveries about the disease. The disease was defined to be a mosquito-borne epidemiologic disease that is transmitted from human to human by the bites of infected female mosquitoes, and this varies depending on the season. Like most of the sub-Sahara countries in Africa, Rwanda is distress with the disease, which presents different risks, including death.

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Rwanda has seasons that allows mosquitoes' to be active and this makes the presence of malaria disease highly infectious in this region since it has been discovered. Numerous strategies to eradicate the incidence were applied but the disease still exists and the result is not enough.

Previous works [2]-[8] review the climate change variables involvement into, mosquitoes' life cycle and how mosquitoes' presence makes a big change to the disease spreading into Human [3] and [9]. The infection rate of the disease depends on time, temperature and related to humidity because they take an effect on the life cycle of the anophelines reproduction, and increase the number of bites [10], [11]. SI/SIR model has been used to study the influence of climate change on the effect of Malaria disease.

The study [4] focused on the mosquitoes' birth and statistical determination of rates of mosquitoes' type. In this work, focusing on the life cycle of the mosquito, some data analyses were applied to improve the beta sensitivity and apply in the SI/SIR model, for the improvement of the model.

Beta sensitivity epitomizes the reaction for the infection rate by the time goes by with the dependency of different factors; in this case, temperature and humidity are the main variables

Susceptible-Infected-Recovery (SIR) is a methodology to predict the spreading disease based on the data in a previous year. This model has been studied and modified by many researchers [9], [12]-[15] depending on their goals; especially Malaria disease study. To solve differential equations in this model, we set the initials variables for certain variable before the use of the function, and those following result will depend on the output of currently vectors result, this is how this model work. As for malaria disease, infection rate should vary depending on the change of the climate condition and change of mosquito number. Applying the model to malaria disease, it does not support these changes, since it treats the infection rate as just a constant. The reason why for this study, is to analyze the influence of climate change on a reproduction of anophelines gambaie,