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# Prediction of Malaria Incidence in Banggai Regency Using Evolving Neural Network

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*Abstract*— **Malaria is an endemic disease in most of area in Indonesia, especially in rural and remote areas. Banggai, one of regencies in Central Sulawesi province, is a high endemic area of malaria with Annual Parasite Incidence (API) in 2010 reached 7.88‰. The incidence and spreading of malaria were influenced by environmental and weather factors, particularly rainfall and temperature. Therefore this study would like to develop a malaria incidence prediction system based on environmental and weather factors, so that it may assist Indonesian Ministry of Health to control malaria. The method used to solve the problem was Evolving Neural Network (ENN). This method was a mixture between Artificial Neural Network (ANN) and Genetic Algorithm (GA).**

**The result of this study shows that the prediction system has acceptable performance for predicting malaria incidence based on weather factors. The best performance in predicting malaria incidence in 2008 was 21.3% MAPE, 75% accuracy, and 84.21% F-value. While in predicting malaria incidence in 2009 was resulted 15.29% MAPE, 75% accuracy, and 40% F-value. These findings proved that there was a sufficient correlation between weather and malaria incidence. ENN also improved the performance of ANN up to 14.84% in MAPE, 25% in accuracy and 40% in F-value.**

***Keywords-Malaria, Prediction, Indonesian, Evolving Neural Network, Artificial Neural Network, Genetic Algorithm***

## I. INTRODUCTION

Malaria is an endemic disease in most of area in Indonesia, especially in rural and remote areas. On a national scale, malaria is one of diseases as a part of global commitment of Millenium Development Goals. Its spreading and incidence are targeted to be stop and reduced in 2015 [6]. Banggai, one of regencies in Central Sulawesi province, is an area that has high endemic of malaria. Data in 2010 shows that malaria Annual Parasite Incidence (API) in Banggai Regency reached 7.88‰, this number were further above than targeted API in malaria control program that is API < 1‰ [3]. Several studies [1][4][7][10] show that malaria incidence and spreading are influenced by weather factors, particularly rainfall and temperature. This study was aimed at developing a malaria incidence prediction system based on weather factors.

Evolving Neural Network (ENN) is a method that integrating Evolutionary Algorithms (EAs) and Artificial Neural Network (ANN). In prediction system, ANN is widely used because of its accuracy. However, there are some difficulties in designing ANN. It does not have general method to determine the optimum structure for solving any problem and the correction weight is limited to search space of steepest descent method which can lead to worse solution or early convergence [2]. Therefore, this study applied GA as the EAs to optimize ANN structure and to train ANN.

## II. MATERIALS AND METHOD

### *A. Data*

The input of prediction system was time series data of weather factors on month m–1, m–2, …, m–n; the output was malaria incidence on month m; where m = month and n = number of time series. Monthly weather data (rainfall, precipitation day, minimum temperature, maximum temperature, average temperature, average humidity, maximum wind velocity, average wind velocity, maximum direction of wind, and average length of daylight) were collected from BPS-Statistical of Banggai Regency. While monthly malaria incidence data were collected from Indonesian Ministry of Health.

### *B. Proposed Method*

This study was divided into three main stages, (1) data preprocessing stage; (2) constructing prediction model stage; and (3) testing stage.

#### *1) Data Preprocessing Stage*

Data preprocessing stage is a preparation-stage before the processing data. At this stage, first, data were normalized in range [0..1] using equation (1); then the data were divided into three sets, i.e. training dataset, validation dataset, and testing dataset.

$$x' = \left((Ra - Rb)\frac{x - min2norm}{max2norm - min2norm}\right) + Rb \quad \ldots (1)$$

where: x' = normalized data
x = original data
min2norm = minimum data – margin
max2norm = maximum data + margin
Ra= upper limit of normalized data (Ra= 0.9)
Rb= lower limit of normalized data (Rb= 0.1)