# Low Flow Forecasting with Recession Analysis Approaches (Poster Presentation)

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**Abstract**

Since hydrologic drought is a slowly developing phenomenon, it may be possible to forecast low flow conditions, especially in areas with long dry seasons. This study proposes hydrological drought forecasting methods based on two stream flow recession analyses. The first one is based on a recursive digital filters for baseflow separation and recession characterization for the baseflow forecasting. The second one is based on the theory of “simple dynamical systems of catchments”. The applications of the two methods were demonstrated in Lombok Island in Indonesia and showed that the latter method, which reflects more flexible recession characteristics showed better accuracy in the estimations of the low flows. Nevertheless, both of the presented applications showed underestimations in low flow forecasting compared to the observed ones. The underestimations were mainly associated with the ignorance of the rainfall, especially for long lead time cases.

**Keywords:** hydrological drought, drought forecasting, recursive digital filters, simple dynamical systems

## 1. Introduction

Drought is a creeping disaster which is difficult to be identified because of less evidence in physical effect. The effect of the disaster could be seen after some time since the disaster hap-pens. However, once the disaster is apparent, it is already late to take a mitigation action. Therefore, the drought forecasting is important for drought mitigation and preparedness to minimize the impact of the disasters [1]

One of the common approaches for drought forecasting is by forecasting low flow with some lead time is to use hydrologic models. They are particularly important because the predicted discharge information used in water allocation under drought conditions.

The objective of this study is to investigate the applications of two different recession analysis methods for low flow forecasting in the Babak River Basin in Indonesia. The two methods are recursive digital filters and simple dynamical systems model.

## 2. Study Site and Data

This study was done for Babak River Basin, Lombok Island, Indonesia (**Fig.1**). The annual precipitation amount in this area range between 800 to 1970 mm/year. The data used for analysis are river discharge data from two automatic water level recorder (AWLR) stations; namely Lantandaya and Gebong stations. 31 years data recorded from 1985 until 2015 is used for the analysis.

## 3. Methods

### a) Recursive digital filters

The baseflow forecasting formulation was done by following the equation,

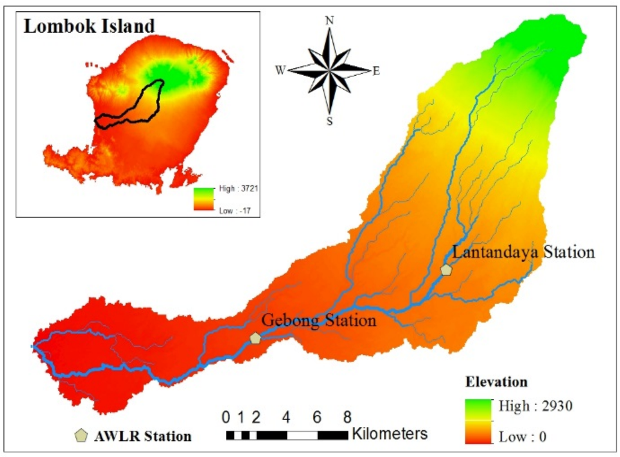


**Fig.1** Babak River Basin.

$$b_{k+1} = a b_k \quad (1)$$

where $b_k$ is defined as baseflow and $a$ is recession constant. The complete explanation of $a$ could be found in Eckhardt 2005 and 2008 [2, 3].

**b) Catchments as simple dynamical systems**

The baseflow forecasting formulation was done based on the following the equation

$$\frac{dQ}{dt} = \exp\left(c_1 + (c_2 - 1)\ln Q + c_3 (\ln Q)^2\right)(-Q) \quad (2)$$

where $Q$ is discharge (mm/day), and the parameters of c1, c2, and c3 were obtained from the quadratic regression plot. The reconstruction of the equation could refers Kirchner, 2009 [4].

## 4. Result and Discussion

### a) Recursive digital filters model forecasting

The forecasting result shows that for both of the station has the underestimate discharge. The forecasting result (**Fig.2**) following the exponential graph while the observed discharge in the Lantandaya Station shows almost stable flow while in Gebong Station shows the fluctuation of the flow.

### b) Simple dynamical systems forecasting

The result of the flow forecasting by using simple dynamical systems (**Fig.2**) shows that the forecasting result by using the model tends to be lower for both stations compared to the measured river discharge. The forecasting result also shows some discontinuation flow in Lantandaya Station. The forecasted flow ends up before 60 days of forecasting. As the forecasted result is strongly influenced by the values of parameters $c_1$, $c_2$, and $c_3$, the discontinuity of the forecasted result may be because of the poor quality of the calibration data.

### c) Forecasting performance

In order to evaluate the quality of both forecasting method, each of the forecasted result is evaluated by calculating the error value between the forecasting result and the baseflow based on the calculation of observed data. The shorter the forecasting, the error value becomes less. The smallest error value is around 40% which happens in the 15 days after the baseflow forecasting was started.

## 5. Conclussions

The baseflow forecasting based on the recursive digital filters model tends to result in underestimated value compared with the simple dynamic system. Although the results of the simple dynamic system also show some underestimations, it provided higher accuracies at least for the shorter lead time ranges (<15 days) than the recursive digital filters model.


## References

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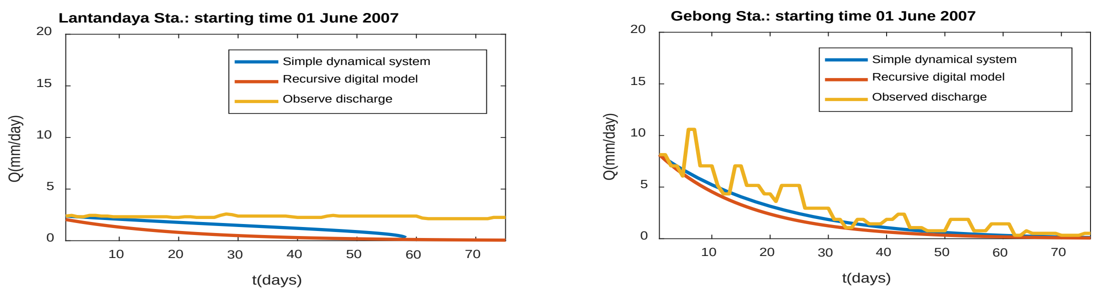


**Fig.2** Forecasted flow based on two method in Lantandaya Station and Gebong Station.