Flash Flood Model Behavior and Calibration of Kali Putih and Nasiri Watershed

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INTRODUCTION

Communities those are living along Kali Putih, Magelang, Central Java Province and those are living in Nasiri Sub-village, West Seram, Maluku Province in Indonesia are vulnerable to flash flood disaster. In order to examine response behavior and reliability of flash flood simulation, sensitivity study of the model was conducted for the two river watersheds and for Nasiri watershed that has AWLR data records a calibration study was carried out.

The GIS-based grid-based distributed hydrology model was used to simulate the rainfall-runoff transformation. This model implements kinematic flow for run-off and channel flow. The topography data were taken from the SRTM, USGS site. The values of infiltration coefficient and Manning's roughness coefficient were studied and calibrated with the initial assumption values were taken from some references and based on field observation data.

WATERSHED AND ITS SCHEMATIZATION

Both Putih and Nasiri Rivers have steep longitudinal slopes of 0.03 to 0.1 and 0.05 to 0.2, respectively. In this study, only the upper part of each watershed is considered. The Putih and Nasiri River watershed shapes can be categorized as narrow strip of 8.4 Km^2 and fishbone of 10.4 Km^2, respectively as shown in **Fig.1**.

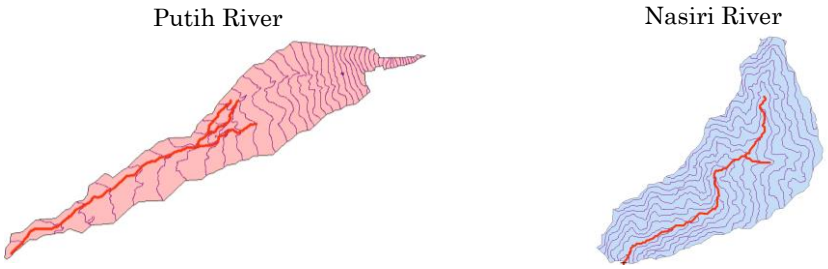

Fig. 1. Upstream Putih River and Nasiri River watersheds

SENSITIVITY ANALYSIS

Sensitifity analyses for infiltration coefficient and roughness coefficient give the following results. From **Fig. 2**, it can be observed that smaller infiltration coefficients result in higher discharge and quicker arrival time of peak discharge. Smaller Manning's n values produce higher flow velocity. Flow with higher velocity creates more runoff flow rather than let the water to infiltrate, thus result in higher discharge. In addition, flow with higher velocity results in higher flow discharge to be drained out from slopes which produces hydrographs that quicker to rise (short rising limb) and to decline (short recession limb).

The study results show that the difference of c_{inf} values does not change so much the value of time to peak of the first peak discharge. However, the value of the peak discharge is strongly influenced by c_{inf} values.

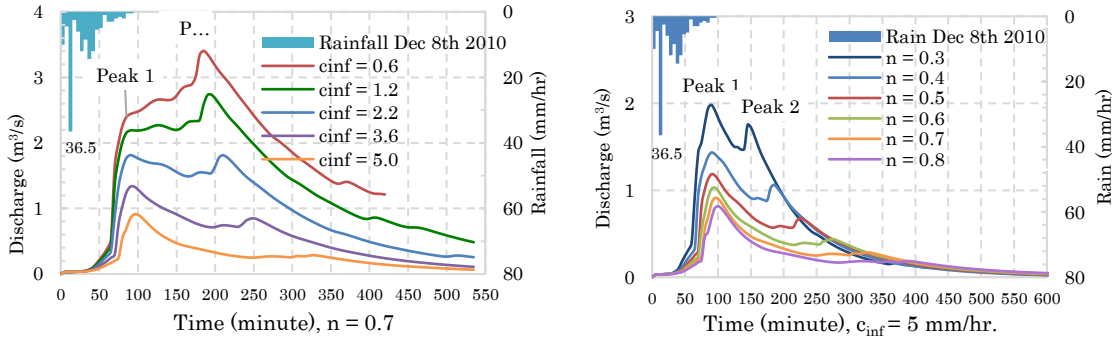

Fig. 2. Hydrographs of Manning's, n, and infiltration coeff., $c_{inf,}$ values of Kali Putih

CALIBRATION STUDY

The observed hydrographs were generated from the AWLR recorded data that installed under the only Nasiri bridge. The water level records were than converted into discharge records by using normal flow assumption.

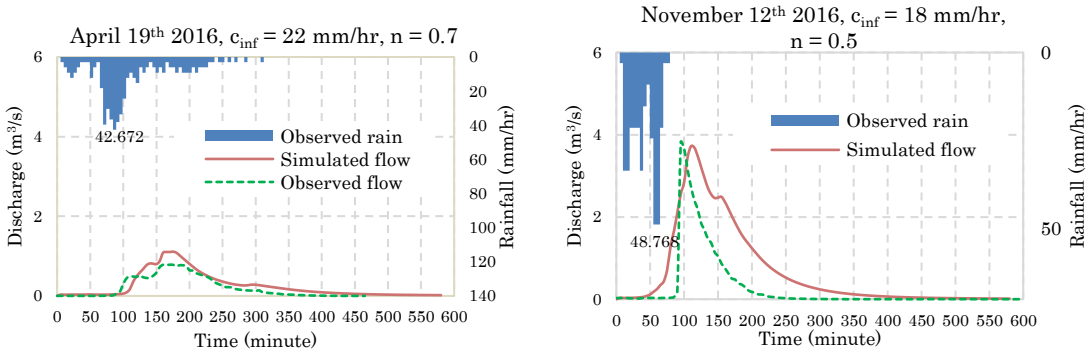

Fig. 3. Calibration result for Nasiri River based on April and November 2016 events

Calibration results of the simulated hydrographs to the observed hydrographs show that the simulation results can be fitted so that they are sufficiently agree with the observed data. It is found that the causing best-fitted values of c_{inf} and n are different for each rainfall event. These differences show that the condition of watershed was changing. In fact, the land cover condition in Nasiri varies within a year due to the cultivation practice of clove trees.

CONCLUSION

The modeling results show that watershed topography and land cover play a significant role in defining the flood characteristic over a watershed. Infiltration coefficient, c_{inf} and Manning's roughness, n, that are affected by type of soils, slope and land cover condition also give effects to the hydrograph's shape and the time to peak.

The calibration of the model for the Nasiri case is able to deliver acceptable result of simulation for both time to peak and the peak discharge data. However, the calibrated parameter values vary within a year and depend upon the changing land cover condition. Further sensitivity study for the effect of variation of the rainfall intensity values will give more beneficial.

Keywords: grid-based distributed hydrology model, flash flood, sensitivity, calibration