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Evaluating Land Use Change Effects on Hydrological Response in Cisangkuy Basin, Indonesia

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The more increasing population rate and economic condition in Indonesia results in the more changing of land use area. The land use management practice has enhanced effect in many disasters such as floods, drought and high-rate sedimentation. Those disasters have all been found to occur in main watersheds of West Java Province, which are also including Citarum Watershed. Seven major sub-streams in the upper Citarum watershed are Citarik, Ciwidey, Cihaur, Cikapundung, Cirasea and Cisangkuy River. Cisangkuy River Basin is an example of the miss management practice. Rapid land use changes from forest to agriculture and from agriculture to urban and industrial development reduce watershed capacity to hold water and thus increase the threats to flooding and sedimentation in the downstream areas and waterbodies. In the Cisangkuy, there are few long-term data series available to estimate and evaluating the climatic and anthropogenic impacts on runoff and erosion. The question is whether and by how much this anthropogenic effect offsets the current flood and sedimentation. To answer this question, a physically based, Cell Distributed Rainfall-Sediment-Runoff Model has been applied to simulate runoff, erosion, and sedimentation, from 1990-2004 rain-series.

The scope of this study can be summarized as follow: analyze of natural disturbances, analyze of land use changes, add conceptual and mathematical approach for determining soil erosion and sedimentation by water to Cell Distributed Rainfall-Sediment-Runoff Model, analyze the relationships of natural disturbances-land use changes with runoff, erosion and sedimentation rate, calibrate and validate the hydrology and sediment components of Cell Distributed Rainfall-Sediment-Runoff Model. The land use changes over a 5-year period were determined using 100-m spatial resolution data from 1997 and 2002. The main land use classes in the basin were forest, paddy fields, agriculture (annual upland, mixed cropping), grass land, urban, and waterbodies. The most visible change between the two periods is the conversion of forest and grass land to agriculture land, paddy fields, and urban area. This shift of land use has contributed mostly to the decrease of the percentage of the watershed covered by grass land unmanaged which amounts to over 90%, the area covered by forest decreased by 46%, while the agriculture land, paddy fields and the urban area covered increased by 85.2%, 19.4% and 41% compared to 1997.

The concept of original model considering the sediment movement on a watershed scale by combining sediment yield, deposit, and transportation processes with the grid-cell based Kinematic Wave Runoff (KWR) model. This study considers the soil erosion process by raindrop and leaf drip impact and soil detachment by over land flow. This study is useful for calculating the joint effect of natural disturbances and anthropogenic processes through the entry watershed and the aquatic ecosystems with considering contribute to severe water flow (flood) and sedimentation. This study also to conduct watershed investigative analyses using the model: (1) prioritize flow (flood) and sediment critical areas, and (2) spatially distributed investment prioritization for water and sediment control. For hydrology and limnology in the future programme (based “ecohydrological approach”), output this study can be used to improve the design of future modelling study about impacts of water flow, erosion, and sediment control scenarios.