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INSTITUTE FOR WATER EDUCATION
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IMPACT OF LAND USE CHANGE
ON WATER MANAGEMENT IN UPPER CITARUM RIVER BASIN

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Master of Science Thesis
by

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SUMMARY

Bandung Basin covers the upper area of Citarum River, the biggest and longest river in West Java Province in Indonesia. Over the past two decades, Citarum River has been severely degraded and its capacity to support the livelihood of the people has significantly reduces. The main problems are triggered by uncontrolled land use change, population pressure and massive urbanization, which have resulted in changes of the water regime pattern.

Land use analysis shows that residential area has grown by 35% (about 5,000 ha) and industrial area has grown by more than 100% (about 1,000 ha) during 1994-2009, subsequently rice field increased by more than 7,000 ha and bush and pasture land by more than 7,000 ha while forest decreased by 40% (about 20,000 ha) during the same period. The pattern of land use change in Upper Citarum River Basin, that is forest opening to agriculture land or pasture and bush, then converted into urban area (residential and industrial) and paddy field. Activity change toward land use has affected the flood occurrences more often either frequency or magnitude in Upper Citarum River Basin.

The main issue of managing water management in Upper Citarum River Basin is not just the problem of land use changes itself, but also land subsidence in this area with the rate of subsidence 0.5-18.8 cm/year during that period which have negatively affected flood occurrences and water resource sustainability due to topographical and river hydraulics gradient changes. The main causes for land subsidence are land use change from natural land to build area especially when it occurs in water recharge areas and dependency of industry to groundwater supply, which can disturb the hydrological function in Upper Citarum River Basin.

The annual discharge and runoff coefficient in the Upper Citarum River Basin showed increasing trend. This is in contrast to the observed change of annual rainfall which showed a decreasing trend, however it indicated that change of discharge is not because of change of rainfall, but it is due to the catchment response. SWAT analysis result at Upper Citarum River Basin during 1994-2009 shows that increasing trend of runoff coefficient from 0.3 to 0.33 is caused by land use changes. Moreover, DUFLOW simulation has proven that land subsidence and additional discharge due to the increasing runoff coefficient in Upper Citarum River Basin has raised water level in one the most flood prone area, Dayeuhkolot, to +1.34 m and caused more severe flood in this area.

Impact of land subsidence and increasing runoff coefficient will cause Dayeuhkolot facing more severe flood in the future whereas in other areas (Sapan and Margahayu) the level of the flood will be reduced. This phenomenon was caused by increasing riverbed slope before Dayeuhkolot reach while after Dayeuhkolot reach decreased due to land subsidence. Therefore, flood water is coming into the Dayeuhkolot more rapidly during heavy rain flushing out more slowly causing flooding for long periods.

To avoid further possible negative impacts, flood control by constructing retention ponds, dikes and artificial infiltration wells in built up areas are proposed, with other benefit as water storage for agricultural purpose and as area for groundwater recharge. In addition, land use control by stopping deforestation and protecting the floodplain area and also land subsidence control by limiting groundwater usage, maximizing of surface water and water recycling program are expected to reduce flood occurrences. Beside those technical measures, five other categories of measures have to be developed, namely: institutional, legal aspects, economic, informative and supporting measures.

Keywords: Land use change, land subsidence, rainfall-runoff, SWAT, DUFLOW