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Urban Drainage and Flood Protection
in Jakarta City, Indonesia
Case Study: Ciliwung River - West Banjir Canal

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Master of Science Thesis
by

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Summary

DKI Jakarta (Jakarta City) lies in the north-west of Java Island. Province of DKI Jakarta serves as the Capital of the Republic of Indonesia as well as autonomous regions at the provincial level.

Big flooding has already occurred at DKI Jakarta in 2002 and 2007. Many people suffer because of that disaster. Flooding in Jakarta is a complex challenge, because there are so many factors influencing the phenomena. Rapid urbanization without improvement of drainage facilities are the main reason of flood in Jakarta City. At many locations, the drainage system cannot accommodate the increasing run-off from local rainfall or upstream rainfall. The drainage system has continuously failed to adjust to the changes.

The area of DKI Jakarta is about 650 km^2. The population of DKI Jakarta in 1948 was about 1.2 million. Jakarta population increases yearly and the number will become 14 million in 2025. The urbanization in Jakarta City affects the hydrology of 13 rivers that flow through this city. This influence is very strong therefore the peak flow for design flood is higher than that of 30 years ago.

Commonly, all catchment areas of the rivers that flow through Jakarta City have a long shape, so the hydrograph of design flood tends to be fast, sharp and very short. The condition is even worse by changing of land use from green area to settlement area that makes run-off become bigger. One of the river systems that can be used as runoff convey is Ciliwung River - West Banjir Canal. The beginning of this system is Ciliwung River that starts from Bogor, enters the Jakarta City Area and flows continuously to West Banjir Canal that has its end point at Jakarta Bay.

There are four objectives for this research. First objective is to describe existing urban drainage and flood protection systems in Jakarta City related to Ciliwung River - West Banjir Canal. The second one is to analyze the possible impacts of sea level rise and land subsidence on inundated area. The third one is to discuss some measures that would have been taken into consideration in order to reduce waterlogging and flooding. Especially future conditions have been checked when the area faces the impacts of sea level rise and land subsidence. Finally is to discuss in brief O&M, institutional and regulation arrangements and stakeholders participation in urban drainage and flood protection. The structural measures can be taken by considering hydrology and hydraulic conditions that can be simulated by modeling (DUFLOW and GIS). The result of the model can be analyzed for decision support to determine improved urban drainage and flood protection in Jakarta City. A design rainfall with a chance of occurrence of 4% per year is used in this modelling. The simulation of the urban drainage follows some scenarios that can be shown as:

- Scenario 1 where the urban drainage was considered as open drainage. This represents the existing condition and has been used as the basic case;
- Scenario 2 is taken by considering all structural measure installed in the system. It can reduce or even remove waterlogging in the flood plain as a result that can be seen in comparison to the first scenario;

- Scenario 3 where the urban drainage was made as similar as in the scenario 2 but by considering the future changed condition due to land subsidence, land use, and sea level rise;
- Scenario 4 is the additional scenario. It has been made while the improvements in scenario 3 cannot manage the flooding in the future condition.

Last objective is discussing in brief how O&M, institutional arrangements and stakeholder's participation in urban drainage and flood protection. It is a key to support urban drainage and flood protection management.

The study shows a large part of the flood plain suffers from flooding. Scenario 1 shows that 2,438 ha of 4,211 ha (57.9 %) floodplain are subject to flooding. Some improvement by structural measures such as dredging, deepening, widening of urban canals, dike heightening, retention pond and flood diversion can manage the flooding. Scenario 3 shows that the effects of land subsidence, sea level rise and land use change can cause more flooding in the future. Areas that are 3.5 km from Jakarta Bay are subject to flooding every day because of back water effect from tide. Therefore an Urban Polder with its properties is proposed to be constructed. This simulation is done in scenario 4 by more dike heightening of West Banjir Canal until 3.5 km to inland. However, improved operation and maintenance, strengthening both institutional arrangements and stakeholder's participation are also important factors to support urban drainage and flood protection management.