Effects of Land-use Change on flood inundation at Ciliwung River Basin in Jakarta, Indonesia

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1. Introduction

Jakarta experienced several floods in 1996, 2002, 2007, 2013 and 2014. Flood Inundation in Jakarta mainly caused by urbanization in Ciliwung river basin[1),2)]. This research focused on impact of urbanization in upstream region of Ciliwung river basin. Land use change was a serious matter in Ciliwung river basin because the development of residential and business area has driven difficulty in the land to absorb the water. The purpose of this research is to investigate the effect of land-use changes on flood inundation at Ciliwung river basin.

2. Study Area

Study area is located in West Java, Indonesia and total area covering in this study is 1,346.6 km^2 as shown in **Figure 1**. The study area consist of Ciliwung River basin, Jakarta city and outside of Jakarta. Ciliwung River has a catchment area of 386.6 km^2 with the river length of 117 km. Thirteen major rivers flow northwards through Jakarta into the Java Sea. Ciliwung River is the main and the longest river in Jakarta which passes through Jakarta and some areas in West Java Province.

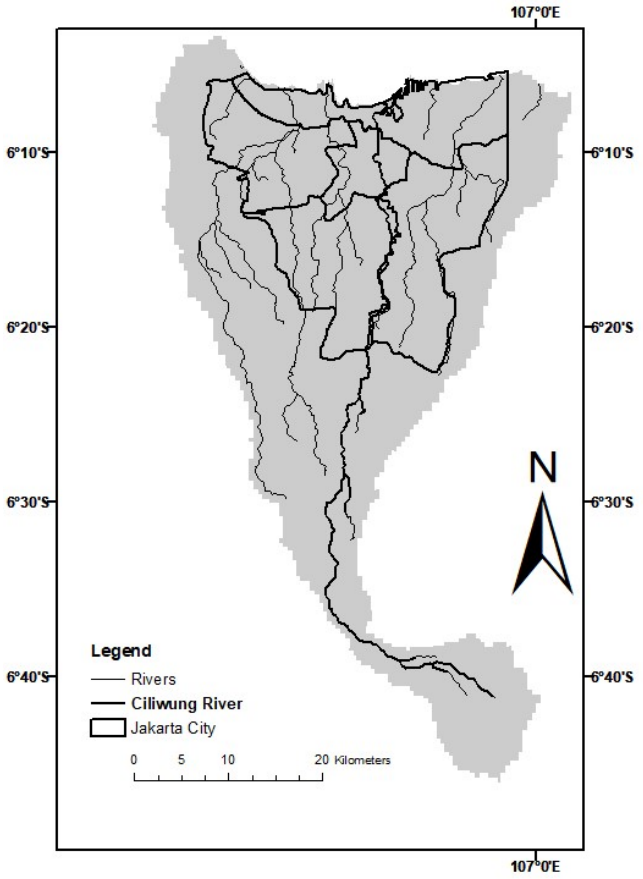

Fig. 1 Study Area

3. Methodology

1) Flood Inundation Model

This research investigated flood inundation situations in Jakarta based on rainfall-runoff [3)] and flood inundation model [3),4)]. The models consist of rainfall-runoff module at each sub basin, hydrodynamic module in the river and canal networks, and flood inundation module for the floodplains. The hydrodynamic module in the river and canal networks consist of continuous equation, and a momentum equation of steady flow (Saint-Venant equation).

2) Future land-use/cover changes

The urbanization has led land-use/cover changes on Ciliwung River basin. The compact and control growth are

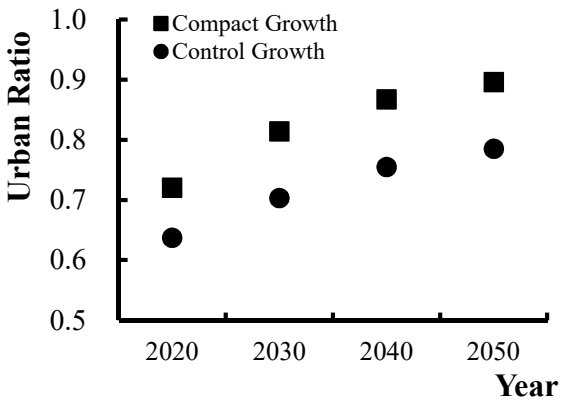

Fig. 2 Urban ratio scenario on the future period

scenarios of land-use/cover changes in the future period, as shown in **Figure 2**. The compact growth scenario was developed using the SLEUTH model[5]. The SLEUTH is a tool that can predict urban growth by using historical slope, land use, exclusion, urban growth, transportation, and hill shade data. Varquez *et al* (2017) applied SLEUTH to Jakarta under representative concentration pathways RCP8.5 and shared socio-economic pathway SSP1 scenario[5]. Compact growth was the urban situation under the RCP8.5 – SSP1 scenario[5]. The control growth scenario was made based on compact growth scenario. In the control growth, land-use in several sub basins were changed from urban to forest, then the urban ratio of control growth is lower than compact growth scenario for each year, as shown in **Figure 2.** From 2020 until 2050, urban ratio in Ciliwung river basin have been increased from 0.72 until 0.90 for compact growth and from 0.64 until 0.79 for control growth.

4. Results and Conclusions

The rainfall-runoff and flood inundation models have been used to investigate flood inundation situation at Ciliwung river basin by considering the land use change based on the SLEUTH model outputs.

Flood inundation areas of compact growth were increased from 64.90 km^2 for 2020 to 75.30 km^2 for 2050 as shown in **Figure 3**. Also, the flood inundation areas of control growth were increased from 62.71 km^2 for 2020 to 71.69 km^2 for 2050**.** As the result of analysis, we conclude that increased of urban ratios in Ciliwung river basin are increased the flood inundation areas. Also, the flood inundation areas of compact growth are higher than control growth of each year.

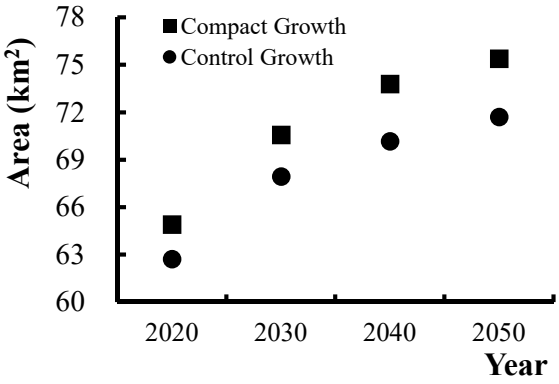

Fig. 3 Flood inundation area on the future period

5. Reference

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