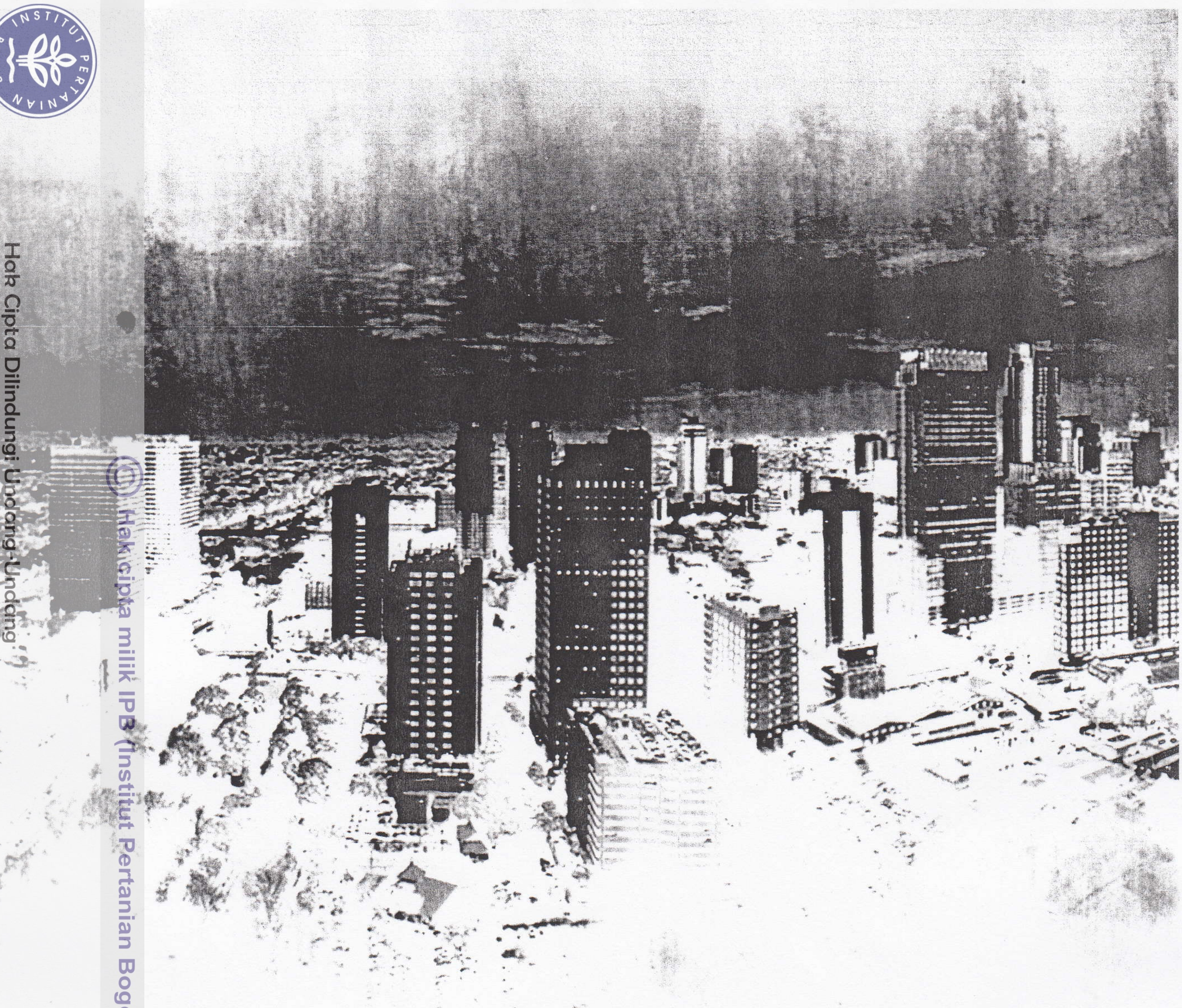

SUSTAINABLE MEGACITIES: vulnerability, diversity, and livability

IPB INTERNATIONAL CONVENTION CENTER
Bogor, 17 - 18 March 2015

Center for Regional System Analysis, Planning and Development
Bogor Agricultural University

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Foreword

More than half of the world's population now lives in urban areas. Rapid urbanization in Asian developing countries over the past half century has been followed by excessive urban population concentration in very large urban agglomerations, so called as megacities. The UN defined megacity as a metropolitan area /urban agglomeration complex with more than 10 million inhabitants. The number of megacities in the world has increased from 10 megacities in 1990 with 153 million of population or 7 percent urban population of the world to become 28 megacities in 2014 with 453 million populations or 12 percent urban population of the world. The United Nations expected that by 2050 about 66 percent of the world's population will live in cities (UN, 2014).

The rapid growth, high population density and high consumption rate of residents in megacities has led to a wide range of local and global socioeconomic and environmental impacts which requires attention from the global community. Therefore, it will significantly affect the future prosperity and sustainability of the world. The Greater Jakarta or Jabodetabek is experiencing continuous growth that seems to be an unstoppable phenomenon and at the same is facing various problems that may not have been experienced by other major cities in the world. The result of many studies showed that the carrying capacity of the environment, especially land and water in Java Island where Jabodetabek lies, is already overshot. However, given the relatively rapid growth of Mega Urban Jakarta, it is possible that Jakarta will grow to be the world's largest megacity.

Amid the global concern on the negative impacts of the continuing megacities' growth on global environment, the Center for Regional System Analysis Planning and Development (CRESTPENT/P4W), Bogor Agricultural University (IPB) has established Jabodetabek Study Forum since 2001. This Study Forum has conducted biennial international seminar on complex mega-urban issues on Asian megacities as well as urbanization and urban-rural linkages in Asian countries. The biennial conference has a tradition of organizing two types of paper presentations, namely scientific papers and community papers. This year's conference will also open a session for local government officials. This proceeding book covers papers from nearly all the presentations delivered during the conference.

We hope that this proceeding book will be able deliver the aims of the conference: to recognize multi-dimentional aspects, perspectives and knowledge on megacities; to communicate and facilitate experiences, policies, and studies related to challenges of continuing development of Jabodetabek and Asian Megacities, as well as solutions to address these challenges; and to bring up common understanding on the development of Jabodetabek and Asian Megacities.

Bogor, April 2015

Organizer

Content

Land-Cover Changes Analysis in Ciliwung Watershed Upstream for Flood Risk Reduction

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ABSTRACT

In Indonesia, flood is a national disaster which has the highest frequency of occurence (37%) during 1985 until 2014. Ciliwung watershed upstream hold an important role in protecting environmental quality for Bogor City and the capital city of Indonesia, Jakarta. Land cover change in Ciliwung watershed has led into increasing of build up area. As an impact, the land cannot infiltrate the water because of the impermeable layer. Therefore, land cover analysis should be done to measure the capacity of land cover for run-off reduction. The purpose of this research is to analyze land cover of Ciliwung watershed upstream in year 2010 related to run off for flood risk reduction. This research was done in Ciliwung watershed upstream, West Java, Indonesia. The data thathas been used in this study are secondary datas, such as land cover data year 2010 and administration boundary data, and precipitation data. The method which is used in this study is CITYgreen model. The methodology was divided into three steps, which are preparation, analysis and output. The results of this study showed that storage volume in Ciliwung waters hed upstream needed to mitigate the change in peak flow is 2.1703e+5 m^3. The Curve Number (CN) and the depth of run off are 76 and 3.48 cm, respectively. The economic value of Green Open Space in the study site is $135,328,710.88 or Rp 1,757,515,730,000.

***Keyword** : CITYgreen, Landsat, Run-off, Supervised Classification*

INTRODUCTION

Watershed is a terrestrial area which has a complete ecosystem from upstream to downstream. Part of ecosystems in watershed are influencing each other. If there are changes in the upstream, then it will affect midstream and downstream. Ciliwung watershed is one of important watershed which sustain the environmental quality of Bogor City and the capital city of Indonesia, Jakarta. Upstream watershed ecosystem become an important part because it has protectional function towards all parts of watershed (Asdak 2010). According to Decree of the Ministry of Foresty Republic of Indonesia, number: SK.328/Menhut-II/2009 about Determination of Priority Watershed within the framework of the Mid-Term Development Plan Year 2010-2014, Ciliwung watershed is included in the list of national priority watersheds.

Land cover change in Ciliwung watershed has been occured rapidly. The development of Ciliwung watershed upstream as tourism area with its supporting facilities increased the need of build-up areas. According the research's result from Ruspendi (2014), build up are known as the highest percentage of land cover change in Ciliwung upstream watershed is 11 percent. The increasing of the build-up areas will lead to the reduction of water catchment area.

Land cover changes can lead into ecosystem imbalance, which later on will be a main cause for disaster, for example flood. High amount of agricultural areas have converted into housing and industrial areas which is caused by high needs for those activities. Commercial agricultural activity has grown rapidly in the Southern of Jabodetabek (stands for Jakarta, Bogor, Depok, Tangerang and Bekasi), where it is a high terestrial area for water catchment area in Jabodetabek. Steep slope, high rainfall intensity, and intensive land cultivtion from seasonal plant has been intensified land erosion and run-off. At the same time, this lead into the decreasing of infitration rate into the soil. The high run-off in highland which is upstream area has led into higher erosion rate and also higher flood frequency in downstream (Jakarta city). In fact, erosion rate has reached up to 193 ton/hectare/year. This number exceed tolerance rate which is 14 ton/hectare/year. In total, agricultural activites has generated more than 500,000 ton sediment per year which is delivered by Ciliwung river, the main river in Jabodetabek area (Firman T, Dharmapatni 1994).

Flood is one of national disaster that continues to be highlighted in Indonesia, especially the capital city of Indonesia, Jakarta. According to National Disaster Mitigation Agency, flood in Indonesia has the highest frequency of occurrence (37%) comparing to other disasters during year 1985-2014. Flood has caused disruption of economy and damage of urban infrastructure in the downstream. Flood that happened in year 2013 in Jakarta has claimed 237,109 victims who had been displaced and 40 victims had died (National Disaster Mitigation Agency Jakarta 2013).

Based on Agency for Assessment Application of Technology (BBPT) which is cited in Sindo Newspaper (2014) stated that economical loss due to flood disaster in Jakarta in the beginning of year 2014 reached up to 12 billion rupiah. Flood that happened in Jakarta cannot be separated with the condition of Ciliwung upstream watershed, which is still going to get land cover changes. Identification of land cover change should be done to measure the distribution on land cover, which one is able to absorb the water yet also unable to absorb the water. Run-off is one of the main components of river hydrograph, which in flood analysis (Asdak 2010). Lack of water catchment area has caused an increasing run-off above the ground, which later becomes flood. Nevertheless, a study between land cover and run off should be done to prevent the flood risk.

Application of Geographic Information System (GIS) and Remote Sensing (RS) can be used as a powerful tool for analyzing and modeling an area for specific purposes. GIS and RS use a technology to arrange, visualize, and analyze physical phenomenon, events, and process to generate understanding and problem solving (Mc Elvaney 2012). CITY green is an extension inside GIS software, which has advantages as a tool for visualization, communication, and education in making model and scenario (American Forest 2002). CITY green can calculate the environmental benefits, which are given by a landscape, for example run off reduction. Run off analysis from rainfall in CITY green can be used to estimates vegetation impact, especially a tree which related to run off volume and peal flow. Percentage of changes in run off volume can be calculated automatically through comparing two different scenarios on the same site (American Forest 2002). This software is very simple and understandable, furthermore it use databases, which is derived from a long-term scientific research.

Application of CITY green in land cover studies has been used widely, for example land cover study and environmental impact analysis by Yuan *et al.* (2008), assessment on urban green open space in carbon fixation and run off reduction (Peng L, Chen S, Liu Y, Wang J 2008), environmental services and urban forest assessment in China by Jimdan Chen (2009) and watershed analysis by Bruns DA and Fetcher N (2008). Application of CITY green is also used by Fatimah (2012) as a tool to develop strategic policy to improve quality and quantity of Green Open Space.

However, there is still lack of research about land cover study in the response of flood disaster in Indonesia with using CITY green model. This application can present an illustration of landscape scenario to measure how much run off that can be reduced based on land cover characteristic. This study is a baseline study for a further temporal land cover change analysis. In the future, this study can give the best land cover scenario in preventing flood risk through a better visual presentation, yet also effective and rational. The purpose of this study is to analyze land cover in Ciliwung watershed upstream in year 2010 related to run off for flood risk reduction.

METHODOLOGY

This research was done in Ciliwung upstream watershed, which consists of City of Bogor and Regency of Bogor. Sub-districts in the regency are Cisarua, Megamendung, Ciawi and Sukaraja. Sub-district in the city is East Bogor. The annual precipitation rate is between 2,862 – 4,495 mm/year with an average 3,587 mm/year. The study site is shown in Figure 1. Software, which is used in this research, are ArcGIS 10.2, ArcView 3.1, and CITY Green 5.4 extension. The data that used in this study is land cover map which derived from Landsat ETM+ (path/row: 122/65) satellite image data year 2010, administration boundary map, and precipitation data. This study used a secondary data from Arkham (2011). Landover map was produced from Supervised Classification tool with Maximum Likelihood method. Precipitation data was obtained from previous research in Ciliwung riverbanks by Agung (2010).

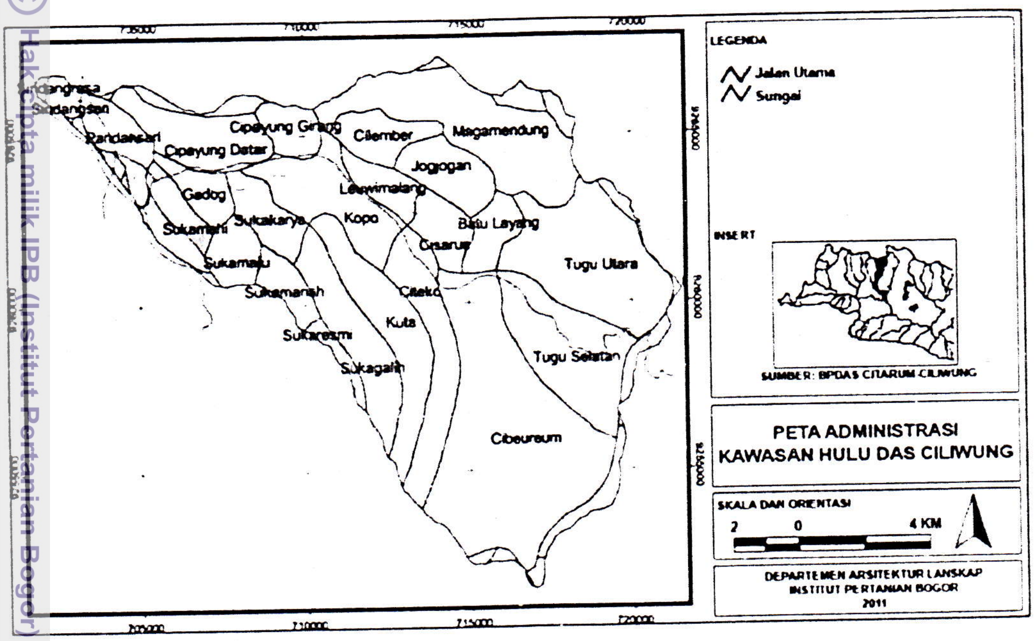

Figure 1. Study Site
(Source: *Hartanto* 2011)

The phase of this study is divided into three steps, which are Preparation, Analysis and Output. In preparation step, the data were collected and managed with using ArcGIS 10.2. Land cover classes were separated into each single land cover class data with using "Query" tool. After that, each single land cover class data was updated and renamed with using CITY green tool. Each land cover class was renamed with default CITY green land cover type. For example, Forest type was changed into "Trees", paddy field was renamed into "Cropland", etc. In analysis phase, when all data have been updated, we can measure the run off result with using "Analyze Data" tool in CITY green. In "Analyze Data" tool, we must set some preferences from the study site for determining the results, which are precipitation rate, average slope, rainfall region, and hydrologic soil group. After that, we can select "Run Analysis". Finally, the CITY green Analysis Report will be appeared in a new window.

RESULT AND ANALYSIS

CITY green's stormwater runoff analysis enables a user to map urban land cover features (grassland/shrub, trees, buildings, and impervious surfaces) and determine percentages of each land cover feature (American Forest, 2002). Based on CITY green analysis, the total area of Ciliwung watershed upstream is 13,234.63 hectares. Land cover distribution in Ciliwung watershed upstream were divided into six default CITY green classes: Water body, Paddy Field, Cropland, Urban area, Forest, and Shrub.

body has the lowest amount of area (47,397 hectares) and cropland has the highest amount of area (11,443.951 hectares).

From the CITY green analysis, we have generated some results, such as Curve Number (CN), depth of run off, and storage volume needed to mitigate the change in peak flow. For the current condition, the depth of run-off for the current land cover in Ciliwung watershed upstream is 1.37 inch or 3.48 cm. Curve numbers represent as the relative amount of imperviousness and water infiltration properties of soil and land cover. Curve numbers range from 30-98 the smaller the number the less the runoff (American Forest, 2002). The curve number for the current land cover is 76. This means that the study site has a high probability of run-off occurrence. In CITY green analysis, we also obtained a scenario result if the study site is in 'without trees" condition. If the study site has no trees, the depth of run off is 1.94 inch or 5.03 cm and the curve number is 84. This means that no trees lead to the increasing of run off.

The storage volume in Ciliwung watershed upstream needed to mitigate the change in peak flow is 217,030 m^3. From those numbers, CITYgreen was able to calculate a construction cost which is needed to mitigate the flood risk. The total construction cost for the study site is $135,328,710.88 or Rp 1,757,515,730,000. This cost also can be interpreted as the economic value of the Green Open Space in the study site. The CITY green result is showed in Appendix 1. A research was done in the same study site by Agustina (2013) which the Curve Number (CN) was calculated with using Soil Conservation Method (SCS). Comparing to her research, CN result showed the same number, which is 76. It means that the calculation of run off with using CITY green can be considered.

CONCLUSION

With an application of the CITY green model, the ecological benefits of green spaces in terms of storm runoff reduction of Ciliwung watershed upstream was studied. This study has generated some results such as Curve Number, Depth of Run-off, and storage volume that needed to mitigate the change in peak flow. From this result, CITYgreen can calculate the construction cost that needed to mitigate the flood. Therefore, this study is quite recommended in order to find the ideal land cover simulation model with the purpose of flood risk mitigation. This model can be used as a solution to reduce the construction cost. This study is still a baseline study, so we will use this result for a further temporal analysis of land cover in Ciliwung watershed upstream.

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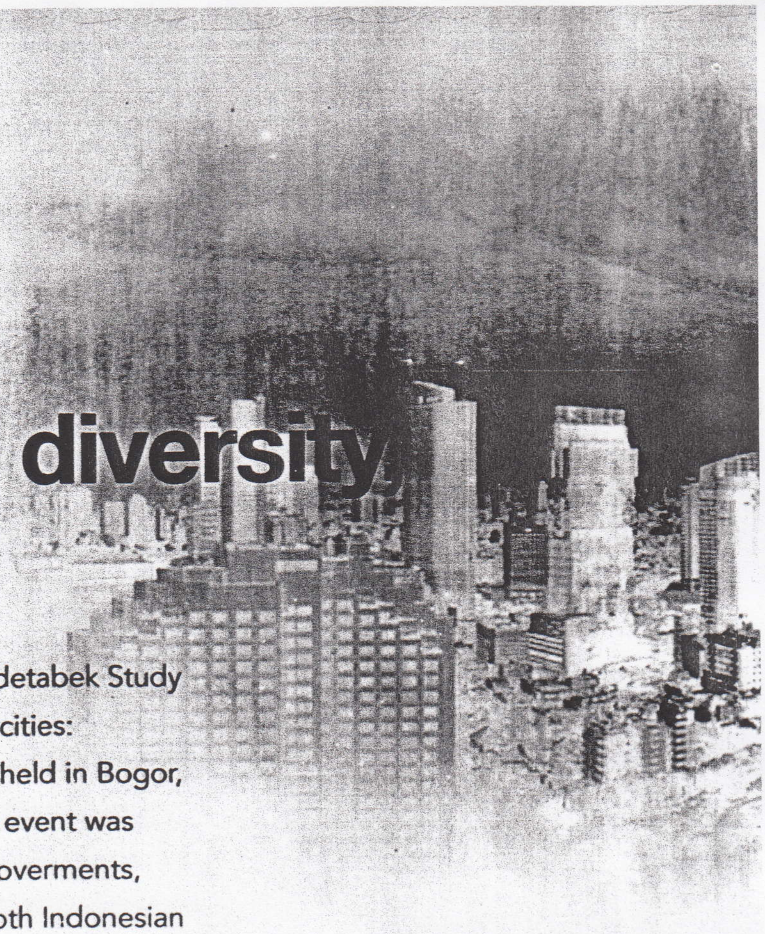

SUSTAINABLE MEGACITIES:

vulnerability, diversity and livability

The 5th International Conference of Jabodetabek Study Forum with the theme "Sustainable Megacities: Vulnerability, Diversity and Livability" was held in Bogor, Indonesia, during 16-18 March 2015. This event was attended by academicians, researchers, goverments, practicioners, NGO's and communities, both Indonesian and foreign participants.

The plenary lectures were delivered by four keynote speakers, which include the Minister of Agrarian and Spatial Planning, Deputy Governor of Jakarta Province, Head of Megacities and Global Environment Project RIHN Japan and Scientific Director of Future Cities Laboratory Singapore ETH Centre. This conference was attended by 92 presenters and 150 participants.

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