SUSTAINABLE MEGACITIES: vulnerability, diversity, and livability

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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

Analysis of Land Use and Cover Changes In Ciliwung and Cisadane Watershed In Three Decades

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ABSTRACT

The globalization and the developing of technology cause the increasing of human needs, which impacted to land use and cover change (LUCC), particularly in watershed area. Two watersheds have been investigating, namely Ciliwung and Cisadane watershed. The LUCC in those watersheds still continues since the growth of society and economy are increasing. Therefore, it needs a significance breakthrough to analyze the driving factors of LUCC. The aims of this research are 1) to monitor and analyze the LUCC, and 2) to figure out the driving factor of the LUCC. The outputs are LUCC maps, spider web diagram and the driving factor of a change during three period of time, i.e. 1978, 1995 and 2012. The LUCC and its driving factors were analyzed through Landsat satellite image. The results show the LUCC are always changed during those periods. The LUCC in those watershed following several processes and in the end changed into settlements and dry lands, predominantly.

Keywords: driving factors, geographic information system, landsat image, logistic regression analysis, watershed management

INTRODUCTION

The fulfillment of community needs always grow and demanding. Those impacts the excessive nature exploitations. One of those impacts can be found in Ciliwung and Cisadane Watershed. The land use and cover change (LUCC) impacted the remain forest only left 12.0 percent in Ciliwung and 36.6 percent in Cisadane watershed (Ministry of Environment, 2010). The excessive change influences the water quality[1], decreasing ecological condition[2-4], giving negative effect to next generation. One of negative effects of LUCC is increasing carbon emissions because reducing area that serves as a regional carbon sequestration[5]. Those negative effects can be minimized by a robust watershed management[6] through geographic information system (GIS) technology. This technology gives information about the occurrence of LUCC remotely of the area to be examined.

This research are planning to achieve goals, i.e. 1) classifying the major changes of LUCC and 2) determining the driving factor impacting on LUCC. The classifying are derived from Landsat image of three periods, i.e.1978, 1995 and 2012. The driving factor are calculating statistically using auto logistic regression[7].

METHODOLOGY

Location

This research was carried out in Ciliwung and Cisadane watershed (Figure 1). The geography, location and boundaries of those watersheds are presented in Table 1. The data acquisition are shown in Table 2.

Table 1. The general information of Ciliwung and Cisadane Watershed

Name of Watershed	Geography Location	Area (ha)	Administrative Regions
Ciliwung	06° 06' 00" - 6° 46' 12" S and 106° 48' 36" - 107° 00' 00" E	38,610.25	Bogor District, Bogor City, Depok City, and Jakarta Province
Cisadane	06° 37' 48" – 6° 46' 12" S and 106° 49' 48" – 107° 00' 00" E	151,808.00	Bogor District, Bogor City, Tangerang District, and Tangerang City

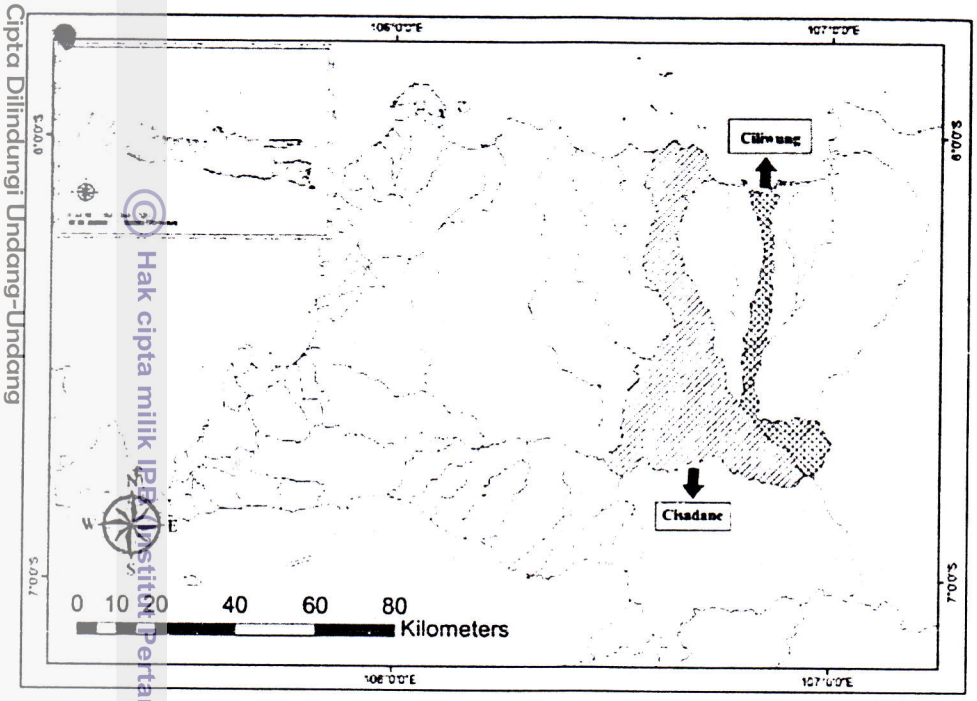

Figure 1. Land use and cover change for Cimandiri and Cibuni Watersheds

Table 2. Landsat Data Acquisition

Landsat Data	Acquisition Date
LANDSAT1 MSS	July 17th, 1978 Path 131 Row 065 July 17th, 1978 Path 130 Row 065
LANDSAT5 TM	August 8th, 1995 Path 122 Row 065 July 25th, 1996 Path 122 Row 065
LANDSAT7 ETM+	May 26th, 2012 Path 122 Row 065

Research methods

The methods used are:

1. Inventory: the compilation of required data for research. The data were obtained by compiling spatial information and field survey check. The spatial information[8] was obtained through Landsat imagery for three periods, i.e.1978, 1995 and 2012 which were used to perform the comparison of the LUCC. The field survey check[9] was conducted by taking 15 sampling of each land use/cover classification.
2. Analysis: the examining of training area followed by classification of supervised classification, prediction accuracy, detection of change of land use/cover and determination of the driving factor.
3. Stepwise regression analysis: the clarifying of correlation of six variables, i.e. rainfall, soil type, slope, population, population density, and the distance to the city center.

Land use and cover identification and changes during three times

Based on image classification, all of land use and cover class in Ciliwung and Cisadane watersheds always changing (Figure 2). Ciliwung watershed is dominated by built up area and Cisadane watershed is dominated by dryland area.

Driving factor

The results of LUCC that occurred during three periods are correlated with six variables. The equation of linear regression using the stepwise regression through logistic regression analyses (LRA) method (Table 3). Our finding shows five variables are impacted the LUCC of Ciliwung watershed, while there are three variables that effect of the LUCC in Cisadane watershed (Table 4). It means the variables of population density, the distance to city center and precipitation should be considered in government development programs in order to detain the LUCC acceleration. In addition, those programs should figure out that the LUCC is the result of the complex interactions between behavioural and structural factors (drivers) associated with the demand, technological capacity, social relations and the nature of the environment in question[10]. On the other hand, this research results in compliance that climate-driven land-cover modifications interact with land-use changes[11].

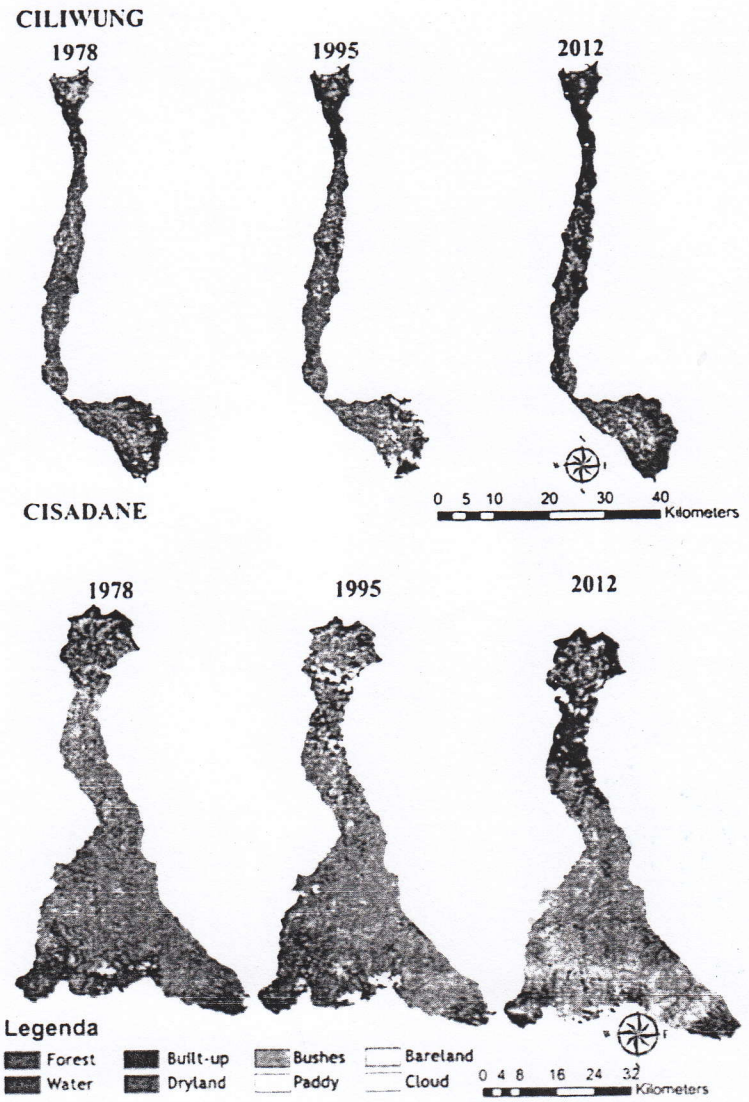

Figure 2. The LUCC of Cimandiri and Cibuni watersheds during three periods

Table 3. The result of LRA method for the correlation of the LUCC

Name of Watershed	Period	Equation
Ciliwung	1978-1995	$Y = 0.100 + 0.156 X_1 - 0.11 X_2 - 0.001 X_3 - 0.010 X_5 + 0.670 X_6$
	1995-2012	$Y = 75.190 + 1.410 X_1 - 0.630 X_2 - 0.070 X_3 - 0.700 X_5 + 12.540 X_6$
Cisadane	1978-1995	$Y = 166.950 + 12.840 X_1 - 7.300 X_5 - 614 X_6$
	1995-2012	$Y = 268 + 2.130 X_1 - 6.720 X_5 - 1332 X_6$

Table 4. The LUCC driving factors of Ciliwung and Cisadane Watershed

Name of Watershed	Rainfall (X_1)	Soil type (X_2)	Slope (X_3)	Population (X_4)	Population density (X_5)	The distance to the city center (X_6)
Ciliwung	(+)	(-)	(-)	no	(-)	(+)
Cisadane	(+)	no	no	no	(-)	(-)

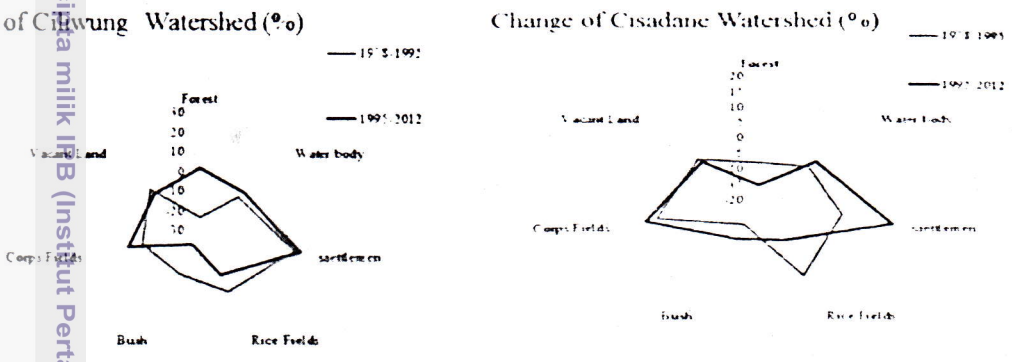

Figure 3. The LUCC Spider Web Diagram of Ciliwung and Cisadane Watershed

CONCLUSIONS

Some of the conclusions are as follows:

1. Based on the results of the land use/cover classification in 1978, the largest is bushes, while water bodies continued to decline from 1995 to 2012.
2. The LUCC of 1978 to 1995 noted that the changing is 64.83 percent while not changing is 35.17 percent. In addition, the LUCC that occurred in 1995 to 2012 is 56.04 percent, while not changing is 43.96 percent.
3. The method of LRA by using stepwise regression produces five variables that influence the LUCC. Five variables impacted to the LUCC of Ciliwung i.e. precipitation, soil type, slope, population density, and distance of the city canter, while three variables that affect the Cisadane watershed are precipitation, population density, and the distance to the city center.

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