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THE ABILITY AND SUITABILITY OF URBAN PARK FOR SUPPORTING WATER CONSERVATION CASE STUDY: JAKARTA

BY

MUHAMMAD KOESWADI

INTERNATIONAL ISLAMIC UNIVERSITY
MALAYSIA

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International Islamic University
Malaysia

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ABSTRACT

The crisis of freshwater has been occurring in the world including Indonesia. Up to now, almost two-thirds of Jakarta's inhabitants and other big cities of Indonesia still rely on the shallow groundwater individually as source of freshwater. The problem is that they always suffer from drought regularly due to the decreasing water table levels in their surroundings. Precisely, the problem relates with the absence of well-planned urban ecosystem. The condition of shallow groundwater is affected by related factors of population density, land use, and green space elements mainly the urban parks. Through the interpretation of the Qur'ānic verse (*an-Naml*: 60) and utilisation of the Zalewski's 'eco-hydrology' concept that stresses the relationship between vegetation and hydrology, this study explores water conservation through urban park. The research method covers observation of the urban parks condition in Jakarta and measurement of the soil water status on roots zone beneath the vertical class of vegetation in Ragunan and Pondok Kopi Parks (2004-2005). The study concludes that urban park has ability and suitability to conserve water. The bigger the urban park is the better for water conservation purposes. Regarding with water status as well as roots zone volume of selected species, tree is more valuable for water conservation than shrub, grass, and bare land. Besides, the study introduces the interlinking parks model that connects to green space elements for improving urban ecosystem including groundwater properly. Hence, this study is useful to add the roles of urban landscape planning, water conservation, urban development policy and urban ecosystem. It is also academically worthy of support since it could help disseminate ideas on Islamisation of knowledge. **Keywords**: urban ecosystem, water conservation, eco-hydrology, urban park, and roots zone.

ملخّص البحث

إن أزمة الماء الصافي قد اجتاحت العالم ومن ضمنه إندونيسيا، خاصة مدينة جاكرتا، حوالي ثلثي سكان هذه المدينة حاولوا الحصول على الماء الصافي من ينبوع الأرض بطريقتهم أنفسهم، ولكن للأسف حال ذلك الماء قد انتقص جودةً وحجمًا من حين إلى آخر، وذلك نتيجة ارتفاع عدد السكان فضلاً عن ضيق المساحات الخضراء وندورتها، مثل حدائق المدينة ليترسب من خلالها المطر، أوما يتعلق بالنباتات، فإن حديقة المدينة تمثل وسيلة في غاية الأهمية وذات وظيفة بيئية (ecology). وما يتعلق بـ ecohydrology (إيكوهيدرولوجي)، فإن جذور النباتات تمثل جزءًا مهمًّا لعملية تعبئة الماء في داخل الأرض. والإفساد في حديقة الأرض سيترتب عليه زعزعة نظام البيئة واضطرابها. وإلى حد الآن فإن الدراسات التي تتعلق بحديقة المدينة والماء في داخل الأرض تعتبر دراسة نادرة، وألهمت هذه الدراسة من تدبّر الوحي القرآني في سورة النمل الآية 60 والتي تتحدث عن البيئة؛ وفيها وجود عنصر الماء، وحديقة المدينة، والأشجار، وأخلاقيات الناس المنحرفة تجاهها. ثم تحاول الدراسة اختبار هذه الآية وفق التطبيقات الهندسية باستخدام الطريقة الإجمالية العامة مما يتعلق بإيكوهيدرولوجي في ولايات المدينة، والطريقة الخاصة الدقيقة مما يتعلق بخصائص الماء في منطقة جذور النباتات. والدراسة التحليلية للحدائق المدنية في جاكرتا باستخدام أدوات تقنيقية neutron probe وtensiometer قد أُجريت فيها في فترة ما بين 2004-2005. وقد اكتشفت الدراسة أنه كلما كانت الحديقة أوسع مساحة فهي أفضل نتيجة لارتفاع مستوى خزانة الماء في داخل الأرض. والموضة للحدائق المرتبطة من حيث نباتاتها في تلك المدينة سترفع مستوى جودة البيئة في المدينة منها مستوى جودة الماء في أرفع مستويات، علماً بأن الأشجار أكثر حفاظاً على الماء من حفاظ الشُجَيرات، والأعشاب (الأبّ)، والأرض الميت عليه. واكتشفت الدراسة كذلك أن الحجم الجذوري تحت الأشجار في مساحة معينة من الأرض في الغالب أكثر بحوالي سبعة أضعاف للحفاظ على الماء إذا قورن بحجم الجذور للشجيرات أو بخمسة أضعاف من حجم الجذور للأعشاب. وحركة الماء في داخل الأرض تحدث في داخل الأرض بمقدار 50-70 سنتيمتر وتمثل في حركة التركيز لنقطة معينة أو الانتشار منها. لذلك هذه الدراسة مهمة لتقوية أسس التخطيط البستاني، وضبط نظام ماء الأرض، واالسياسة العمرانية فضلاً عن الحث على نشر إسلامية المعرفة.

الكلمات المفتاح: أزمة الماء الصافي، الحفاظ على الماء، إيكوهيدرولوجي، الحديقة، الشجر، منطقة الجذور.

APPROVAL PAGE

The thesis of Muhammad Koeswadi has been approved by the following:

_____
Ismawi Hj Zen
Supervisor

_____
Mansor Ibrahim
Supervisor

_____
Alias Abdullah
Internal Examiner

_____
Mohd. Sarofil Abu Bakar
External Examiner

_____
M. Ibrahim Zein
Chairman

DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

Muhammad Koeswadi

Signature …… Date ……..…….

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Affirmed by Muhammad Koeswadi.

…….. ……..

Signature Date

Dedicated to Allah swt., and to those who reflect…

"Is not He Who created the heavens and the earth, and sends down for you water from the sky, whereby We cause to grow wonderful parks full of beauty and delight? It is not in your ability to cause the growth of their trees. Is there any ilaah (god) with Allah? Nay, but they are a people who ascribe equals (to Him)!"

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Ālhāmdulillāh, praise be to Allah SWT who has granted me the opportunity to conduct this study that benefits from His signs, literal and natural. It was a special moment for me when I managed to begin and to have further completed my study. The main reason of writing the thesis entitled "The Ability and Suitability of Urban Park for Supporting Water Conservation, Case Study Jakarta" was chiefly motivated by the eagerness to explore the Qur'ānic verses literally and naturally, as stated in *an-Naml*: 60 "…It is not in your ability to cause the growth of their trees.…"

IIUM, a campus highly spirited with the mission of creating a Garden of Knowledge and Virtue, enabled me to seek to comprehend Qur'ānic verses in technical perspective. Why is it important that Allah cite the trees rather than other kinds of vegetations? In the efforts of discovering this secret, a number of urban parks and vegetations researches especially ones related to the water conservation measured with various equipments and laboratories were conducted. Findings of the research are expected to provide significant contributions to overcome freshwater problem and efforts of developing urban ecosystem in Jakarta.

In the efforts of completing my study, I received meticulous field supervision from Dr. Kasdi Subagiyono, Head of Department of Hydrology and Agro-climate, Department of Agriculture, Republic of Indonesia, to whom I express my deepest gratitude for his patience. This study has been polished through the aid of conception and fundamentals of research shared with Prof. Ismawi Hj. Zen (main supervisor) and Prof. Mansor Ibrahim (co-supervisor). I am indebted to them for their supervision and their support to equip me with "Islamic knowledge development." I have a very high regard to both Prof. Alias Abdullah and Assoc. Prof. Mohd. Sarofil Abu Bakar, as internal and external readers respectively, for their painstaking efforts and critical comments that helped me to understand more clearly the crucial matters being discussed in the thesis. I extend my thank to Assoc. Prof. Maisarah Ali, Deputy Dean of Kulliyah of Architecture and Environmental Design IIUM and Dr. Sohirin M. Sholihin, Head of Department of Qur'ān Sunnah, Kulliyah of Islamic Revealed Knowledge and Human Science IIUM. I am also thankful to my colleague in career, Mr. Rifandi and Mr. Aidid Gaffar, for the facilities rendered to me so that I can manage to complete my thesis writing smoothly. My colleagues, to name a few, Ust. Muntaha, Ust. Khairul Fuad, Ust. Furqon, Br. Dody, and Br. Nanang, deserve my utmost appreciations for their availability to discuss and share their thoughts and ideas that helped to complete my study. I do apologize for the inability to include all parties here who have contributed in various ways. Allah SWT alone is the giver of bounties without measure.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

By 1900, 14 per cent of the world's population were already leaving in urban centres. After the 1950s, this proportion increased rapidly (close to 50 per cent today),[1] with 70 per cent of that increase occurs in Western Europe.[2] Consequently, there was an upsurge in urban housing developments that were also incorporated with some aspects of urban economic activities, energy source and human's basic needs. To ensure the sufficiency and competency of these aspects, local governments should provide proper and detail mechanism to control the land use planning and the allocation of development directions. Without it, the urban environmental equilibrium will be seriously affected.

A case in point is when due to the population explosion, more agricultural lands were continually converted into built up areas in favour of expanding the urban neighbourhood. The practice could hardly be stopped and directed properly. As the greed for domestic housing grew, most stakeholders of urban development ignored the existence of necessary green spaces that were manifested in the form of greenbelts, urban parks, urban forests, and the like. Fazal[3] had predicted that by the year 2000, the amount of agricultural land loss in the cities would be more than 476,000 ha, annually, especially in low-middle income countries. Additionally, according to

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[1] Shahab Fazal, "Urban expansion and loss of agriculture land – a GIS based study of *Saharanpur* City, India," *Environment & Urbanization,* vol. 12, no. 2 (2000): 134; See also William B. Honachefsky, *Land planner's environmental handbook*, (New Jersey: Noyes Publications, 1991), 32.
[2] Karen Attwell, "Urban Land Resources and Urban Planting –Case Studies from Denmark," *Land scape and Urban Planning Journal*, 52, (2000): 146.
[3] Fazal, 134.

Wong,[4] there is a trend in urban development towards super high-rise, high-density living and working. The implication on the urban green space is the decrease of urban parks, urban forests, protected hazardous zones, and cutting down roadside trees gradually. Water deterioration, flooding, and urban sedimentation are just some examples of the direct impacts of disrespecting and neglecting the environmental equilibrium.

Efforts to promote environmental equilibrium will be challenging to implement due to the people's lack awareness on ecological advantage. Such cases have been found in many big cities of Indonesia, such as in Bandung, Surabaya, Medan, and Jakarta. All those cities are categorised with high density population and each is occupied by more than two million people. Jakarta, as an example, with an approximate of 8.0 million people (2004), is one of the metropolitan cities located in the equatorial zone[5] that suffers from freshwater deficiency. As the capital city of Indonesia,[6] Jakarta is officially named DKI Jakarta Raya (around 664.5 km^2) with five municipalities: Jakarta Pusat (Central Jakarta), Jakarta Barat (West Jakarta), Jakarta Utara (North Jakarta), Jakarta Timur (East Jakarta), and Jakarta Selatan (South Jakarta). According to the statistical data of Jakarta (2004),[7] the total green space (minus the agricultural land) is around 20.76 km^2 or 0.3 per cent of Jakarta region. From that, around 15.06 km^2 (72.5 %) is allocated in the South and East Jakarta municipalities.

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[4] K.M. Grace Wong, "Vertical Cities as a Solution for Land Scarcity: the Tallest Public Housing Development in Singapore," *Urban Design International Journal*, 9, (2004):19.
[5] Equatorial zone is the region of 11^0 NL (North Latitude) to 11^0 SL (South Latitude).
[6] DKI Jakarta - *Daerah Khusus Ibukota Jakarta Raya* - is the official name of capital city of Indonesia that region administratively located in $106^0$45'– $106^0$52' East Longitude (EL) and $6^0$12'- $6^0$25' South Latitude (SL). From now and after it is called Jakarta.
[7] Centre of Statistic Board, Jakarta, *Jakarta in figure-2004.* (Jakarta: Author, 2005).

Morphologically, Jakarta is classified as a plain-region with a slight incline slope to the southern region. The pattern of city development had historically begun from the port in the northern region of Jakarta (1527) then shifted to the centre (1945), which was dominated by civic and municipal complexes. Later, it was further expanded to cover the corridor of the 'east-west wing region' (1960s) which was mainly housing estates and mixed land uses. Finally, it ended up in the southern part (1965), which was more of an agricultural land. The 'greening programme' of Jakarta has designated part of the southern region of Jakarta as water catchments area.[8]

By 1961, the population of Jakarta was 2.9 million people. It had increased rapidly between 1971 and 1985 to become 4.5 and 7.6 million people.[9] In 1999, there were 9.2 million people, and in 2004, due to the national economic crises, the number of registered citizens had decreased to around 8.0 million. Although, there were around 12.1 million people living and working in the city[10] during day time, the average density of Jakarta was 12,000 people per km^2. In short, since 1999, calculations showed that the average population growth of the city had declined from 4.4 to 2.1 per cent per year. This urban population decrease in Jakarta was caused by the high living cost; the fast growing urban infrastructures mainly toll roads in its hinterland and satellite towns; and the spread of modern facilities, such as mall complexes, have reached the fringes of Jakarta.

The economic activities increased tremendously following the fast population growth of Jakarta in the era of 1980s until 1990s. The consequences of these were that many new high-rise buildings and housing estates were built rapidly and were

[8] Pemerintah Daerah DKI Jakarta, *RUTR Rencana umum tata ruang kota DKI Jakarta 1965-1985* [General plan of DKI Jakarta province 1965-1985] (Jakarta: Author, 1965), 59.
[9] Pemerintah Daerah DKI Jakarta, *Master plan of Jakarta 1985-2000* (Jakarta: Author, 1985), 17; also see Pemerintah Daerah DKI Jakarta, *Master Plan of Jakarta 2005* (Jakarta: Author, 1987), 10 and 31.
[10] Centre of Statistic Board, Jakarta, *Jakarta in figure 2004* (Jakarta: Author, 2005), 26.

scattered in the west and southern regions. As an implication of this growth, many agricultural lands in the outer ring road had quickly been converted into housing estates, apartments, hotels, offices, shop-houses, shopping malls and others. As a result, the enlargement of urban built up area in Jakarta had almost doubled, from 35,000 ha in 1987 to 66,450 ha in 2004.[11] Although the documents of the 'Master Plan of Jakarta' had stated that the southern regions were dedicated to cater for the maximum population density of 15,000 persons/km^2,[12] the actual average density is now very high - around 18,200 persons/km^2 or 182 persons/ha (as reflected during daylight working hours). It means that the number of people per unit space is beyond the approved amount.

Either to anticipate the acceleration of developments or to accommodate the rapid growth of population, the local government of DKI Jakarta province had issued a number of environmental regulations. Some important regulations to control and supervise physical developments related with water conservation are the 'Master Plan of Jakarta' in several periods of 1965-1985, 1985-2005 and 1999-2010; the Local Act (*Perda*) No. 93/76 of the Building Coverage Proportion to its lot called 'KDB' or *Koefisien Dasar Bangunan* (see chapter I, articles of 21, 38 and 42 of Master Plan of Jakarta, 1999-2010) and the Local Act of the 'Groundwater Conservation Region.'[13] These regulations were aimed to establish and protect the condition of groundwater body system. For instance, the volume fluctuation of shallow groundwater as the source of freshwater for people is influenced by the land surface condition, mainly land coverage system such as urban parks and other green spaces.

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[11] Pemerintah Daerah DKI Jakarta, *Master plan of Jakarta 2005,* 2.
[12] Pemerintah Daerah DKI Jakarta, *Master plan of Jakarta, 2005*, (Jakarta: Author, 1987), 21.
[13] See hydrological map of 'Jakarta sheets *1209-4 Jakarta, scale 1:100,000*' by Directorate of Environmental Geology, Republic of Indonesia, *Hydrological map of Indonesia,* (*Bandung:* Author*,* 1993).

Urban parks as an urban landscape feature perform many functions such as recreation, wildlife habitat,[14] and urban facilities. As a part of urban facilities, they are scattered from the inner cities to the fringe areas. Generally, they appear to provide aesthetical function rather than an ecological one. For that reason, most people only derive the psychological rather than ecological advantages from the existence of the urban parks. Furthermore, because urban parks have a lot of developmental potential and occupy many prime locations, many private enterprises try gain only economic advantage from them without regard for the urban parks necessary ecological existence. In short, they thought that the land is valuable because of its developmental potential. However, urban parks are valuable spaces for the interaction among vegetations, soil, and water. In terms of water conservation, urban parks can be utilised as an urban watershed. The protection of the storage for shallow groundwater is absolutely vital in order to overcome the problem of freshwater for the people whose needs are not well-served by the urban water pipe system.

1.2 PROBLEM STATEMENT

Rapid developments in Jakarta have led to the drastic decrease of green space. Even, the local government's commitment on green space as legalised by the Master Plan of Jakarta has ignored either the quantity of space or the quality of distribution especially with regards to the existence of urban parks. Many environmental problems have emerged particularly regarding the groundwater recharge.

The brisk pace of urbanisation has led to the skyrocketing of land prices. The increase in population by urbanisation dramatically pushes the need for space to increasingly develop housing areas. On average, the housing areas in Jakarta, as well

[14] William D. Solecki and Joan M. Welch, "Urban parks: green spaces or green walls," Landscape and Urban Planning 32, (1995): 93.

as other big cities of Indonesia occupy around 60-70 per cent of the urban area. Furthermore, due to the heavy demands for housing, many speculators and developers after purchasing farmlands, leased out the farming status to preserve the tax benefits until the lands are subdivided. This was indeed seen as a lucrative financial move by many people who were interested in big profits. Therefore, developers and owners of the lands began to think of the prices of the remaining lands that had not been developed yet. The estimated loss of urban park space due to urban expansion in Jakarta was about 0.57 per cent per year or 7.4 ha during in 1965 and 2005. The decreasing green space proportion in the Master Plans reflects the superficial perception of the government and the people toward the green city spirit. This condition will threaten the quality of the urban environment mainly by increasing the temperature, the rate of flooding, and decreasing water table.

Within three decades, the green space of Jakarta has shrunk drastically either in the urban parks, conservation zones, or in the hazardous zones of riverbanks including areas under electric power lines and railways fences. Hundreds of hectares of these areas have been converted into illegal developments such as urban infrastructures, buildings, illegal housings, and slums. The culprits behind these problems are the developers, the people, and even the local governments. Although the local government has established several regulations to implement water conservation, thousands of trees either belonging to the government or private owners have been cut for the expansion of buildings and housings without any appropriate tree replacements. The implication of it is as Jellinek[15] stated: "…so, Jakarta in dry season

[15] Lea Jellinek, "Jakarta, Indonesia: Kampong culture or consumer culture" in *Consuming cities,* edited by Nicholas Low, Brendan Gleeson, Ingermar Elander, and Rolf Lidskog (London: Routledge, 2000), 278.

becomes hotter, harsher, and to face a fresh water problem permanently. In the wet season many places are flooded."

The local government has revised the 'Master Plan of Jakarta, 1999-2010' that also highlighted the proportion of green space in Jakarta. However, it has a merely 13.9 per cent of the total size of Jakarta,[16] while, the previous documents either in the 'Master Plan of Jakarta, 1965-1985,' had stated that the size of green space was 37.2 per cent, or in the continuous period of the 'Master Plan of Jakarta, 1985-2005' remained around at 25.8 per cent, this figure was actually bigger.

The decrease in green space affects the existence of urban parks and hazardous zones. Specifically, many urban parks have been turned into apartments, government offices, stalls, slum houses, and other man-made infrastructures. The cases in point are the apartment buildings in Tebet Park, the gas stations in Gunung Agung Park. These areas were previously part of the green space which functions had been transformed into other economic purposes. The decrease in green space has also resulted from the alteration of the space into a non-economic purpose such as the following: the State Secretary building was established at the heritage area of the 'Harmony Park' and the high-rise building of the local government office of South Jakarta was built at the area of the cemetery and flood control pound. Besides, the degradation of urban park quality has also occurred in the national sports complex in the Senayan area, where an abundant of trees had been converted into a lawn for the driving range. Some environmentalists had delivered criticisms to address the seriousness of these incidents. Subsequently, there exist the polemics between many professionals on the option of vegetation type that are better for water conservation purposes, in particular between the trees and the grasses.

[16] Pemerintah Daerah DKI, *RUTR, Rencana umum tata ruang kota* 2010, [Master plan of Jakarta, 2010], (Jakarta: Author, 1999).

This circumstance parallels with what Kondoh and Nishiyama[17] postulated, that urbanisation reduces evapo-transpiration process and groundwater recharge, but increases indirect runoff, which consequently leads to the drying up of wells, the emergence of urban flooding, and others. It is understandable that many existing and functional urban parks and green spaces will probably be gradually converted into other land uses of impervious surfaces such as housings, apartments, offices, and shopping complexes. As a result, the proportion of green space per administrative boundaries expansion is steadily shrinking. Woudstra and Fieldhouse[18] also stated: "…too often conservation is seen as standing in the way of urban development. The evidence however contradicts this." Moll[19] commented: "investors do not build urban infrastructure to fit their environment, but they build it according to standardized engineering and financial scheme." As mentioned previously, the limitation of urban space, the principle of product efficiency, and the high price of land, has led the stakeholders of development (especially the local government and investors) to exploit the potential of green spaces as land saved for future developments. The outcome of such avaricious attitudes is the shrinking of precious vegetated land. In addition, the local government did not spare the much consideration in response to the people's mislead perceptions as well as to the building encroachments. So, planning ethics must be initiated for they are essential for development actors to observe and serve appropriately.

[17] A. Kondoh and J. Nishiyama, "Changes in hydrological cycle due to urbanization in the suburb of Tokyo metropolitan area, Japan," *Adv. Space Res.* vol. 26, no. 7 (2000): 1173.
[18] Jan Woudstra and Ken Fieldhouse (Eds.), *The regeneration of public park*, (London: E & FN Spon, 2000), 18.
[19] Gery Moll, "Urban forestry: a nation initiative" in *Urban forest landscape: Integrating multi-disciplinary perspectives*, edited by Gordon A. Bradley (Seattle: University of Washington Press, 1995), 13.