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研究課題名(和文) A comparative sustainability study of rapidly growing megacities in Southeast Asia (Bangkok, Jakarta and Manila) using geospatial and social-ecological approaches

研究課題名(英文) A comparative sustainability study of rapidly growing megacities in Southeast Asia (Bangkok, Jakarta and Manila) using geospatial and social-ecological approaches

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研究成果の概要(和文)：東南アジア諸国では、経済のグローバル化を背景に、メガシティへの人口集中が加速している。水平的都市化に加え、最近では垂直的都市化が急速に進み、人口高密度な都市空間が形成されつつある。この状況を踏まえ、本研究では、バンコク、ジャカルタ、マニラの三大成長都市を中心に、GISとリモートセンシングの技術を援用して、都市化の実態を土地利用変化から定量的に把握するとともに、その規定要因を探った。三つの都市で、大都市圏化のメカニズムが異なることが明らかになった。

研究成果の概要(英文)：Comparative analysis was performed, focusing on the spatiotemporal patterns of urban land changes and their implications for sustainable urban development in the three cities. The details of the analysis can be found in Estoque RC, Murayama Y (2017) Trends and spatial patterns of urbanization in Asia and Africa: a comparative analysis. In: Y Murayama, C Kamusoko, A Yamashita, RC Estoque (Eds) Urban Development in Asia and Africa: Geospatial Analysis of Metropolises. Springer, Singapore, pp 393-414. In brief, the analysis revealed that the urban land of Bangkok has increased by 1401 square km over the past two and a half decades (c. 1990-2014), while the urban lands of Manila and Jakarta have increased by 393 and 312 square km. In terms of percentage increase, Bangkok also had the highest (198%), followed by Jakarta (100%) and Manila (86%). The study hypothesizes that these three cities might have already undergone through the alternating process of diffusion-coalescence many times.

研究分野：空間情報科学

キーワード：GIS リモートセンシング 空間解析 東南アジア メガシティ 都市化 比較分析 持続可能性

1 . 研究開始当初の背景

At the current stage of our geological epoch, the Anthropocene, we are entering an urban era. From about 52% in 2010, the world urban population is projected to be at about 67% by 2050. It has also been projected that rapid urbanization will happen in the developing countries, including those in the Southeast Asian region, whose urban population is projected to increase from about 44% in 2010 to approximately 66% by 2050. This shows that urban landscapes are continuously becoming more and more important for the everyday living of the majority of the population in the Southeast Asian region in particular and the global population in general.

Amidst this trend, there is a growing concern about the rapid and unprecedented land changes (i.e. land-use/cover changes), as well as the consequent degrading environmental quality and worsening overall livability of urban areas, including those in the Southeast Asian region. The continuous decline of natural resources (e.g. valuable urban green spaces) due to the rapid land changes and growth of urban areas poses various challenges in ensuring and sustaining environmental quality and human well-being in cities. Apparently, there is a need to push for an urban development that could support and promote sustainable urbanization, a type of urbanization that is characterized by having a well-balanced relationship between the environmental, social and economic dimensions of a society. To help achieve this goal, there is a need for a comprehensive study that could provide valuable insights on the social-ecological status and sustainability trajectories of these urban areas.

There has been a growing interest on the ecological dimension of urbanization, but this is

still young and immature in many aspects, e.g. theoretical, conceptual and analytical frameworks. In the contexts of urban ecology, global environmental change, land change and sustainability studies, the social-ecological system approach, also known as the coupled human-environment system approach, can offer a new understanding of the complexities of urban ecosystems.

2 . 研究の目的

The purpose of this research is to examine and compare the social (including socio-economic, urban volume and spatial structure) and ecological (including land-use/cover, ecosystem services) status and sustainability trajectories of three rapidly growing megacities (with > 10 million population) in Southeast Asia (Bangkok, Thailand; Jakarta, Indonesia; Metro Manila, Philippines) using geospatial and social-ecological approaches. Overall, this research aims to provide valuable learning and insights in the context of sustainable landscape and urban development planning and governance for these three important megacities.

The conceptualization of this research was stimulated by my past research. Most of my major previous research focused on the application of geospatial approaches (including the use of remote sensing and geographic information systems (GIS) tools and techniques), in combination with social-ecological approaches (including ecosystem service value estimation, social-ecological status index determination, sustainability assessment). In this research, I planned to extend the level of sophistication of the methodology and analysis for scenario-based land-use/cover change modeling, social-ecological status measurement, and sustainability assessment. Moreover, a new

methodological framework for measuring urban volume using remote sensing and GIS techniques were developed and applied.

3 . 研究の方法

To attain the main purpose of this research, the following major research activities were conducted: literature review, fieldwork, multi-temporal land-use/cover mapping, analysis of urban volume and spatial structure, analysis of spatio-temporal land changes, and analysis of social-ecological status and sustainability trajectories. The results were synthesized, presented in international conferences and submitted to international journals for peer-review and possible publications.

4 . 研究成果

The main focus of the study was on a comparative analysis of the social-ecological status of the three cities. Proxy social-ecological indicators were used, such as the fraction of impervious surface (social) and the fraction of green space (ecological). Land surface temperature (LST) was used as an indicator for the negative impact of urbanization in the context of the urban heat island (UHI) phenomenon. Remote sensing data and GIS techniques were used to facilitate the comparative analysis. The details of the study can be found in Estoque RC, Murayama Y, Myint S (2017) Effects of landscape composition and pattern on land surface temperature: An urban heat island study in the megacities of Southeast Asia. *Science of the Total Environment*, 577, 349-359. In brief, the analysis revealed that, in Bangkok, the mean LST of impervious surface was 2.2 °C higher than the mean LST of green space. In Jakarta and Manila, it was 2.9 °C and 3.7 °C higher, respectively. On average, the mean LST of impervious surface is about 3 °C higher than that of green space,

highlighting the important role of green spaces in mitigating UHI effects, an important urban ecosystem service. The study recommends that the density and spatial pattern of urban impervious surfaces and green spaces be considered in sustainable landscape and urban planning so that these cities can have healthier and more comfortable living urban environments.

In addition, another comparative analysis was also performed, focusing on the spatiotemporal patterns of urban land changes and their implications for sustainable urban development in the three cities. The details of the analysis can be found in Estoque RC, Murayama Y (2017) Trends and spatial patterns of urbanization in Asia and Africa: a comparative analysis. In: Y Murayama, C Kamusoko, A Yamashita, RC Estoque (Eds) *Urban Development in Asia and Africa – Geospatial Analysis of Metropolises*. Springer, Singapore, pp 393-414. In brief, the analysis revealed that the urban land of Bangkok has increased by 1401 km² over the past two and a half decades (c. 1990-2014), while the urban lands of Manila and Jakarta have increased by 393 and 312 km². In terms of percentage increase, Bangkok also had the highest (198%), followed by Jakarta (100%) and Manila (86%). The study hypothesizes that these three cities might have already undergone through the alternating process of diffusion-coalescence many times. Today, infilling and sprawling development patterns are important issues that can have profound impacts on the sustainable urbanization of these cities. Thus, these issues need to be looked at more closely and considered in landscape and urban planning.

5 . 主な発表論文等

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6 . 研究組織

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