國立臺北大學 96 學年度第一學期 博士學位論文提要

論文題目： 社經代謝作用與土地利用變遷之整合與空間動態　論文頁數：265

所 組 別：都市計劃研究所　（學號：89081005）

研 究 生：李俊霖　指導教授：黃書禮、詹士樑

論文提要內容：

近年來探討社會經濟系統（socio-economic system）對自然與生態系統（ecosystem）所造成的衝擊時，跨學門（interdisciplinary）的觀點與整合開始被提出來，以試圖探討單一學門無法解決的問題，而社經代謝作用（socio-economic metabolism）即為其中重要的一支。IHDP 與 LUCC 將社經代謝作用與土地利用變遷之探討列為核心計畫（core projects），其不但點出此領域之發展方向應著重在探討社經代謝作用與土地利用變遷間之關連性，並應加強其間相互驅動關係與理論之發展。然而，目前國際上此一領域之發展仍侷限在以會計帳（accounting）形式，探討整體性的社經代謝作用與土地利用變遷，而缺乏空間型態與互動關連性方面研究的發展。

本研究中在克服空間系統模擬（spatial system simulation）方法論上之缺點後，提出一套空間系統模擬模型發展程序，並以生物物理與系統觀點（biophysical and system approaches）為基礎，探討土地利用變遷過程中物質與能量的流動，且配合空間系統模擬方法於ArcGIS 之 Model Builder 中開發台北都會區 SEMLUC（Socio-Economic Metabolism and Land-Use Change）空間系統模型，以探討社經代謝作用與土地利用變遷空間型態（spatial patterns）上之演變趨勢與其間之互動假說。其中，主要發現生態經濟系統之發展在最大功率原則（maximum power principle）的引導下，藉由大量不可再生物質的輸入（收斂）促使都市資產累積；為能使都市系統持續的成長，當其資產累積達到容受力（carrying capacity）上限時，將透過回饋（feedback）部分都市資產的途徑，引導不可再生物質的投入（擴散）促使土地利用變遷發生，以使都市系統有更多的發展空間。而土地利用變遷所呈現出來的都市土地擴張，亦將進一步吸引不可再生物質的輸入，來促使該地區都市資產的持續累積，而都市空間階層即在這樣持續的物質收斂與都市資產擴張下被形塑出來。此外，為維持都市系統的運作亦自系統外輸入大量的不可再生能量，而這些能量輸入與都市空間階層具有一致的空間型態。

本研究所建構之空間系統模型開發程序與方法論改良，為空間系統模擬方法應用之重要基礎，而都市能量假說的驗證以及社經代謝作用與土地利用變遷互動假說的提出，也可作為該領域中理論與假說發展的重要參考。後續如何以空間系統模擬方法探討溫室氣體排放、全球環境變遷、社經代謝作用與土地利用變遷空間型態上之關連性，則為未來有待進一步研究之領域。

關鍵字：社經代謝作用、土地利用變遷、生物物理觀點、最大功率原則、容受力、空間系統模擬、SEMLUC 空間系統模型

ABSTRACT

THE SYNTHESIS AND SPATIAL DYNAMICS OF

SOCIO-ECONOMIC METABOLISM AND LAND-USE CHANGE

by

LEE, CHUN-LIN

January 2008

ADVISOR(S): Dr. HUANG, SHU-LI and Dr. CHAN, SHIH-LIANG
DEPARTMENT: GRADUATE INSTITUTE OF URBAN PLANNING
MAJOR：SYSYEM ECOLOGY AND SPATIAL SYSTEM MODELING
DEGREE: Ph. D. IN URBAN AND REGIONAL PLANNING

The concept of socio-economic metabolism can provide a useful framework for both natural and social scientists to study the interrelations between human societies and their natural environments. Resources consumption, assets accumulation, and waste emission of socio-economic metabolism are involved with complex processes of land-use change. However, current researches focus on macroscopic comparison of socio-economic metabolism for different countries and regions from accounting approaches. Therefore, the International Human Dimension Programme (IHDP) and Land-Use and Land-Cover Change (LUCC) list researches on socio-economic metabolism and land-use change as core projects, and suggest the relationship between land-use change and socio-economic metabolism must be analyzed using a more dynamic and spatial approach.

This article overcomes methodological disadvantages of spatial system simulation and proposes a procedure for developing spatial system models. Socio-Economic Metabolism and Land-Use Change (SEMLUC) model, based on the procedure and biophysical approach, was developed via Model Builder in ArcGIS to investigate spatial patterns and spatial interaction hypotheses of socio-economic metabolism and land-use change for Metropolitan Taipei in this research. SEMLUC is a raster-based model and divided into 9,827 cells (cell size, 500x500 m^2). Simulation results illustrated that spatial patterns of land use are the results of assets competition between natural, agricultural, and urban subsystems. In addition, urban assets have the characteristics of spatial convergence and diffusion, which are driven by the maximum power principle and carrying capacity of assets accumulation. The spatial diffusion process of urban assets triggers off land-use change. Moreover, spatial patterns of land-use change dominate the spatial distribution of non-renewable material and goods inflows. Based on the spatial pattern analyses, the spatial interaction hypotheses of socio-economic metabolism and land-use change are proposed in this research. These hypotheses can be bases for developing interaction theories between land-use change and socio-economic metabolism. Furthermore, impacts of global climate change on spatial patterns of socio-economic metabolism and land-use change will be important issues in the future.

Key words: Socio-economic metabolism, Land-use change, Biophysical approach, Spatial system simulation, SEMLUC, Metropolitan Taipei.