Ecological footprint analysis for urban agglomeration sustainability in the middle stream of the Yangtze River

Hongqi Wang
College of Water Sciences, Beijing Normal University, Beijing, China (wanghongqi5880@163.com)

How to balance ecosystem health and economic development is essential to study sustainability of urban ecosystems. Many methods for assessing urban sustainability have been developed, among which ecological footprint analysis (EFA) has been widely applied as a promising policy and planning tool. This paper proposed a modified EFA with the local ecological footprint being justified by adapting equivalence and yield factors in context of net primary productivity (NPP) from the Miami model. Biodiversity reserves were also incorporated using GIS technology and synthetic assessment of attributes to reflect various ecological functions. In addition, ecological footprint deficit (EFD), implying that the productive land cannot sustain current levels of consumption for a given population, was used to reveal the extent of ecological debt, while the ecological footprint variation index (EFVI) was proposed to describe the tradeoffs between real consumption and the carrying capacity of a specific region. A case study of urban areas in the middle stream of the Yangtze River Basin showed that the per capita EFD of the Wanjiang urban belt, central Poyang Lake urban agglomeration, suburban Poyang Lake urban agglomeration, Wuhan megalopolis, Jingmen–Jingzhou–Yichang urban agglomeration, central Changsha–Zhuzhou–Xiangtan urban agglomeration, and suburban Changsha–Zhuzhou–Xiangtan urban agglomeration increased by 64.83%, 178.05%, 214.82%, 59.08%, 71.68%, 100.62%, and 91.06% between 2000 and 2010, respectively. The local ecological footprint pressure index (EFPI) was classified into five levels. The Poyang lake urban agglomeration was found to be in a slight deficit, while all others were in a severe deficit in 2010. Calculations of EFVI also revealed that the booming urbanization occurred at great cost to the deteriorating ecosystems between 2000 and 2010. Accordingly, relevant influence factors were investigated using a forward stepwise regression method, which indicated that ecological deficit was positively correlated with GDP, population density, and emission of industrial waste, but negatively correlated with the tertiary industry.