Land use and land cover changes and their rffect on the flow regime in the upstream Dong Nai River Basin, Vietnam

*Truong Nguyen Cung Que[1]、Hong Quan Nguyen、近藤 昭彦[2]
*Nguyen Cung Que Truong[1], Hong Quan Nguyen, Akihiko Kondoh[2]

1. 千葉大学大学院理学研究科、2. 千葉大学環境リモートセンシング研究センター
1. Graduate School of Science, Chiba University, 2. Center for Environmental Remote Sensing, Chiba University

Land use and land cover change (LULCC) is one of the major factors that alters flow regime. Many studies worldwide have evaluated the impacts of LULCC on the flow regime. Understanding the influence of LULCC on river flow regimes is important for sustainable catchment management. In Vietnam, starting in the mid-1980s, the government initiated a series of economic reforms aimed at stimulating economic growth; the most remarkable policy was the New Economic Zones program. It displaced many residents to uninhabited areas and expanded the total agricultural area in the country. This led to the conversion of land use and land cover in Vietnam. On the other side, although the studies on hydrological alterations have received more attention since 2009, after “the climate change and sea level rise scenarios for Vietnam” was issued, however studies on regional-scale environmental assessments, especially on hydrology are still limited. While hydropower accounts for the a large proportion of energy source. The Dong Nai River Basin, the second largest catchment in Vietnam, is in the country’s key economic development region and accounts for 23% of Vietnam’s GDP. Water from the Dong Nai River is used to provide drinking water, to irrigate agricultural land, to supply electricity to Southern Vietnam, and to ensure dry season for reduction sea water intrusion downstream. Therefore, water resource management is an important element to ensure sustainable development in this region. The purpose of this study was to evaluate the LULCC and its effect on the flow regime of Vietnam’s upstream Dong Nai River Basin using Flow-duration curves analysis.
Two different temporal and spatial scales of satellite data, Landsat and Global Inventory Modeling and Mapping Studies (GIMMS) normalized difference vegetation index (NDVI) were combined to analyze land use and land cover changes (LULCC). Landsat data were used to classify Land cover maps of the upstream Dong Nai River Basin of 1973, 1989, 1994, 2005, and 2014 with seven land cover classes, Dense-forest, Spare-forest/Shrub, Perennial/Orchard, Crop Land, Built-up/Residential, Marsh/Grasses, and Water Bodies. The results show that in 1973, the forest area, including dense forest and sparse forest/shrub, constituted 86% of the total area, and agricultural land, including perennial orchard and crop, were 14% of the total. These proportions experienced no major changes until 1994, when they changed to 73% and 24%, respectively. In 2005, the forest area decreased significantly to 51% (7,588 km^2), and in contrast, the agricultural land area increased to 45%. In 2014, the proportions of forest area and agricultural land continued to drop to 45% (6,565 km^2) and 51%, respectively. This mean the forest area decreased significantly in the period of 1994 to 2005 due to land conversion for agriculture. To complement the Landsat images between 1994 and 2005, the GIMMS-NDVI dataset from 1994 to 2006 was used to assess the short-term land cover changes. The NDVI decreased from 1994 onward, especially in the upper region of the basin, then started to decline in 1996 and declined the most in 1998. The NDVI of the entire area dropped substantially in 1999 before showing an increase again from 2000 to 2003, followed by a slight decrease. Moreover, the results indicated that during the period of 1994 to 2005, the majority of deforestation occurred since 1998 and that the largest area of forest cover was lost in 1999.
The results of Flow-duration curves analysis show that at basin outlet, all the plentiful-ordinary-low-scant runoff suddenly increased in 1999 and decreased after that until 2004, and the reductions were 380 mm, 320 mm, 77 mm, and 10 mm (35%, 67%, 61%, and 40%), respectively. Besides, even though the amount

of rainfall and the rainfall patterns were similar for the years analyzed, the total discharge and maximum flow dramatically increased by 1999 and decreased thereafter.
We can conclude that the deforestation or the conversion of forest areas to agricultural land has led to an immediate increase in the total discharge, maximum flow, and all plentiful-ordinary-low-scant runoffs, and subsequently a decline in these quantities due to vegetation regrowth.

キーワード：Dong Nai River Basin、土地利用・土地被覆変化、流況曲線
Keywords: Dong Nai River Basin, land use and land cover change (LULCC), flow-duration curve

