ASSESSING THE IMPACT OF BRIDGE CONSTRUCTION IN HANGZHOU BAY ON THE LAND USE/COVER AND SOCIO-ECONOMIC INDICATOR TIME SERIES

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INTRODUCTION

Human activities consistently shaped land surfaces, changed land use and influenced socio-economic development by urban expansion, agriculture intensification, transport construction, and natural resource exploration. Among these activities, transportation infrastructure construction is a vital step in boosting economic and societal opportunities, and results in land use changes.

Estuarine areas where rivers flow into oceans, like bays, usually serve as a major source of economic activities, supporting agriculture, fishing, transportation, mining and tourism sub-sectors. Accordingly, transportation construction plays a stronger role in land use dynamics and socio-economic development in those areas. In this study, we focused on the land use dynamics of the urban agglomeration around Hangzhou Bay, where the Qiantang River flows into the East China Sea, crossed by the recently constructed Hangzhou Bay Bridge (opened in 2008).

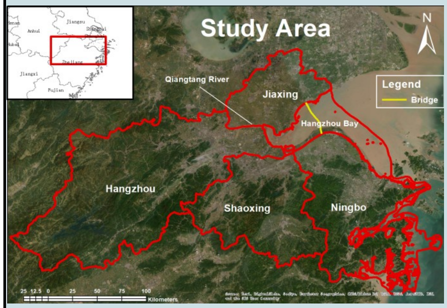

Figure 1. Study site: urban agglomeration of Hangzhou Bay

In order to analyze the influence of transport infrastructure construction on the land use time series of the surrounding areas and correlation with social-economic indicators, we classified ten land use and land cover (LULC) classes from Landsat satellite imagery time series from 2000 to 2017, quantified the long-term LULC class dynamics in the urban agglomeration, and analyzed the LULC changes before and after the opening of the Hangzhou Bay Bridge. Additionally, we explored the effect of bridge connection on the change of socio-economic indicators and land use types. This research can contribute to policy making for sustainable urban development and land management in future.

DATA & METHODOLOGY

Table 1. Overview of the main datasets used in this study

Data name	Year	Source	Detailed information
Landsat 5, 7 (ETM+)	2000-2012	Google Earth Engine (GEE)	Landsat data for the classification procedure
Landsat 8	2013-2017		
30m LULC data	2000, 2010	GLC30 information service (Chen, Chen et al. 2015)	LULC reference maps for map comparison with the classification results
	2015, 2017	FROM-GLC website (Gong, Liu et al. 2019)	
Yearbook data	2000-2017	Annual statistics yearbook from Municipal Statistics Bureau of Jiaxing, Shaoxing, Ningbo and Hangzhou city	GDP, Investment in Fixed Assets, Total Tourism Revenue, Total Tourists, Urban Population, Population

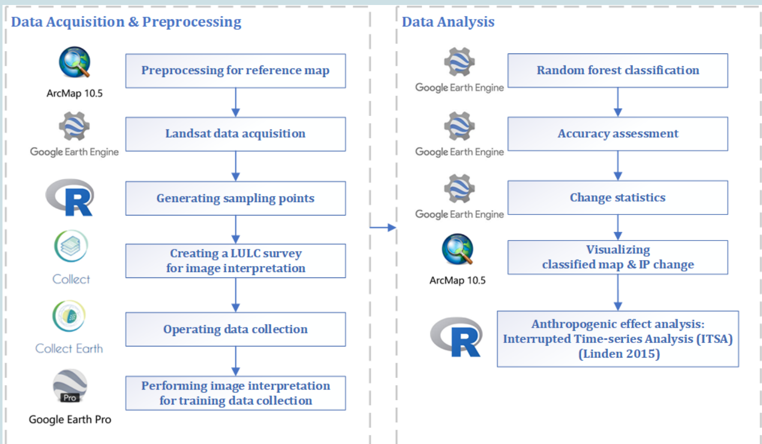

Figure 2. Overall workflow used in this study

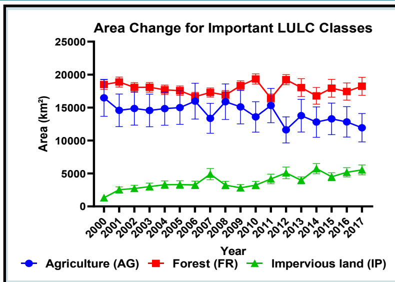

Figure 3. Area change for LULC classes with major change.

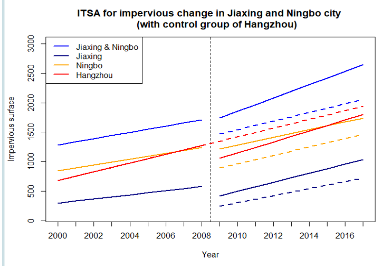

Figure 5. ITSA applied on Impervious land

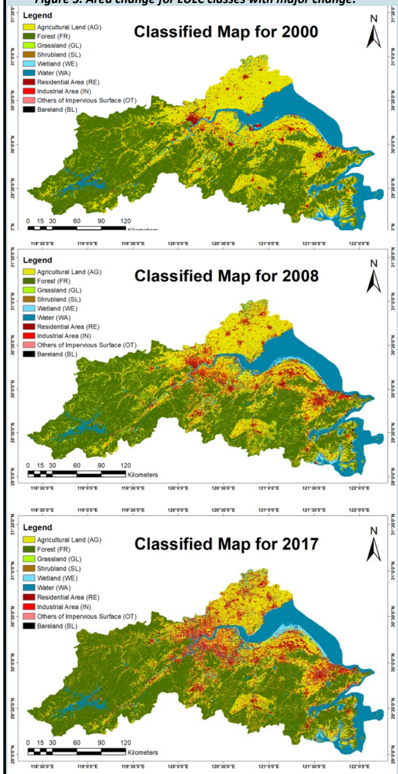

Figure 4. Classified map of 2000, 2008 and 2017

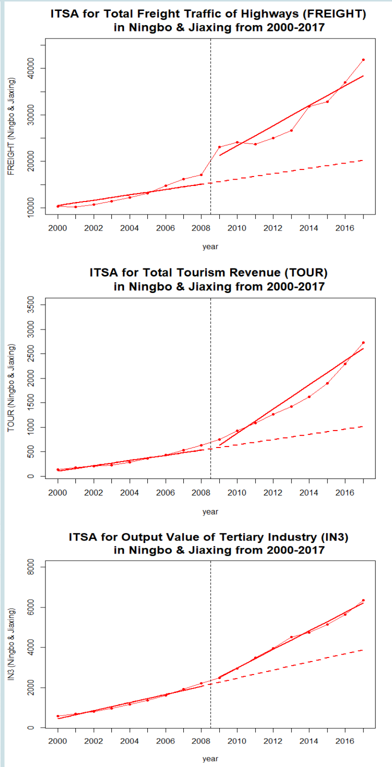

Figure 6. ITSA applied on social-economic factors

MAIN RESULTS

- The most obvious change was the expansion of the impervious land and the simultaneous decrease of agricultural land. Impervious land kept expanding after the bridge opening (Fig. 3).
- The majority of the study area was covered by the forest class, which was mainly distributed in the municipality of Hangzhou and Ningbo. Agricultural land and impervious land were mainly distributed around the Hangzhou Bay. Industrial and residential impervious surface increased before the opening of the bridge, and after the opening, other impervious surface (such as infrastructure) increased sharply, whereas the two others relatively stalled. Additionally, water has been converted into wetland and agriculture along the coastline of Ningbo after the bridge was opened (Fig. 4).
- The area of impervious land in the bridge-connected cities has shown notable increase in both level and trend in comparison with the control group (Hangzhou). Particularly the impervious land change in Jiaxing presents more remarkable change from the intervention of the bridge construction. On the contrary, Ningbo shows an insignificant change in trend after the bridge was opened to the traffic (Fig. 5).
- The level of FREIGHT (Total Freight Traffic of Highways) factor had a substantial increase owing to the bridge intervention. The remarkably upward trend was found in FREIGHT, output value of tertiary industry, and Total Tourism Revenue after the bridge intervention in 2009 (Fig. 6).

CONCLUSION

It can be concluded from the anthropogenic effect analysis on LULC change that the connection of the sea-cross bridge boosts the expansion of impervious land in the bridge-connected cities. It can also promote the accessibility of local transportation and thus stimulate the development of the population and economy.

This study provides potential support for policy making as to achieve sustainable urban development and land management. The methods used in this study are universal and therefore can also be used to assess the effect of any notable event that may impact LULC change.

Reference

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