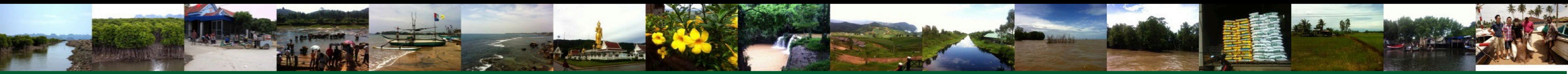

Estimation of land price in Yangon, Myanmar based on Empirical Model using Remotely Sensed data

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11 SUSTAINABLE CITIES AND COMMUNITIES

11.5 decrease the economic losses relative to GDP caused by disasters

Abstract: This research proposed a methodology to estimate the land price in Yangon, Myanmar based on the empirical model by using Remote Sensing technology. In the estimation, we defined the land price is referred to four factors with (1) building types (2) land cover change (3) elevation (4) distance from railways. By using remotely sensed data, we employed stereo GeoEye images and multispectral Landsat images also VIIRS nighttime light data to provide building types with commercial, industrial, and residential buildings. We used Landsat time series to obtain the land cover change. We extract the elevation from stereo GeoEye images. The empirical model as a linear function was applied to link between the defined factors and in-situ land price. To estimate the coefficients in the estimator, the regression method was applied. In the experimental results, our methodology estimated land price in Yangon with the efficiency at the township scale. In the validations of the remotely sensed data, the estimated building types map was compared with the land used map and also the elevation were compared with surveying elevation data.

1. Introduction

Yangon, Myanmar
- the largest city (> 5 million population)
- the major economic area of the country
- Floods have occurred every 1-2 years
- An earthquake affected in 1930
- Land price map + Disaster vulnerable map
→ Disaster risk in term of economic loss

Downtown in Yangon

2. Methodology

2.1 Factors to indicate land price

(1) Building types, (2) land cover change, (3) elevation, (4) distance from railways

Table 1. Remotely sensed dataset

No.	Satellite and sensor	Bands	Resolution	Year
1	Landsat-3 MMS	4	60 m.	1978
2	Landsat-4 TM	7	30 m.	1990
3	Landsat-7 ETM	8	30 m.	2000
4	Landsat-5 TM	7	30 m.	2009
5	Landsat-8 OLI	11	30 m.	2015
6	GeoEye RGB	3	0.5 m.	2013
7	VIIRS DNB	1	460 m.	2012

2.2 Data preparation

- Building types : Stereo GeoEye images, Landsat image, VIIRS nigthttime light
→ building types with (1) commercial, (2) industrial, (3) residential buildings
- Land cover change : Landsat time series → Land cover change from 1978 to 2009 with (1) urban and (2) non-urban
- Elevation : Stereo GeoEye images → Elevation
- Distance from railways : Railways (GIS data) → Distance from railways
- Land price information : Land price information at township scale

2.3 Defining land price index

$$LPI = w_B \bullet B + w_E \bullet E + w_R \bullet R + w_L \bullet L$$

Where B = building types,
E = elevation,
R = distance from railways,
L = land cover change,
w = the weight of the factor

LPI of 0 → the lowest land price
LPI of 1 → the highest land price

Table 2. Parameter values

Parameters	Class	Index value
Building types (B)	Commercial building	1.0
	Industrial building	0.5
	Residential building	0.25
Land cover changes (L)	Urban from 1978	1.0
	Urban from 1990	0.75
	Urban from 2000	0.5
	Urban from 2009	0.25
Elevation (E)	17-68 m.	1.0
	8-17 m.	0.67
	0-8 m.	0.33
Distance from railways (R)	0-684 m.	1.0
	685-1,416 m.	0.8
	1,417-2,358 m.	0.6
	2,329-4,024 m.	0.4
	4,025-8,228 m.	0.2

2.4 Estimating the weights of land price index

The least square regression → the estimated weights of land price index

$w_B = 0.213$, $w_E = 0.219$, $w_R = 0.029$, $w_L = 0.108$

3. Experimental Results

3.1 The estimation of the land price map

Low land price High land price

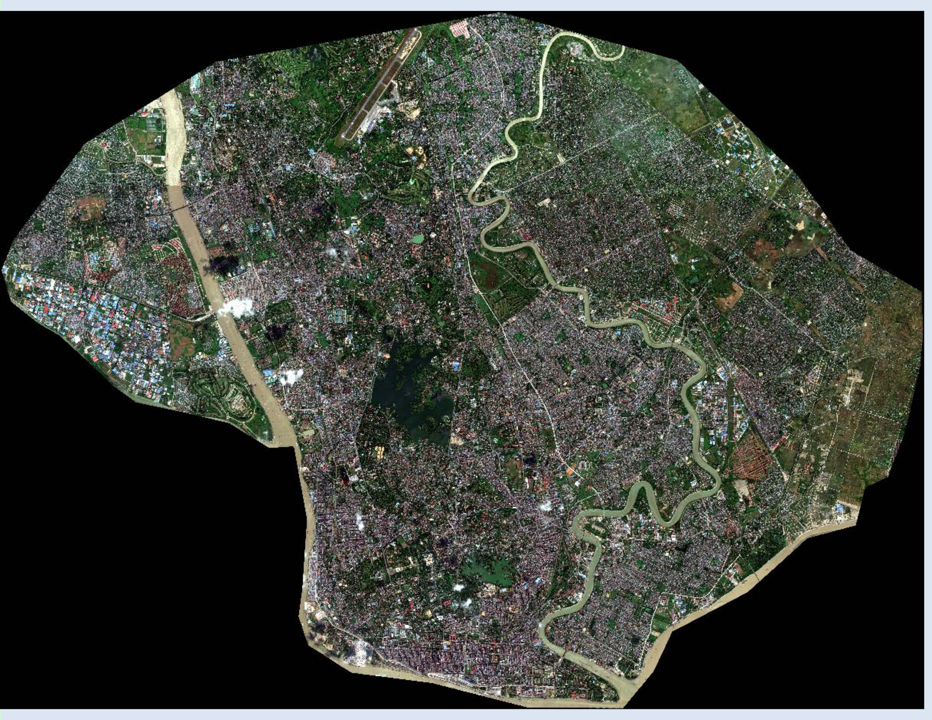
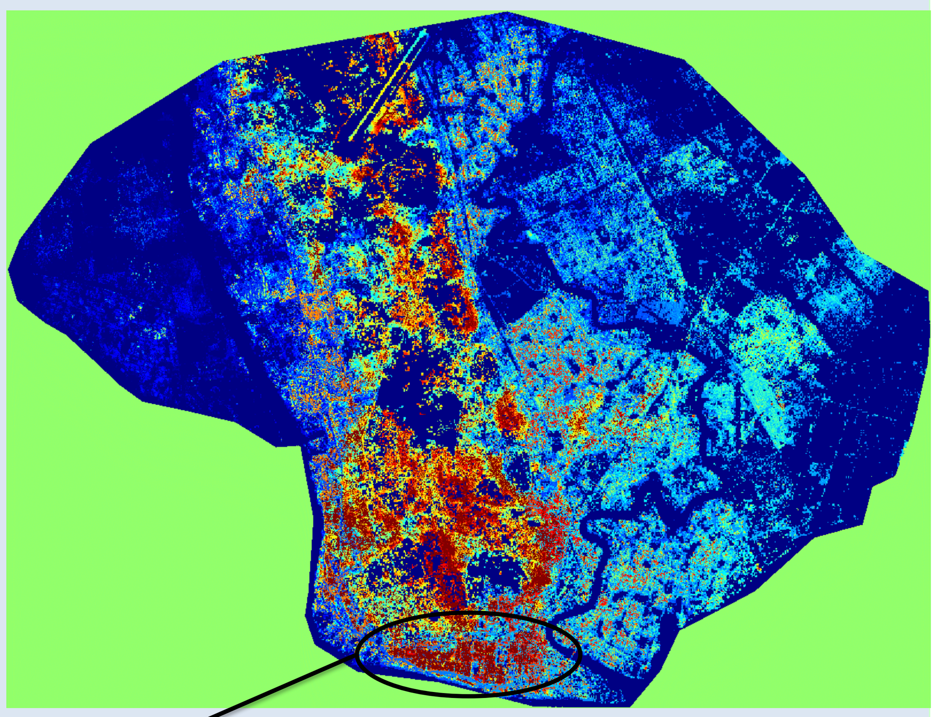


Figure 1. GeoEye RGB image over Yangon, Myanmar



Downtown area (High land price)

Figure 2. The estimated land price map based on the empirical model

3.2 The validation of the estimation of land price

Low land price High land price

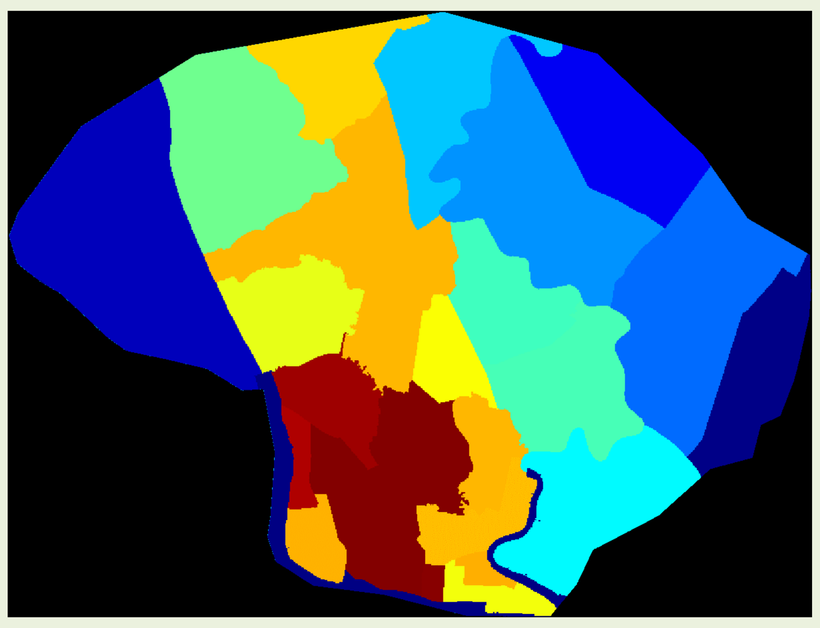


Figure 3. The estimated land price map in 2012 at the township scale

Low land price High land price

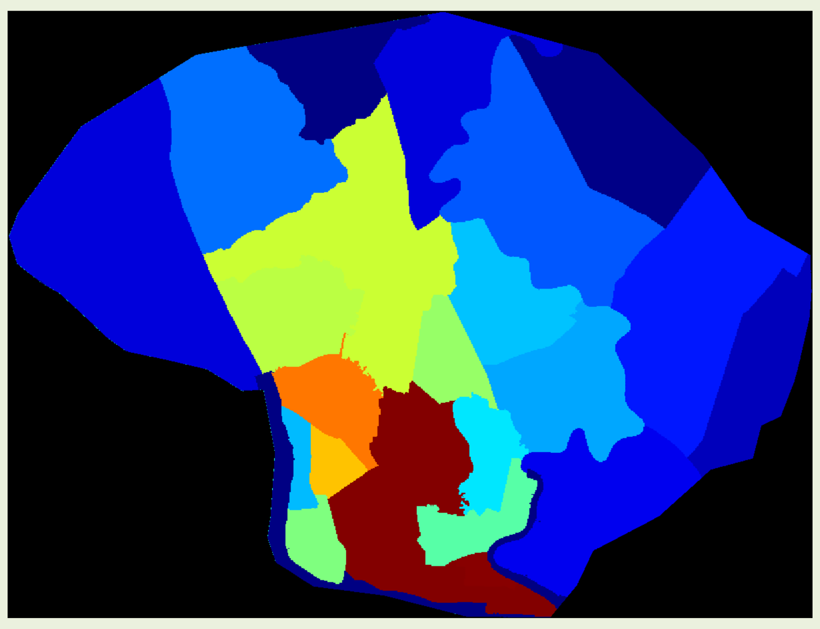


Figure 4. The actual land price map in 2012 at the township scale

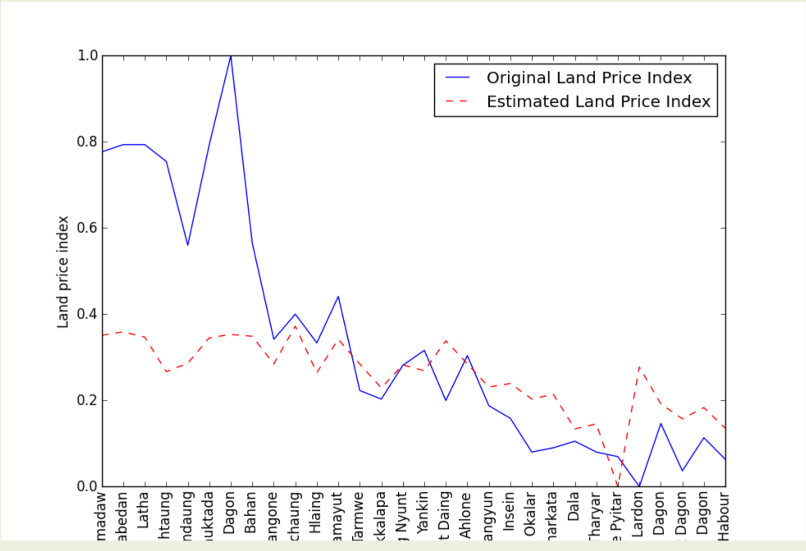


Figure 5. The comparison between estimated and actual land prices in 2012 at the township scale

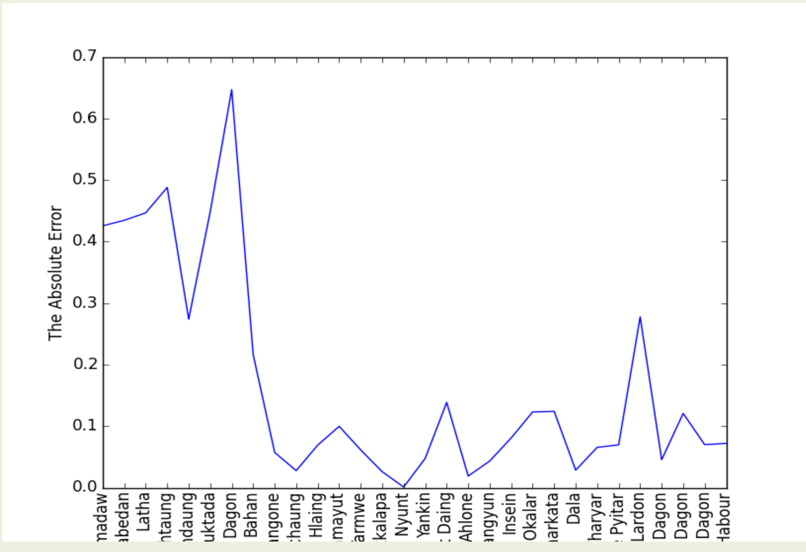


Figure 6. The absolute error between the estimated and actual land price in 2012 at the township scale

3.3 The validations of remotely sensed data

- Comparing with land use map in 2012
Accuracy of the estimated building types is 76%
Kappa coefficient of 0.58
- Comparing with the surveying elevation (98 locations)
RMSE of estimated elevation is 1.62 meter

3.4 Discussions

- Building types, Elevation → high impact to land price
- Land cover change → medium impact to land price
- Distance from railways → low impact to land price
- Validations of the estimated building types and elevation
→ the estimated data can be employed in the model with the reliability

4. Conclusions

- Methodology to estimate land price
→ mean absolute error of 0.175 at the township scale)
- the validations of the estimated building types and elevation
→ reliability of the estimation
- To improve the accuracy,
→ Assigning parameter values as an exponential function
→ Using other factors (the road types, other transportations, and the remark structures)

Reference
(1) Morley, I. 2013. Rangoon, Cities, 31, pp.601–614.
(2) Tsutsumi, M.; Shimada, A.; Murakami, D. 2011. Land price maps of Tokyo Metropolitan Area. Procedia - Social and Behavioral Sciences, 21, pp.193-202.
(3) Xu, Z.; Li, Q. 2014. Integrating the empirical models of benchmark land price and GIS technology for sustainability analysis of urban residential development. Habitat International, 44, pp.79-92.
(4) Hu, S.; Cheng, Q.; Wang, L.; Xu, D. 2013. Modeling land price distribution using multifractal IDW interpolation and fractal filtering method. Landscape and Urban Planning, 110, pp.25-35.
(5) Lin R.; Zhu, D. 2014. A spatial and temporal analysis on land incremental values coupled with land rights in China. Habitat International, 44, pp.168-176.

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