

# Effect of Land Policy Change on Flood Risk in Shenzhen Special Economic Region

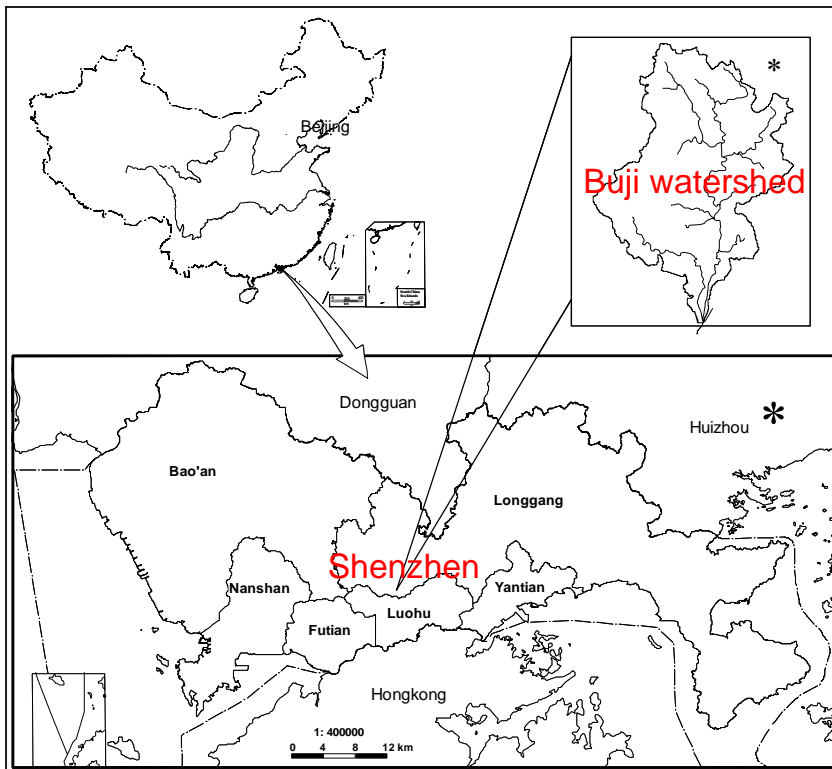
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# Introduction



Location of the Buji watershed

● Shenzhen has been undergoing urbanization at an unprecedented speed since 1980.

● The Buji watershed is a typical fast urbanizing region, with more than half of its area having been transformed into urban land.

## Data

- ***Land policy data (1980-2004)***
- ***socioeconomic data (1980-2004)***
- ***Land use data*** (1980, 1988, 1994, 2000 and 2005)
- ***Topographic data (resolution of 15 m)***
- ***Soil data***

## Methods: Risk

$$R = H * V$$



$$R + R_i = (H + H_i) * (V + V_i)$$



Supposing risk, hazard and vulnerability equal 1 in the beginning of study period

$$R_i = H_i * V_i + H_i + V_i$$

Where, R is Risk, H is Hazard, V is Vulnerability,  $R_i$  is change of Risk,  $H_i$  is change of Hazard, and  $V_i$  is change of Vulnerability.

## Methods: Hazard

SWAT model was applied to simulate different scenarios



$$H_c = \frac{\sum_{j=1}^n \left( \frac{S_{sj}}{P_j} - \frac{S_{pj}}{P_j} \right)}{n}$$

$H_c$  divide maximum of  $H_c$  we can get  $H_i$ .

Where,  $S_{sj}$  and  $S_{pj}$  are annual surface runoff of j year in different scenarios,  $P_j$  is annual rainfall of j year, n is the number of years between two scenarios.

## Methods: Vulnerability

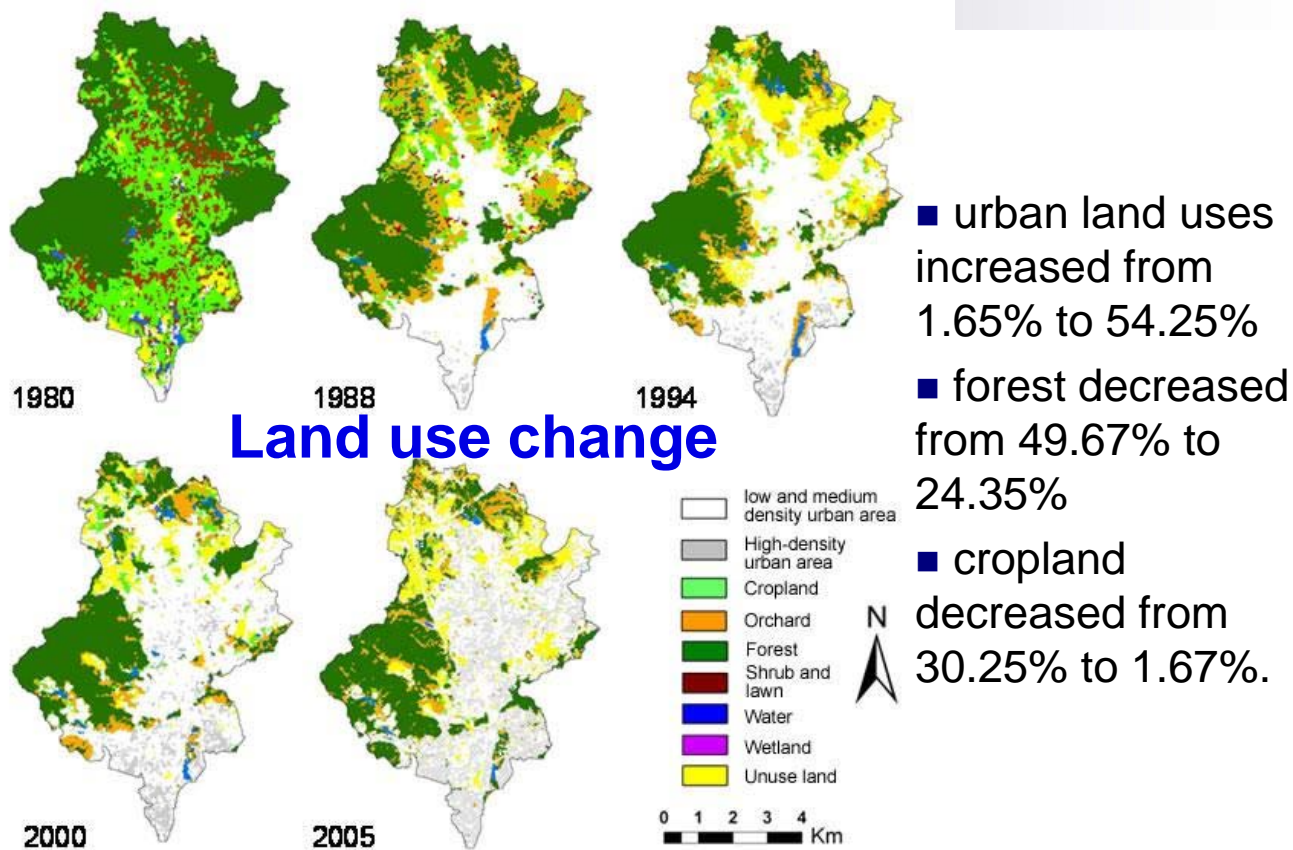
$$V_i = \frac{\frac{G_i}{A_i}}{\max\left(\frac{G_1}{A_1}, \frac{G_2}{A_2}, \dots, \frac{G_n}{A_n}\right)}$$

This paper didn't consider the change of resistant ability.

Where,  $V_i$  is the annual change of vulnerability,  $G_i$  is non-agricultural GDP of  $i$  year, and  $A_i$  is built-up area of  $i$  year.

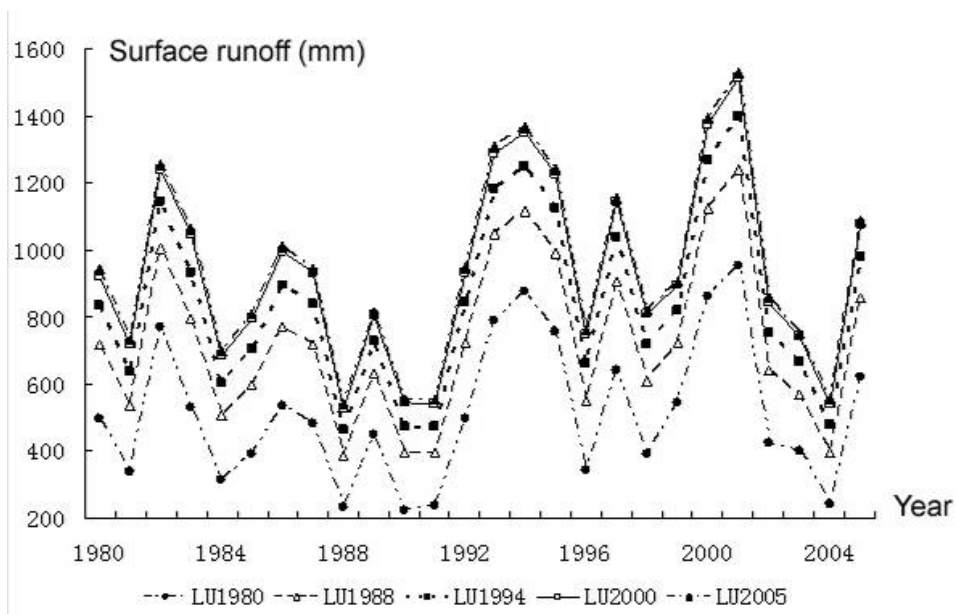
## Land policy reforms

- *Land property rights reforms*
- Land rent system reforms
- Land price system reforms

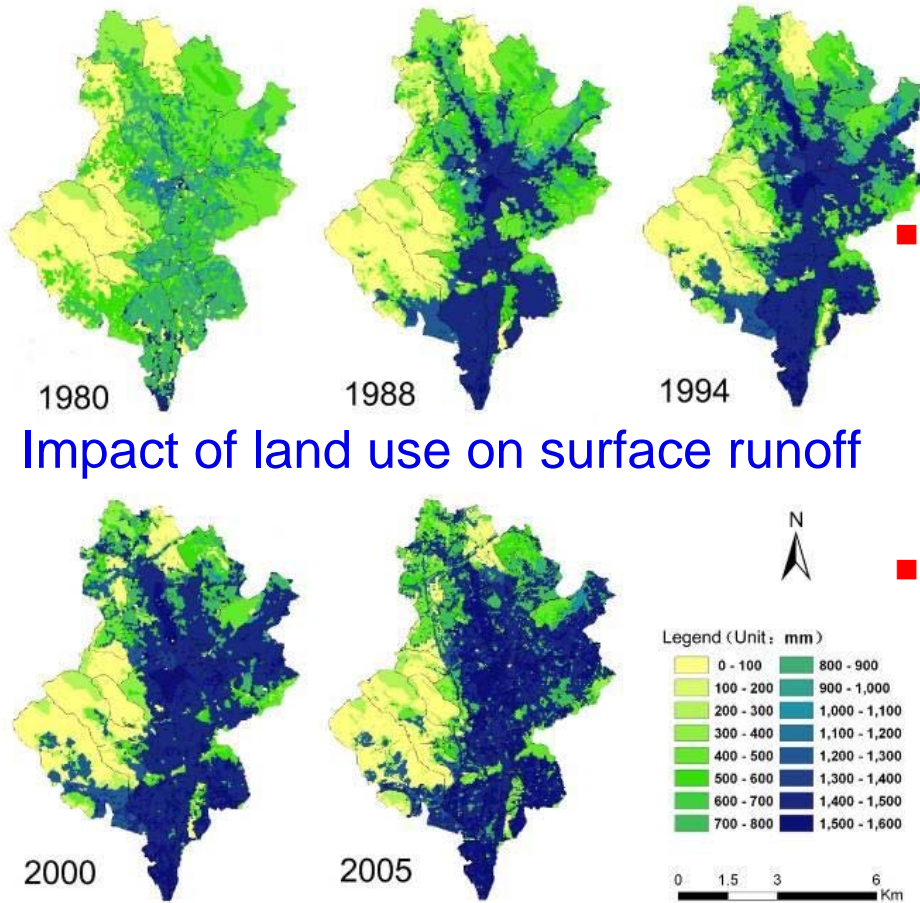


Land use maps of the Buji watershed (1980, 1988, 1994, 2000 and 2005)

## Impact of land use on surface runoff



Yearly time series 1980–2005 Surface runoff for different land use scenarios



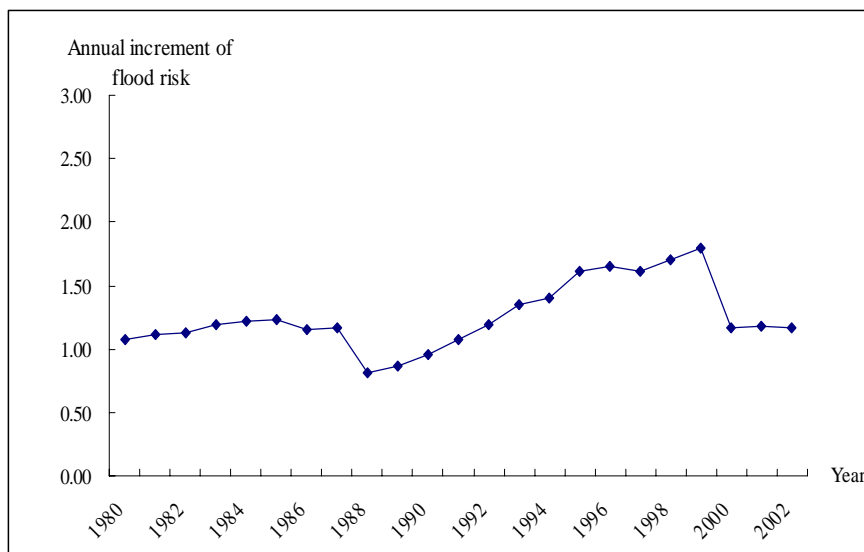
## Impact of land use on surface runoff

■ With development of urbanization, surface runoff increased sharply, especially in urban uses land.

■ From 1980 to 2005, Surface runoff increased by 431.97mm, with a range of 93.75%.

Spatial distribution of HRUs' annual surface runoff for different land use scenarios

## Impact of land policy change on Flood risk



■ 1980 -1987, annual increment of flood risk increased slowly.

■ 1988 -1993, annual increment of flood risk increased obviously.

■ 1994 -, annual increment of flood risk increased slowly and began to decrease later.

Annual increment of flood risk without considering change of resistant ability



## Conclusion

- Driven by land policy reforms, percentage of agricultural land uses dropped from 86.22% to 50.16%, while urban land uses increased from 0.63% to 33.47% from 1980 to 2005.
- Land use change, especially increasing of urban uses land, increased stream flows, which make the flood risk increased.
- In different stage of land policy reforms, annual increment of flood risk has different change tendency and reason.
  - 1980 -1987, annual increment of flood risk increased slowly
  - 1988 -1993, annual increment of flood risk increased obviously.
  - 1994 - , annual increment of flood risk increased slowly and began to decrease later.



## Discussion

- The methodology used to reveal the impact of land policy change on flood risk is a simplified methods with a few elements.
- The result can explain the relationship between land policy change and annual increment of flood risk to some extent.
- It can not reveal the underlying mechanism and none-dynamics process.
- Resistent ability is not considered.
- The structure and pattern of urban uses land are not considered.



**Thank you for  
your attention !**