The characteristics and influencing factors of the urban river transformation in China

Caractéristiques et facteurs ayant une influence sur la transformation urbaine des rivières en Chine

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RÉSUMÉ

La pratique consistant à améliorer les cours d'eau existants et à créer de nouveaux paysages aquatiques s'est propagée en Chine au cours des deux dernières décennies. Dans notre étude portant sur 104 villes chinoises, choisies de façon aléatoire, nous avons identifié 14 types de projets fluviaux basés sur des rapports de recherche technique et leur apparence sur des images aériennes séquentielles, classées en trois catégories : « technique », « espaces riverains » et « projets écologiques ». Les « espaces riverains » étaient les plus courants (61%), suivis par les projets « techniques » (28%) et les « projets écologiques » (11%). Nous avons constaté (à l'aide de la régression par étapes multiples) que les types de projets entrepris étaient fortement influencés par des facteurs tels que le climat, la typographie, le contexte socioéconomique et la désignation de « ville-jardin ». La désignation de « ville-jardin » était liée à des projets « d'espaces riverains » et de « nouveaux paysages aquatiques », mais pas aux projets « techniques » ou « écologiques ». Nous avons constaté que les villes ayant des climats plus secs (mesurés par « les précipitations moins l'évaporation ») ont construit plus de projets, parmi lesquels de nombreux projets qui utilisaient les rivières saisonnières pour créer des plans d'eau toute l'année. Sur la base de nos résultats, nous concluons que les villes chinoises sont encore en train de « décorer » les rivières et que la désignation de « ville-jardin » favorise de tels projets de « décoration », en particulier des projets d'écologisation linéaire et d'espaces publics le long des rivières. Ces résultats démontrent également que les nouveaux projets fluviaux en Chine sont souvent en contradiction avec le climat local.

ABSTRACT

The practice of enhancing existing rivers and creating entirely new waterscapes has exploded in China over the past two decades. In our study of 104 randomly selected cities across China, we identified 14 types of river projects based on grey literature reports and their appearance on sequential aerial imagery, falling into three categories: 'engineering', 'waterfront spaces' and 'ecological' projects. 'Waterfront spaces' were the most common (61%), followed by 'engineering' (28%) and 'ecological' (11%). We found (using multiple stepwise regression) that the types of projects undertaken was strongly influenced by factors such as climate, typography, social-economic setting, and 'Garden City' designation. Designation as a 'Garden City' was correlated with 'waterfront spaces' and 'new waterscape' projects, but not 'engineering' and 'ecological' projects. We found that cities in drier climates (as measured by 'precipitation minus evaporation') constructed more projects and they included many projects that impounded seasonal rivers to create year-round water bodies. Based on our results, we conclude that Chinese cities are still in the process of 'decorating' rivers, and that the 'Garden City' designation promoted such 'decorating' projects, especially 'linear greening' projects and 'public spaces along rivers'. The results also demonstrate that the new river projects in China are often at odds with the local climate.

KEYWORDS

Engineering, Garden City, New waterscape, Urban river, Waterfront spaces

1. INTRODUCTION

The practice of enhancing existing rivers and creating entirely new waterways has exploded in China over the past two decades, accompanying the rapid expansion of urban areas. While these river projects share many attributes with urban riverfront projects that have proliferated in Europe and North America over the same time period, there are some significant differences. To better understand these differences, we explore the influence of social-economic status, climate condition and the 'garden city' designation on urban river projects in Chinese cities since YEAR. We focus on urban river projects, excluding whole-watershed or water resources development projects, although these larger-scale projects could certainly merit comparable study.

2. METHODS

2.1. Data collection

From the 665 cities (as designated by the central government) in China, we identified cities to study through a stratified random selection process. Finally, we selected 104 cities all over China. For each city selected, we compiled basic information on climate data (including local temperature, precipitation and evaporation), topographic data (including elevation, slope, relief amplitude, terrain roughness), social-economic indicator (including urban district population, city population, Gross Domestic Product (GDP), urban district area) and river related data (including number of rivers, maximal river width, widened river width, original river width), etc.

For the 104 cities, we identified the years with high resolution aerial imagery available on Google Earth, and we scoured the academic, professional, and grey literature for accounts of river enhancement projects. We developed a typology of river enhancement and creation projects (Figure 1), which includes 14 types of river projects. We grouped them in three groups respectively are 'engineering', 'waterfront spaces' and 'ecological projects', then separated 'new waterscape' and 'more ecological' groups for further analysis.

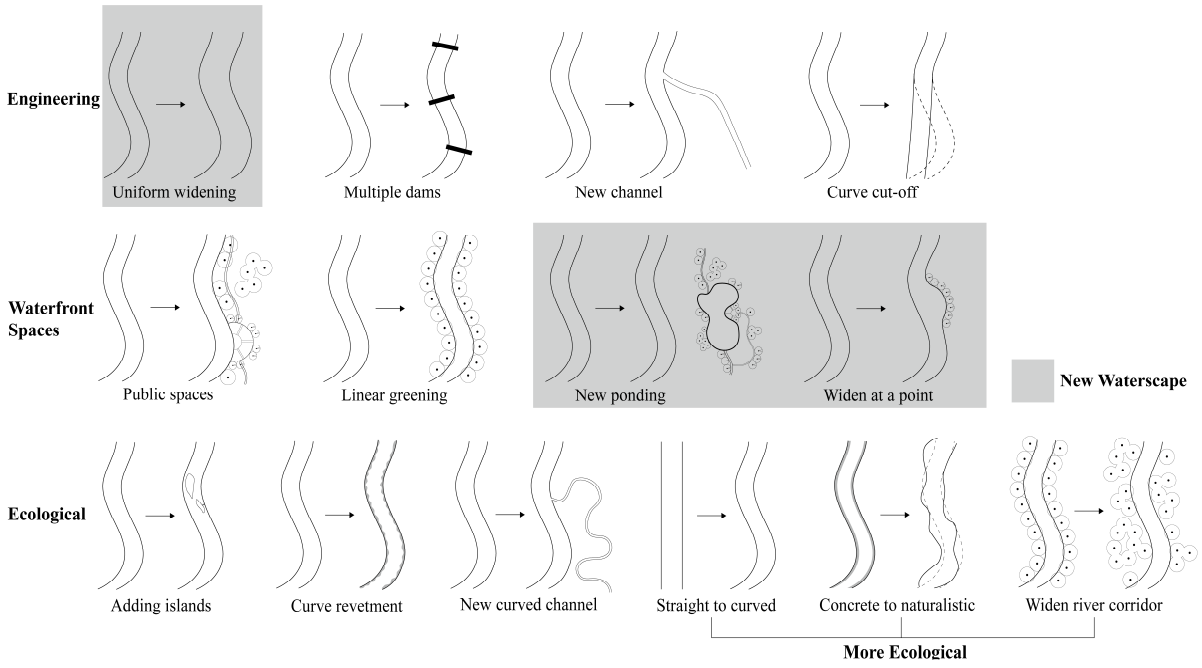

Figure1 The grouped 14 types of river projects which we identified

2.2. Data analysis

After the data collection, we set the different river projects as independent variable, and select 11 independent variables (Table 1). We performed Stepwise Regression analyses separately for the different river projects, first pooling together all the projects, and thereafter for the projects grouped into engineering, waterfront spaces, ecological, more ecological, new waterscape. For every regression, we attempted to identify appropriate independent variables and avoid multicollinearity. And every model we established passed the tests including F-test, Durbin Watson (DW), etc.

Table 1 Variables used in the different stepwise multiple regression analyses

Independent variables		Dependent variables
Climate	1-Temperature(T)	Total river projects
	2-Precipitation(P)	Engineering
	3-Evaporation(E)	Waterfront spaces
	4-Precipitation minus evaporation(P-E)	Ecological
	5-Maximal precipitation of a month(MAP)	More ecological
	6-Minimal precipitation of a month(MIP)	New waterscape
Topography	7-Altitude(A)	Uniform widening
	8-Slope(S)	Widened rate
	9-Relief Amplitude(RA)	New ponding
	10-Terrain roughness(TR)	Curve revetment
Social-economic	11-Urban district population(UDP)	
	12-Urban district area(UDA)	
	13-Area of built district(ABD)	
	14-Area of green space(AGS)	
	15-Gross domestic product (GDP)	
	16-GDP per capital	
River related	17-Number of rivers(NR)	
	18-Maximal river width(MRW)	
City Designation	19-Garden City(GC)	

3. RESULTS

3.1. Overview

Among all the river projects, the ‘waterfront spaces' projects take up 61%, then following with ‘engineering' and ‘ecological' groups respectively are 28% and 11%. And for the 14 types, ‘public spaces’ and ‘linear greening’ are the two largest numbers, following with new ponding, uniform widening, and multiple dams. For the ratio of the projects in new district, except public spaces, linear greening and multiple dams, most of the percentages are more than 90%. During our identification, it is clear that river projects are clustering in new districts, or in districts other than the central district.

3.2. Regression results

Except the ‘urban district population’ and ‘GDP per capital’, ‘Garden City’ designation is significantly positive correlation with ‘waterfront spaces’, and ‘new waterscape’ projects, but not ‘engineering’ and ‘ecological’ projects. And ‘precipitation minus evaporation’ has a significant negative correlated with ‘engineering’, ‘new waterscape’ projects and ‘widened rate’. Moreover, a significant negative correlation is found between ‘maximal river width’ and ‘waterfront spaces’ projects.

4. CONCLUSION

The results indicate that China is still in the process of ‘decorating’ rivers, and ‘Garden City’ designation promoted such ‘decorating’ projects, especially ‘linear greening’ projects and ‘public spaces’ along rivers. Though there are some ecological principles in the standards of ‘Garden City’, to meet the ratios stated in the Garden city designation, cities were most likely to build river projects with green banks and linear parks in new districts, where it was easiest to gain larger scores in these categories. The ‘Garden City’ designation encouraged ‘new waterscape’ projects including ‘uniform widening’, ‘new ponding’ and ‘widen at a point’, which take decorating as the first principle and neglect ecological function. In addition, new river projects in China seem not to be based on availability of water resources. The cities in drier climates tended to construct more river projects, especially ‘engineering’ and ‘new waterscape’ projects, with many projects turning formerly seasonal rivers into year-round water bodies through impoundments.

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