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Title: Examining the governance of urban ecological commons in the Chinese rapid urbanization context: case studies from Guangzhou

Abstract: The planning and management of urban natural resources (UNRs) have attracted much attention given their positive environmental and health potential. UNRs such as street trees, parks, wetlands and ecological corridors are a type of common-pool resource (CPR) given limited urban land availability and the needs of all urban inhabitants. How is UNRs governed, particularly in the Chinese rapid urbanization context and what are the institutional challenges? I try to answer this question through examining three case studies that occurred in the last two decades from Guangzhou, a coastal megacity with a subtropical climate. The recent Chinese national environmental governance framework "Ecological Civilization" has prompted Chinese local governments to enhance the planning and management of UNRs. Governance of UNRs in China is informed by planning technicians and primarily government-led, but subjected to negotiations with central government, private sector interest, and communities, particularly the former two. Land scarcity and the associated property rights arrangements are the central challenges for governance of UNRs in China. Social equity issues prevail despite successful governance of UNRs for health and environmental benefits, indicating the need for deeper institutional reform for the betterment of UNRs as commons.

Keywords: Urban natural resources, governance, common-pool resources, rapid urbanization, property rights, environmental sustainability, China

1. Introduction

As global urban population grew rapidly from 30% in 1950 to 55% (or 4.2 billion) in 2018, we are living on an urban planet (Bai et al. 2018). Future land-use forecasts suggest 110%~185% increase in global urban land cover from 2000 to 2030, a greater increase than actual pattern, with Asia accounting for nearly half of this increase (Angel, Parent, Civco, Blei, Civco, et al. 2011). Consequently, the pattern, dynamics, and functionality potential of ecosystems, e.g., surface temperature and precipitation patterns, soil moisture levels, vegetation growth rates, water and aquifer levels, and air quality, have been drastically changed (Elmqvist et al. 2013; Revi et al. 2014; Gong et al. 2018).

The Chinese urbanization grew even more extraordinarily from 17.9% in 1978 to 53.7% in 2014, during which 560 million people have moved into cities and 465 new cities have been built (State Council of China 2014). The country is projected to reach 70% urbanization rate with over one billion living in cities by 2030 (Pan 2016). Rapid urban development and population growth in China have induced profound transformations in land-use and landscape patterns (Bai et al. 2014). Urban developed land in China grew grew by 78.5% between 2003 and 2013, much faster than that of urban population, which grew only 46% (Bai et al. 2014). The remarkable transformation of natural spaces to built-up areas in China has even gained the reference 'landscape urbanization,'in contrast to 'demographic urbanization' (Bai et al. 2012).

Today, nearly half of the total urban environment in all Chinese cities, including surface water, air, and soil quality, has been defined as degraded or moderately degraded (He et al 2017). Furthermore, climate change in recent decades have caused negative impacts on natural and human systems on all continents and across oceans (IPCC 2014). Many of the impacts - increase in average surface temperatures, possibility of extreme weather events or hazards, numbers of most intense tropical cyclones, inland and coastal flooding, landslides, drought, aridity, water scarcity, air pollution, sea levels, storm surges, and fatal heatwaves - are concentrated in urban areas (Elsner et al. 2008; IPCC 2014; Walsh et al. 2014). Globally, Guangzhou, Shanghai, Tianjin are among the 10 most vulnerable megacities regarding value of property and infrastructure assets exposed to climate change (R. J. Nicholls et al. 2007).

Urban natural resources (UNRs) such as street trees, parks, wetlands and ecological corridors provide multiple ecosystem services beneficial not only for improving urban environmental quality, mitigating and adapting to climate change impacts, but also for improving human health and wellbeing (Smith and Balakrishnan 2009). UNRs provide multiple services for cities, e.g., surface temperature regulation, air filtratoin, rainwater absorbtion and storage, soil fixation, biodiversity maintainance, nature education, spiritual wellbeing, and social cohesion (Pramova et al. 2012; WHO Europe 2017). From an economics standpoint, UNRs are ideally a type of common-pool resource for that they are extractable but not excludable. Land scarcity in cities,

particularly megacities in China, naturally limits the amount of conservable UNRs; yet no one can exclude urban residents from accessing or enjoying the multiple ecosystem services and consequential environmental and health benefits provided by UNRs. However, adopting UNRs as an ecosystem-based solution is not easier compared to 'hard engineering' solutions (Roberts et al. 2012). To implement an ecologically functional, well-integrated and well-managed network of UNRs, it requires not only data, expertise, and resources, but also enabling institutional conditions and frameworks (Revi et al. 2014).

In the Chinese rapid urbanization context and under climate change, how are UNRs governed and what are the institutional challenges? In this paper, I try to answer this question through applying Ostrom's Institutional Analysis and Development framework (IAD framework) on empirical case studies of UNRs governance in China. Specifically, I examine three case studies that occurred in the last two decades from Guangzhou, a coastal megacity with a subtropical climate. The aim is to inspect the ways in which UNRs planning and management in China have evolved along rapid, dynamic, and centrally coordinated urbanization processes, and to examine inspirations or challenges incurred in the governance of UNRs as commons under such political system and socio-economic contexts. The objective is to foster learning of good urban sustainability practices that are resilient regardless of cultural or political differences. The second section of this paper reviews existing literature on Chinese urban planning history, planning and ecology of UNRs, and relevant institutional aspects. The third section presents a theoretical framework. The fourth section explains the methodology, the fifth and sixth sections introduce China's national development framework and three case studies. The seventh analyzes the governance dynamics and effectiveness in the case studies within the Institutional Analysis and Development (IAD) framework as well as through a multi-criteria assessment (MCA). Finally, the paper concludes with proposals of prospective research directions on UNRs as a type of urban commons.

2. Literature review

Gaubatz (1999) and Zhang (2006) consider that the Chinese urban planning system has been influenced first by traditional philosophies such as Confucianism and Daoism, and then by socialist theory and Soviet centralism, and later by Western rational planning theories and practice which often involve private sectors. Wu (2000) and Douay (2008) point out that in the socialist context, Chinese urban planning was mainly conducted through a classical top-down approach by two actors - political leadership and planning experts. Douay (2008) criticizes this planning process as authoritarian, elitist, technocratic and bureaucratic despite the aim of the socialist practice of urban planning was to "serve the people." Wolch et al. (2014) and Bai (2015) argue that since the country's economic reform in the late 1970s, Chinese urban planning has involved private sector and primarily served economic development, and the planning of UNRs was a common strategy to increase the overall economic benefits of urban land. Yin et al.

(2008), Douay (2008), and Gould and Lewis (2012) argue that to date, the centralized planning model is still present and, externalities such as marginalization of migrants from rural areas and the degradation of urban living environment have emerged during the rapid urbanization and economic development processes.

China embarked with the concept of sustainable development with the launch of its first national white paper Agenda 21 in 1994 (China Population Today 1994), which envisioned the interconnections between population growth, environmental potential, and visions of development in the 21st century. The central government further introduced the principle of people-centered development as guidance for the country's urbanization process (Wen 2004). Consequently, scholarly interests on the planning and management of UNRs in China coupled with the rapid urbanization context increased, primarily from technical planning and landscape ecology perspectives. Wang (2009) points out that the Chinese urban planning system needs greater ecological literacy, including ecological awareness and technical planning knowledge. Jim and Chen (2003) demonstrates how to integrate landscape ecology principles into the planning of urban green spaces at three different landscape scales - metropolis, city, and neighborhood, using the case of Chinese compact city Nanjing. Kong, Yin, and Nakagoshi (2006; 2007) use GIS and landscape metrics to present the spatial-temporal distribution patterns of UNRs and assess the amenity value of UNRs in hedonic price modelling. Kong et al. (2014) further show how spatial configuration of urban green spaces could enhance cooling effect through studying a large metropolitan area in eastern China. Gong et al. (2018) examine the urban expansion dynamics and modes in Guangzhou and argued that, zoning as a major urban planning technique is not the major factor influencing urban landscape or the distribution of UNRs.

Zhao (2005) argues the Chinese urban development principles such as *sustainable development* and *people-centered development* are too normative, and have not been able to indicate practical, 'how-to' type of policy solutions. To analyze the actors, policies, and governance aspects of UNRs, Maddox (2017) stresses the need to understand first what types of economic properties UNRs are in theory. Foster and Iaione (2016) consider urban spaces as common-pool resources (CPRs), as rapid land consumption in cities often creates rivalrous conditions under which one resident's use of that space and the resources within is likely to subtract the usability of urban spaces for others. Similarly, Fischer and Steed (2008) argue that UNRs such as street trees may be best considered as CPRs due to their nonexcludable, yet subtractable nature. Matisoff and Noonan (2012) and Colding et al. (2013) refer to UNRs as 'urban green commons' and, with evidences from Europe and South Africa, argue that, what marks UNRs as urban green commons is the right for urban inhabitants to actively manage them, regardless of property rights arrangements of land being private, public, club, or hybrid. The above literature shows UNRs has increasingly received scholarly attention from the commons perspective in various regions of the world, but not yet in China, as Wang (2017) argues, despite the country is one of the most fertile

grounds with diverse and abundant CPRs and governance practices. The commons perspective could contribute to articulate the complexity of stakeholders, governance measures and environmental outcomes within the realm of UNRs planning and management.

3. Theoretical framework

3.1 Governance

Governance, according to the Natural Resource Governance Institute1, is "the form of political regime or the manner by which authority is exercised in the management of a country's social or economic resources for the public good. Can also refer to the capacity of governments to design, formulate and implement policies and discharge functions." Governance approaches determine the types of environmental policies and actions made and implemented on the ground. A top-down approach originates and is often directed based on decision-making from "the top," whilst a bottom-up approach describes data collected and processed, decisions made and acted upon locally (Nicholls et al. 2015). In urban planning, top-down governance offers advantages of efficiency and benefits of scale (Pissourios 2014; Nicholls et al. 2015). Top-down and bottom-up tendencies have marked the history of post-Second World War urban planning, with a shift towards more bottom-up (Healey et al. 1982). Nonetheless, the appreciation of technical expertise, a characteristic of top-down approach, has also increased (Pissourios 2014). Over the years, top-down approach has received criticism for being potentially exclusive and paternalistic in nature, and tending to prioritize "expert" knowledge, thereby neglecting local needs and their self-organization ability (Smith 2008). On the other hand, bottom-up governance has gained popularity in recent years for appreciating and incorporating local people and knowledge, skills, needs and experiences into decision-making (Smith 2008). Local governments are increasingly recognized as playing a central role in climate adaptation planning (Blanco et al. 2009; Sanchez-Rodriguez 2009; Matthews 2012). In urban planning, bottom-up approach often delivers greater accuracy and lowers costs for decision-making thanks to more immediate and small-scale data collection (Nicholls et al. 2015). Yet, bottom-up approach could be weak for master planning of urban infrastructures which impact large population (Pissourios 2014). Despite increasing recognision on their importance, local agencies are increaingly confronted by wicked environmental and climate problems due to their high complexity in time and spatial dimensions (Mimura et al. 2015).

Multi-level governance refers to established arrangements with multiple actors (individuals and institutions) participating in policy-making within and across various politico-administrative institutions at different territorial levels (Stephenson 2013). Global climate governance is an

¹ https://resourcegovernance.org/analysis-tools/tools/natural-resource-governance-glossary

example of multi-level governance, for its entirety of political institutions are put forward to deglobalize and to solve specific national and regional problems, or to provide transnational common goods and services (Zürn 2012). In today's increasingly complex social-ecological circumstances marked by urban sustainability issues, multi-level governance approach has the potential to create positive incentives for sustainable use or resources thanks to its characteristic of shared responsibility, which facilitates learning and adaptation that are context specific, values and trust based (Adger et al. 2005; Armitage 2007; Newig and Fritsch 2009). Compared with top-down governance which has a command-and-comply trait, multi-level governance involves more sophisticated rules of power distribution, responsibility sharing, and mechanisms of policymaking. Although, how exactly power from higher level impacts the learning and integration of policy-making processes across levels of governance, are not yet well understood (Doherty and Schroeder 2011; Bache 2012; Marquardt 2017).

Collaborative governance refers to public and private stakeholders engaging together in consensus-oriented planning and decision-making for environmental management and resource allocation (Ansell and Gash 2007). Collaborative governance relies on face-to-face dialogue, trust building, and development of commitment and shared understanding to prevail (Ansell and Gash 2007). Scholars have recommended collaborative governance for the planning and management of UNRs (Jim 2013).

Participatory governance seeks to enable public, civic, and private sectors to participate in decision-making, emphasizes the space for public expression, and explores aspects related to citizen competence, empowerment, capacity building, and impacts on service delivery, social equity, and political representation (Ron 2012; Fischer 2012). "Participatory," "democratic," and "inclusive" are interchangeable terms. However, providing space for public expression does not automatically guarantee implementation or capacity to implement (Ron 2012). Participatory governance is both desired and hesitated by governments as it both informs decision-making and increases uncertainty and costs of implementation (Phillips 2012). Collaborative and participatory governance share the same democratic characteristic and potential to improve government capacity for problem-solving in the long term. Nevertheless, comparing the two approaches, collaborative approach tends to demonstrate higher potential in improving governments capacity thanks to its emphasis on equal stakeholder collaboration, whilst participatory governance delivers more social equity in policy-making (Papadopoulos 2012).

Scholars across disciplines have stressed the need for a comprehensive, institutionally innovative governance approach that combines different types of governance, is context-specific, responds to local values, and enables trust building for learning and coordinated actions across multiple actors for urban sustainability (Lowe et al. 2009; Agarwal 2009; Tompkins and Eakin 2012; Pissourios 2014; Mimura et al. 2015). Effective governance depends on how institutions and actors perform and interact as a whole (Fisher et al. 2005). The *Millennium Ecosystem*

Assessment laid out four universal core principles of effective governance: *compliance*, *legitimacy*, *interlinkages between institutions* and *adequate financing*. *Compliance* describes the degree to which states follow formal rules and obligations dictated by a next higher-level government. *Legitimacy* includes the clarity of the rules, the interpreted coherence of the rules and their adherence to the existing hierarchy of rules. And then, the *interlinkages between institutions* also influence the effectiveness of governance, as several institutions must inevitably become involved in response formulation and implementation to ensure effectiveness. Furthermore, *adequate financing* is important for supporting an adequate implementation infrastructure, and for addressing the environmental problem itself (Fisher et al. 2005). Finally, effective governance, through institutional and technological support, is both the reason and result for lowering the costs of governance.

3.2 UNRs as CPRs and bundles of rights

Ostrom (1977; 1990: 30) proposes common-pool resources as a new type of goods distinctive from private, public, and club goods, and refers to them as "natural or man-made resources that are sufficiently large as to make it costly but not impossible to exclude potential beneficiaries from obtaining benefits from its use." CPRs shares the attribute of subtractability with private goods and non-excludability with public goods. The use of CPRs by one individual will result in lower availability for others. Furthermore, just like public goods, CPRs face similar problems of free-riding, or opportunism. CPRs can be governed as either government, private, or community property, or a mixed one (Bromley 1986), each associated with a different bundle of rights possibly including access, withdrawl, management, exclusion and alienation (Ostrom 2005).

UNRs are ideally a type of CPRs crucial for urban health and has potential as climate solution. UNRs have both the low excludability and high subtractability characteristics. No one can exclude urban residents from using UNRs and their ecosystem services for, e.g., physical exercises, better air, water and soil quality, contact with nature, and mitigation of the impacts of extreme weather such as heatwaves and urban inundation. Urbanization process happens when the amount of residents and the land consumed for economic services increase. Hence, the number of urban residents and frequency of use influence the overall availability of UNRs. Therefore, UNRs are a type of commons, as Wendell Berry (1987) portraits: "… (*CPRs*) is a commonwealth: a place, a resource, an economy. It answers the needs, practical as well as social and spiritual, of its members – among them the need to need one another." Street trees, urban parks, urban wetlands, ecological corridors, and the ecosystem services they provide correspond strongly with the features of CPRs. UNRs are significant to the health and wellbeing for urban residents especially facing increasing environmental degradation and intensified climate change impacts. Viewing UNRs from the *commons* perspective responds to the big picture which considers not only current generation's needs but also that of future generations

and can initiate a fundamental shift of values. Arranging the right bundles of property rights within context is critical to the success of UNRs governance.

3.3 Institutional Analysis and Development framework (IAD framework)

Ostrom and her colleagues developed the IAD framework (Fig. 1) to examine how institutions promote or obstruct human collaboration and governance (Ostrom 1975; 1986; 2005; Kiser and Ostrom, 2000). The IAD framework is proven effective in many empirical studies of CPRs such as irrigation systems, forest management and atmospheric CO₂ emission in the context of climate change (e.g., Lam 1998; Neeraj et al. 2000). In addition, it is able to capture a consistent set of variables for CPRs studies also in urban context (e.g., Ostrom and Whitaker 1973). UNRs as a type of CPRs hence can be studied under this framework. The IAD framework contains a general set of variables for examining human interactions in diverse institutional settings e.g., markets, private enterprises, families, community organizations, legislatures, and government agencies (Ostrom 2005).



Figure 1. the Institutional Analysis and Development (IAD) framework. Source: Ostrom (2005)

The cluster of external variables in the IAD framework - biophysical conditions, community attributes and rules in use, influences action situation, the center of the framework. Biophysical conditions refer to the natural environmental conditions in a given research context. Community attributes refer to the internal homogeneity or heterogeneity, knowledge and social capital of those individuals or groups who may participate or be affected by others. Rules-in-use are the information which shapes common understanding among those involved related to actions of permision, possibility and proibition, and changes of these rules through interactions over time (Crawford and Ostrom 1995; Ostrom 2005). These external variables together impact an action situation which then generate patterns of interactions and outcomes. Participants of the action situation as well as researchers evaluate the interaction and outcome, which could feed back to the external variables and action situation (Ostrom 2005). In the center of the IAD framework is action situation, where participants interact with one another from the position they are assigned to, information and options given.

4. Methodology

This is a qualitative and case-based inquiry based on data collected through in-depth semistructured interviews, policy archives search and field trips. The cases are then studied under the IAD framework and evaluated with a multi-criteria assessment (MCA). I carried out data collection in Guangzhou over a period of nine-month in total between end of 2017 till the summer of 2019.

I chose three cases to understand the governance of different types of UNRs: an ecological corridor, an urban wetland park converted from orchards, and a Sponge City demonstration site (for definition of Sponge City please see Section: Case Studies). All three cases have been implemented in the last two decades, or since the new millennium, in Guangzhou, Entering the new millennium, the Chinese central government adopted *sustainable development* as a major goal in the nation's 10th Five-Year Plan (FYP) for economic and social development in 2001-2005. The new FYP would lead sub-level governments - provincial and city levels - to plan their sustainability goals accordingly. Choosing three case studies within the same city allows for analysis of UNRs governance dynamics through time within the same biophysical and political context. Focusing on city or municipal level is adequate for this research as in China, urban governments are the decisionmakers of master plans, all issues related to land-use, environmental and social externalities. Urban governments are uniquely situated to understand local contexts, to coordinate and to implement local actions across sectors and actors (Brunner et al. 2005). I chose the city of Guangzhou to study Chinese UNRs governance also because of the city's biophysical condition: Guangzhou is an emerging, compact megacity located in a low-lying estuary and in a sub-tropical climate zone with 15 million population, high land scarcity and facing high risks of climate change impacts.

I use in-depth, semi-structured interviews to gather qualitative, descriptive data about the decision-making processes and outcomes in the three UNRs governance cases in Guangzhou. Semi-structured interviews allow flexibility to follow up on valuable threads or specific insights emerged during interviews. The interviews are complemented with archive research including policy documents, media reports, and collection of secondary data from the Guangzhou Municipal Archives effective from 2000 to 2018.

5. Macro-level institutions for urban sustainability in China

In China, the notion of *sustainable development* has evolved through several stages since the launch of China's *Agenda 21* in 1994 (*China Population Today* 1994), the first white paper envisioning the interconnections between population growth, environment potential, and visions

of development in the 21st century. In 1996, *sustainable development* was elevated as a national strategy to navigate the country's urbanization process. Entering the new millennium, the national government further integrated the concept of *sustainable development* into the proposal of a *scientific development concept* (*kexue fazhanguan*, 科学发展观) which had the reference of "people-centered, comprehensive, coordinated, and sustainable development" (Wen 2004).

In 2007, the concept of *Ecological Civilization* was introduced into the National Party Congress Report as a strategic goal of China's modernization in 2012 (Pan 2012). The concept of *Ecological Civilization* emphasizes respect and compliance with Nature, social equity, energy and resource efficiency in industry, balance in regional development status, as well as life quality (Pan 2015). Over the last decade, the concept gradually became the development paradigm and national environmental policy framework. Despite its seemingly ideological emergence, the concept *Ecological Civilization* has come to introduce distinctive methodological propositions and policy recommendations under the centralized government system (Wang and Su 2015). For example, the 'Ecological Red-Line' system launched since 2018, demands paid use of sensitive ecological areas and compensates deeds of ecological conservation. In 2015, the State Council launched the *Integrated Reform Plan for Promoting Ecological Progress* outlining the need to restore the ecosystems more efficiently through systematic, holistic and better-coordinated governance systems.

In addition, Adhering to the concept of *people-centered development* in *Ecological Civilization* means framing economic growth as a means to achieve the end goal of fulfilling citizens' needs and improving human-nature relationship (People's Daily 2008). The concept was operationalized further in 2015, when the State Council launched an umbrella proposal - the *Overall Plan for the Reform of Ecological Civilization System* (《生态文明体制改革总体方案》) for institutional reform. The proposal defines the overall requirement of the reform, including ideological guidance, main ideas, principles, and goals, and lists eight categories for system reform:

- 1) property rights of natural resources;
- 2) development and protection of land resources;
- 3) development of a spatial planning system;
- 4) management and conservation of total resources;
- 5) paid use and compensation of resources;
- 6) governance of the environment;
- 7) market systems of environmental governance and ecological protection; and
- 8) assessment of governance performance and accountability.

In early 2018, the central government conducted a profound institutional reform, including the creation of two brand new ministries –Ministry of Ecology and Environment, and Ministry of Natural Resources, to concentrate the scattered responsibilities of different government

departments. Since launching the *Integrated Reform Plan*, the national administration has pushed forward institutional reform from central to local level to align with the paradigm of *Ecological Civilization*, and is likely to continue (Wang and Su 2015).

A recent adoption of the *people-centered development* principle in China is the launch of the National New Urbanization Plan (2014–2020), which flagged the ambition to transform the current land-intensive urbanization model. The goal of the National New Urbanization Plan is to improve the quality of public infrasctructure and services such as public transportation, housing, utility, health care, and education, to reduce rural-urban disparities by granting rights to rural migrants to access urban services2, to institutionalize environmental protection programs and, to innovate urban governance approaches (State Council of China 2014).

6. Case studies

Overall biophysical conditions

Guangzhou is located at 23°07′55″N, 113°15′58″E on the estuary of the Pearl River Delta by the Southeastern coast of China (see Fig. 2) with a total urban territory size of 7,434 km₂ and population of 15 million. The city has a subtropical climate with an average temperature of 22_oC featuring hot, humid summers and dried, mild winters. Guangzhou is facing the threat of tropical cyclones, precipitation and heatwaves, all of which have increased both in numbers and intensity in the last decades₂ (Nicholls et al. 2007). As one of China's three largest cities (the other two are Beijing and Shanghai), Guangzhou is particularly vulnerable facing climate change impacts with ongoing urban density and environmental degradation problems (Malik et al. 2012). Guangzhou is ranked at the greatest risk in a global ranking of 10 megacities with regard to the value of property and infrastructure assets exposed to sea-level rise and coastal flood risks induced by climate change (Hallegatte et al. 2013).



Figure 2. Geographic location of Guangzhou and three cases. Source: Google Maps.

² City Government of Guangzhou. Natural and geographical conditions of Guangzhou. Available at: http://www.gz.gov.cn/zlgz/gzgk/zrdl/index.html

Left: Map of China and location of Guangzhou (small red mark) Middle: Location of Guangzhou (dark purple) in Guangdong Province (light purple) Right: Location of three UNRs governance cases. The pink block refers to the first case: The Panyu Ecological Corridor. The yellow block refers to the second case: the Haizhu Wetland Park. The light blue block refers to the third case: the Sponge City demonstration site.

Table 1 provides an overview of the characteristics of three UNRs governance in Guangzhou (The color highlights correspond to the colors on the last map in Fig. 2)

Characteristics	Cases				
Characteristics	Panyu Eco-Corridor	Haizhu Wetland Park	Tianhe Sponge City demo-site		
Period	2000-2006	2012-2015	2015-2017		
Size (km2)	/	11km2	3.57km2		
Administrative body	Municipal government of Guangzhou				
Stakeholders involved or influenced	Panyu district government	Haizhu district government	Tianhe district government		
	Business/individual residents with interests in land	Villagers/orchard land collective owners	Other departments of municipal government		
	Residents in neighboring area	Urban migrant workers	Residents in neighboring area		
Method	landscape adjustment/ conversion	land property right acquisition	landscape adjustment/conversion		
		landscape adjustment/ conversion			
Urban planning basis	Guangzhou Ecological Conceptual Plan	Guangzhou Master Plan	National Sponge City Initiative (under <i>Ecological Civilization</i>)		

Case 1: The Panyu Ecological Corridor

Biophysical condition: Rapid urban expansion in China has often caused land consumption to outpace land-use indicators stated in master plans, invalidating them before the end of planning periods. In this context, the planning and management of UNRs are in relatively weak position that often gets compromised by the needs for land to construct for economic development. Such is the case for the Panyu Ecological Corridor in Guangzhou.

Community attributes: By administrative category, Panyu was a county, a sub-level unit of cities in China, and was independent from Guangzhou city prior to the new millennium. Thirst for land for future economic development prompted Guangzhou to propose a merger with Panyu, which occurred in 2000. Panyu is located at the south of the city and at the estuary of Pearl River. The district has an alluvial landform and lacks natural landscape features that have a

blocking effect, such as mountains; therefore was at risk of losing UNRs to the urban sprawl trend.

Rules in use: From an urban ecology perspective, ecological corridors are an excellent way to plan UNRs as they provide crucial ecosystem services such as air, water and soil purification, noise cancellation, soil fixation, food production, education, recreation and many more, thereby playing a supportive role for urban development. The Panyu Ecological Corridor, based on such ecological principle, was laid out on a what was referred to as a 'conceptual plan' along with six other ecological corridors in Guangzhou (Fig. 3). In the Chinese urban planning system, 'conceptual plan' refers to plans that serve as optional technical references rather than regulation or blueprints for implementation.

Action situation: The conceptual plan came into formation when the municipal government of Guangzhou began to plan to respond to the 10th national FYP (2001-2005) which proposed the goal of *sustainable development*. The Guangzhou government was in the position to come up with a strategy to respond to this national goal: to plan an ecological corridor network within the city boundary and name the plan "Ecological City" (Xinhua News Agency 2018). By the conceptual plan, the ecological corridor network in Guangzhou (Fig. 3) would have four horizontal (east-west) and three vertical (north-south) corridors established based on existing natural landscape features. The Panyu Ecological Corridor referred to in this research is the vertical (north-south) corridor in the middle, which was planned alongside the S105 Nanshagang Expressway (南沙港快速公路, Abbrev.: S105). According to the conceptual plan, the Panyu Ecological Corridor to the conceptual plan, the Panyu

Actors: The Municipal Government of Guangzhou was the main actor in this conceptual plan, yet had conflictual interests between promoting economic development and responding to central government's goal for *sustainable development*. The District Government of Panyu is the second actor in this case, which holds a primary interest in economic development through accepting the merger and free-riding the policy and infrastructure bonuses provided by the city government. The third actor is private sector or business community whose sole interest is to acquire land where prices are low and transportation are available. The fourth actor is the local residents or the village communities who prefer the ecological corridor for health but also hope to find jobs nearby.



Figure 3. Structural map of the Ecological Corridor Network in Guangzhou Left: Location of the Panyu Ecological Corridor among seven corridors Middle: Current status of land use in Panyu District Right: Planned ecological functional structure of Panyu District Source: Source: *Master Plan, Planning and Construction Guideline of the Guangzhou Ecological Corridors*, 2016(《广州市生态廊道总体规划与生态廊道规划建设指引》), *Conceptual Plan of Panyu District Ecological Corridor* (Qiao and Yang 2013).

Outcome: The green spaces alongside the S105 resulted in constant encroachment. Physically, as the area has an alluvial landform without natural landscape features such as mountains or waterways that have a blocking effect, it was susceptible to encroachment or urban sprawl due to growing land demand. Legally, the Panyu Ecological Corridor is part of a conceptual plan which has no proper legal effect. Economically, this lack of proper legal effect makes the costs to implement the conceptual plan high and costs to encroach the green space low. Consequently, various private construction plans for housing or business near the S105 were either formally or informally approved, encroaching the Panyu Ecological Corridor. As a result, the initial 500-meter-wide greens pace on each side of the S105 was reduced to 100-meter-wide on each side. The well-intended ecological corridor eventually shrank into a green belt (narrower green space than ecological corridor) (see Fig. 4) (Guangzhou Forestry and Gardening Bureau 2012). Costs of this project is unknown.



Figure 4. Satellite image of the Panyu Ecological Corridor area prior and after planning Left: prior to planning and construction of the S105 in 1999 Right: after planning and construction of the S105 Expressway in 2016) Image source: Google Earth

Case 2: The Haizhu Wetland Park

Biophysical condition: Before being converted to a wetland park, the Haizhu Wetland Park was an area of orchards referred to as the Guangzhou Wan Mu Orchard run by farmers in the neighboring villages. The Guangzhou Wan Mu Orchard area is situated at the southeast of the Haizhu district in Guangzhou covering an area of about 8 km₂. As an urban wetland located in the center of the city, the Wan Mu Orchard has been an important component of the city's ecological system, therefore also referred to as the city's "Southern Lung". Traditionally the Wan Mu Orchard had served as a major farm land for the neighboring villages, which are now surrounded by the expanding urban construction and high-rise buildings in Guangzhou. These villages therefore are also referred as urban villages (Lan 2005).

Community attributes: The Orchard has been encroached by urban infrastructures as the land demand has been rising. Many temporary housing arrangements were made by farmers to meet the growing demand of urban migrants. The reason urban migrants gather in these urban villages and choose the temporary housing arrangements is because they tend to be of lower costs. The comparatively lower housing costs in these villages is an attribute of the local land ownership: although located within the city of Guangzhou, the land of these urban villages and the Orchard are collectively owned by villagers rather than by the city (public), and is not categorized as urban development land. The comparatively low housing costs is the primary determinant that has attracted urban migrants to settle in the neighboring urban village area of the Orchard. Second, the Orchard area has been polluted due to the growing number of urban migrants residing in the area without systematically-planned grey infrastructure such as waste treatment facilities. As migrant population grew, the temporary housing arrangements were made by an order of the second area providing the temporary housing arrangements were pro

greater income for the farmers than traditional agricultural practices, further accelerating environmental degradation.

Costs: The Municipal Government of Guangzhou compensated the farmers financially with a total sum of 4.585 billion RMB (~ 647 million US\$, Municipal Government of Guangzhou 2018), in exchange for the property right to own, access, and manage the Orchard, which accounted for around 90% of the collectively-owned land. The remaining 10% collective land, which includes the existing villages and some vacant spaces, is attributed as "development land" permited for commercial purpose, the economic benefits of which would become the alternative income as villagers lost their livelihood source with the Orchard. The Wetland Park project has received 16 million RMB subsidies from the central government for wetland protection and conservation. Since its launch in 2012 till 2018, the Wetland Park project has costed the city as well as district governments 6.3 billion RMB in total for the land property transfer, park conversion and maintenance (Municipal Government of Guangzhou 2019a).

Actors: The Haizhu Wetland Park project was coordinated by the Haizhu District Government, the land acquisition, planning, and conversion were mainly performed by the Haizhu District Housing and Construction Water Authority and other departments collaborated to various extents. The Haizhu Wetland Management Office, a sub-coordinate of the Haizhu District Construction and Gardening Bureau, was set specifically to perform the management function for the Wetland Park. These actions were taken under the several regulations or rules, including:

- the Regulation of Guangzhou Wetland Protection,

- the Master Plan of Guangzhou Haizhu National Wetland Park,

- the Measures for the Management of National Wetland Parks, and last but not least,

- *the Plan for the Ecological Restoration of the Haizhu Wetland*, which was in the process of making as of in 2018.

In addition, some collaborative institutions also emerged in the process of the Wetland Park development. For instance, the Haizhu Wetland Ecological Science Park, a collaborative attempt with a local university – the Sun Yat-sen University, was also in the process of making as of in 2018.

Table 2: Timeline of the Haizhu Wetland Park project

2011	The City Government of Guangzhou confirmed the ecological significance of the Haizhu Wan M				
	Orchard for the city and wanted to protect, restore and conserve the Orchard. The City Government				
	then launched an international campaign calling for proposals to redesign the Orchard. A proposal				
	co-designed by the Guangzhou Urban Planning and Design Survey Research Institute and the				
	Hangzhou Landscape Architecture Design Institute was selected.				
2012	The Ministry of Land and Resources under the State Council approved the property right transfer				
	approach proposed by the City Government to acquire the farm land from urban villagers but not to				
	change its existing function. An initial budget of 4.585 billion RMB was approved for the land				
	acquisition and relocation of property occupants. The cost was shared between the Municipal				

	Government of Guangzhou (80%) and the District Government of Haizhu (20%). A work plan for			
	the land acquisition was formulated and a bill was made to regulate budget use. The land acquisition			
	involved 34 thousand people in 11 thousand households across the eight neighboring villages. The			
	first phase of the Wetland Park was delivered and was open to the public in October.			
2013	The Haizhu Wetland Management Office, a sub-coordinate of the Haizhu District Construction and			
	Gardening Bureau, was set specifically to perform the management function for the Wetland Park.			
2014	The second phase of the Haizhu Wetland Park was completed.			
2015	The Ministry of Forestry approved the Haizhu Wetland Park as a national-level wetland park.			
2016	The third and fourth phases of the Haizhu Wetland Park were completed. In the meantime, the State			
	Council formulated and promoted national implementation of the Proposal for Institutionalizing			
	Wetland Protection and Restoration (State Council 2016).			
2018	The Wetland Rehabilitation Plan for the Guangzhou Haizhu National Wetland Park was compiled			
	to formalize operational guidelines, standards and targets for the Haizhu Wetland Park.			

Outcome: The newly established Haizhu National Wetland Park is designed to be a semi-natural wetland-orchard hybrid ecosystem. The problem of environmental degradation and urban sprawl have been partially resolved or slowed down, the city government of Guangzhou became the land owner of the Wetland Park, meaning the park is now public or state-owned property.



Figure 5. Satellite image of the Haizhu Wetland Park area prior and after conversion Left: prior to conversion in 2009 Right: after land transfer and conversion in 2019 Image source: Google Earth

Case 3: "Sponge City": Concept and demonstration site

Concept: The Sponge City Initiative is China's first systematic effort to enhance the ecological functions of urban green infrastructure for climate adaptation or a ecosystem-based climate management scheme. The scheme refers to a series of planning of new urban green infrastructure and improvement of existing ones for enhanced ecological functions, particularly, of stormwater absorption, storage, retention, purification, and, when needed, release, for controlling surface runoff and thereby adapting to climate change impacts (Liu and Sun 2017). The concept "Sponge

City" resonates with two other concepts commonly used in urban governance literature - low impact development (LID) and green infrastructure (GI) technology (Jia et al. 2017). LID refers to engineering practices that "use or mimic natural processes that result in infiltration, evapotranspiration or use of stormwater in order to protect water quality and associated aquatic habitat" (EPA n.d.a). GI is defined as "...the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspirate stormwater and reduce flows to sewer systems or to surface waters" by the US Environmental Protection Agency in the Clean Water Act (EPA n.d.b).

Rule in use: The Chinese Sponge City Initiative launched by the State Council of China under the *Ecological Civilization* policy framework and *people-centered development* principle in 2013 endorses three approaches: 1) conserving existing major urban parks, green spaces which deliver substantial ecosystem services; 2) restoring degraded ecosystems; and 3) LID. While the first two approaches are ecosystem-based, the third one is characterized primarily by engineeringbased interventions. The Initiative sets the standard for a Sponge City qualification: through applying the ecological as well as engineering means of intervention and ultimately has the ability to absorb, retain, store, and utilize 70% of the stormwater within an urban territory. The initiative sets the goals that cities should have at least 20% and 80 of urban built-up areas that meet the standard by 2020 and by 2030, respectively.

The Special Plan of Sponge City Initiative Implementation in Guangzhou 2016-2030 established by the City Government of Guangzhou urges district governments to treat the implementation of the Sponge City Initiative as a priority and sets the technical procedures for quality inspection. The technical procedures and standards for implementing the Sponge City Initiative range from urban water supply standards to outdoor drainage, urban greening, vertical greening, and flood control standards. These standards constitute the information necessary for implementing the Sponge City Initiative locally up to expectations. In addition, the Special Plan proposes to enhance the accountability of local officials for Sponge City Initiative implementation by adding it to their regular performance evaluation. The potential sanction for the local officials as an outcome of negative performance evaluation, such as demotion or not being rewarded or encouraged by the national government, is a trade-off that local officials must take into consideration. Furthermore, the supervision, technological, and professional support aggregate to jointly affect the outcome of Sponge City Initiative implementation. Although supervision aggregates to promoting the implementation through providing control, while technological and professional support aggregates through support. Financially, local officials are advised to actively explore different channels of financing while operating with available financial capital for the implementation of the Sponge City Initiative.

Actors: The central government of China defined the Sponge City Initiative as a means of ecosystem-based climate management and urban water governance, and the municipal government of Guangzhou implemented it by establishing the Special Plan of Sponge City Initiative Implementation in Guangzhou 2016-2030. The initiative is implemented within the country's top-down administration structure. At the central level, the implementation is led by the Ministry of Housing and Urban-Rural Development (MOHURD) with the financial support from the Ministry of Finance, and technical support from The Ministry of Water Resources. At the central level, the Ministry of Housing and Urban-Rural Development (MOHURD) leads the implementation of the Sponge City Initiative with the financial support from the Ministry of Finance (MF) and the technical support of the Ministry of Water Resources (MWR) (see Table 3). At the local level, the Sponge City Initiative in Guangzhou is implemented by the Leading Group of Sponge City Construction, which is primarily led by the municipal government of Guangzhou and participated by other governmental departments, particularly the housing and urban-rural development bureau, the finance bureau and the water authority. Each district under the Guangzhou municipality is then equipped with the same organizational structure. The Special *Plan* defines that the Sponge City Initiative should be implemented within a particular focus area of 1092.5 square kilometres within the urban boundary of Guangzhou. The district governments are then responsible for implementing the Sponge City Initiative on the focus area within their respective territory or boundary.

Table 3. The Chinese Sponge City initiative				
Main attributes	Characteristics			
Launch	2013			
Responsible government branches	Lead: Ministry of Housing and Urban-Rural Development (MOHURD) Financial support: Ministry of Finance (MF) Technical support: Ministry of Water Resources (MWR)			
Approaches	Conserving existing major urban parks, green spaces Restoring degraded ecosystems LID			
Standard	Being able to absorb, retain, store, and utilize 70% of the stormwater within its urban territory Indicator: annual rainfall-runoff rate control			
Goals	By 2020, 20% of urban built-up areas meets the standard By 2030, 80% of urban built-up areas meets the standard			
Pilot cities	First batch: 16 cities in 2015 Second batch: 14 cities in 2016			
Finance	Funding from central government for each pilot city varies from 400 to 600 million RMB (57- 85 million US\$) per year Implementation via public-private partnerships (PPP)			

Fig. 6 give an impression of the Sponge City Initiative planning and implementation in Guangzhou.



Figure 6. Sponge City construction plan of Guangzhou Left: The Special Plan for Sponge City Construction of Guangzhou 2016-2030. Source: Guangzhou Urban Planning & Design Survey Research Institute. Upper right: The Green Sponge System of Daguan Park in Guangzhou. Lower right: An aerial view of the Daguan Wetland Park in Guangzhou. Sources: Turenscape

Finally, the national-level Special Plan advises local governments to amend current regulations and policies, integrate plans from different sectors, and make concrete project-based action plans to enhance the local implementation of the Sponge City Initiative. This provides local officials with the choices or flexibility when it comes to collaborating with other departments and local non-governmental actors, for example, real estate developers, to co-invest or co-design green infrastructures that meet the standard of the Sponge City Initiative. Last but not least, the *Special Plan* also suggests local officials engage further with the public by educating them on the benefits of urban green infrastructure and mobilizing them to participate in the Sponge City Initiative by protecting urban green infrastructure.

7. Analysis

7.1 Institutional analysis using the IAD framework

Fig. 7 provides an overview of the institutional dynamics in UNRs governance in Guangzhou. In Case 1, the Panyu Ecological Corridor in the "Ecological City" plan was only partially implemented, which means the area has eventually succumbed to the increasing land demand for urban economic development. It is not unexpected as China has been placing economic development as the primary goal for the country since the leading government's founding in 1049. *Sustainable development* was newly-endorsed as a national development strategy, yet it was normative and had no institutional mechanism to secure a top-down delegation. The lack of proper legal effect meant that the conceptual plan could be subjected to modification depending on the needs in context. For example, the desire for infrastructure and employment made Panyu district government engage in a cross-level negotiation with Guangzhou city government for flexibility when building the ecological corridor network.



Figure 7. Institutional analysis of three UNRs governance cases in Guangzhou (2000~2020). C1 refers to Case 1: the Panyu Ecological Corridor. C2 refers to Case 2: the Haizhu Wetland Park. C3 refers to Case 3: the Sponge City Demonstration site. EC refers to *Ecological Civilization*.

In Case 2, the plan to conserve orchards and convert it into the Haizhu Wetland Park had a similar context of land expansion but a more focused goal of conserving UNRs. At the central level, Ecological Civilization served as a stronger development paradigm (than sustainable development) and top-down political dynamic which shaped the initiative of the Haizhu Wetland Park project. In this case, innovative governance approaches such as public-private partnership (PPP), public participation, government-community negotiation were experimented. With a considerable amount of financial compensation made to the local farmers (residents), the city government of Guangzhou succeded in converting the orchards into a wetland park and conserving UNRs. The social costs prevail among the community of urban migrants, who defacto reside in informal housings in the area without adequate rights. The conversion of the Haizhu Wetland Park further exposed them to the lack of public services from sanitation to education, to proper housing and health care, by narrowing informal housing area. Despite ongoing social externalities, biodiversity at this park has increased by 31.9% (District Government of Haizhu 2016). The Haizhu Wetland Park management, a government-led PPP, succeeded in institutionalizing the project into permanently conserved UNRs. The project was also elected as one of the "40 innovations of local reforms in China's 40 years of economic reform and liberation" (Municipal Government of Guangzhou 2019b).

In Case 3, the Sponge City demonstration site was established based on the central government's assessment of climate change impacts and requests for ecosystem-based solutions at local levels. The request is coupled with the national institutional context to pursue a more *people-centered* urban development within the environmental policy framework of *Ecological Civilization*. Compared to Case 2, the Haizhu Wetland Park project, the planning and management of Sponge City demonstration site targets more directly and involves fewer actors. The interaction between actors is conventional - led by top-down delegation and followed by PPP. The technical standards and functions of the Sponge City demonstration site are institutionalized in the *Special Plan of Sponge Construction in Guangzhou* 2016-2030. Yet, implementing an emerging urban planning practice like the Sponge City initiative touches the vested interests of other government departments (e.g., the hydraulic engineering department), making it difficult to achieve the consensus needed within the city government for scale-up.

7.2 Evaluating Guangzhou's UNRs governance with multi-criteria assessment (MCA)

I further conduct a multi-criteria assessment (MCA) to evaluate the interaction and outcome of UNRs governance in Guangzhou. MCA is frequently used for estimating the quality of governance by assessing the decision-making processes, as well as the social, economic and environmental impacts of relevant policies. I use the evaluative criteria in the IAD framework as the first tier criteria, which are: 1) economic efficiency, 2) equity, 3) adaptability, resilience, and robustness, 4) accountability, and 5) conformance to general morality. Based on these five

criteria, I further took reference from two publications. One is the The *Millennium Ecosystem Assessment*, which laid out four universal core principles of effective governance: *compliance*, *legitimacy*, *interlinkages between institutions* and *adequate financing* (which I have introduced in Section: Theoretical framework - Governance). The other publication is the Multi-Criteria Evaluation (MCE) guideline3 developed by the Institute of Advanced Sustainability Studies (IASS) in 2018 for analyzing ENavi - the Energy Transition Navigation System, one of four Kopernikus Projects for *Energiewende*, the German national energy transition scheme. This evaluation guideline includes 10 criteria divided into three groups highlighting more diverse aspects of sustainability. The 10 criteria are:

1st Group: Evaluating targets: (1) Effectiveness; (2) cost efficiency; (3) total costs; (4) resilience 2nd Group: Evaluating "side effects": (5) economic predictability and contribution to the common good; (6) health and environmental protection and resource conservation; (7) fostering social cohesion

3rd Group: Evaluating compatibility with legal, political, and ethical norms and values: (8) legitimacy; (9) ethical acceptability; and (10) legality

1st tier criteria	2nd tier criteria	C1	C2	C3
Economic efficiency	1. Cost efficiency of planning	?		?
	2. Cost efficiency of implementation	?		?
	3. Direct economic efficiency			
	4. Indirect (non-market) efficiency (e.g., ecological)			
Equity	5. Health and wellbeing			
	6. Economic benefits			
	7. Rights to participate			
	8. Rights to monitor			
Adaptability, resilience, and robustness	9. Institutional adaptability (change over time)	?		?
	10. Ecological resilience (ability to stay resilient)			
	11. Engineering robustness (ability to resolve climate impacts)			
Accountability	12. Administrative accountability			
	13. Information transparency			
Conformance to general morality	14. Ethical acceptability			
	15. Legitimacy (conformity to the law)			
	Very clearly negative		Very clearly	positive
	Clearly negative		Clearly positive Slightly positive Neutral / Insignificant	
	Slightly negative			
?	Insufficient information			

Based on these criteria, I created table 4 with the second tier of criteria, 15 in total number, to assess the effectiveness of UNRs governance in Guangzhou.

Table 4. Multi-criteria assessment of UNRs governance in Guangzhou

³ <u>https://www.iass-potsdam.de/en/news/energiewende-guidelines-multi-criteria-evaluation</u>

I assessed the three UNRs governance cases in Guangzhou in this MCA. As shown in Table 4, both Case 2 the Haizhu Wetland Park and Case 3 the Sponge City demonstration site have performed positively on bringing positive economic as well as ecological efficiency. Social equity issues, namely the rights to participate and the rights to monitor, stand out particularly in Case 1 - the Panyu Ecological Corridor project and Case 3 – the Sponge City demonstration site. In Case 1, what could have been a decent ecological corridor became compromised for short-term economic gains, showing weak accountability of the local authorities. Even years after, it was challenging to collect information about Case 1, the Panyu Ecological Corridor project, due to the frequent redeployment of local officials and probably low awareness for information transparency. The fact that the Panyu Ecological Corridor project was planned in a legally non-binding conceptual plan without clear arrangements of property rights, shows a low degree of legitimacy (conformity to the law). Case 1 did not manage to resolve the issues around who have the rights to monitor the implementation of the ecological corridor and who to manage it, plus weak accountability, hence has negative ethical acceptability.

Case 2 – the Haizhu Wetland Park scored positively overall with a slight minor impression on providing health and wellbeing, particularly those of the urban migrants who are the real residents of the area. Administrative accountability, information transparency and ethical acceptability notably improved compared to Case 1, probably as results of the diversified actors and governance approaches.

Case 3 – the Sponge City demonstration site delivered positive ecological efficiency critical to the health and wellbeing of residents in the climate change context. Rights for residents and other non-government actors to participate and to monitor are limited probably due to strong central command which was primarily delegated downwards. It is still unclear whether the national Sponge City Initiave will have the institutional adaptability to change over time, due to the lack of inter-departmental consensus within city governments to scale-up the initiative.

8. Discussions

The institutional analysis and MCA conducted above reveal that multiple forms of governance have been applied in UNRs governance in Guangzhou, from top-down to multi-level and from collaborative to participatory. This finding contrasts the conventional assumption in the literature that governance in China is mostly or even solely top-down. UNRs in Guangzhou are considered a type of CPRs whose subtractability is highlighted in the rapid urbanization context with evident land scarcity. The unexcludability of UNRs in Guangzhou is reflected by a paradigm shift towards more *people-centered*, *sustainable* urban development under the Chinese national environmental governance framework *Ecological Civilization*.

Some of the UNRs governance practices in the Chinese rapid urbanization context can be considered successful. They are represented by the example of Case 2, the Haizhu Wetland Park – a local initiative served by a strong national paradigm *Ecological Civilization* and shaped by top-down political dynamics. This type of UNRs governance practice is also marked by innovative governance approaches such as public-private partnership (PPP), government-community negotiation, and public participation experimented among a diverse range of actors.

The rapid urbanization context and subsequent land scarcity are biophysical challenges for UNRs governance in China. In addition, institutional challenges remain in the Chinese UNRs governance practices, when 1) governance approach being primarily top-down without proper articulation with other institutions and actors, such as Case 3 - the Sponge City demonstration site; and 2) legal arrangements or bundles of property rights (to access, to participate, to manage...) are unclear, such as Case 1 - the Panyu Ecological Corridor.

The CPR theory and bundle of rights distinction proposed by Ostrom (2005) are applicable to study Chinese UNRs governance to the extent that, in theory, all UNRs in China are government property, beyond which, suggestions given to arrange the proper bundles of property rights for UNRs governance in China cannot go.

9. Conclusion and future research direction

This research focused on the governance of UNRs within the Chinese rapid urbanization context. The underlying condition was, as more literature showcasing the positive environmental and health potential of UNRs, the planning and management of UNRs have attracted much scholar as well as policy attention. UNRs are a type of common-pool resource for that their existence is subjected to limited urban land availability and no one can exclude any urban inhabitants from getting the environmental and health benefits. In this research, I tried to answer this question: "How is UNRs governed in the Chinese rapid urbanization context and what are the institutional challenges?" through examining three case studies that occurred in the last two decades from Guangzhou, a coastal megacity in southeastern China.

These three cases of UNRs planning and management have been influenced by several nationallevel institutions such as *sustainable development*, recent Chinese national environmental governance framework *Ecological Civilization*, and the subsequent notion of *people-centered* urban development. These institutions have prompted Chinese local governments to enhance the planning and management of UNRs. Governance of UNRs in China is informed by planning technicians and primarily government-led in a classical top-down approach but not only; central government, district governments private sector, and communities also interacted and formed patterns of multi-level governance, collaborative as well as participatory governance.

Land scarcity from rapid urbanization and the associated property rights arrangements are the central challenges for the governance of UNRs in China. Sometimes, despite successful governance of UNRs for environmental benefits, such as Case 2 – the Haizhu Wetland Park, social equity issues prevail with the urban migrant community. This indicates that: 1) UNRs governance is an intriguing topic as cities evolve to become ever more complex adaptive social-ecological systems; and 2) normative guidance such as *Ecological Civilization* in China could be insufficient for guiding UNRs governance despite its powerful and political gesture. These findings imply 1) the need for deeper institutional reform in China for the betterment of UNRs as commons, as well as 2) the directions for future research on UNRs governance.

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