

Article

Unsuccessful Urban Governance of Brownfield Land Redevelopment: A Lesson from the Toxic Soil Event in Changzhou, China

Chunhui Liu ¹, Weixuan Song ^{2,*} and Chen Zhou ³

¹ School of Geographic and Oceanographic Sciences, Nanjing University, Nanjing 210093, China; liuchunhui@smail.nju.edu.cn

² Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences, Nanjing 210008, China

³ Biodesign Swette Center for Environmental Biotechnology, Arizona State University, Tempe, AZ 85281, USA; Chen.Zhou.2@asu.edu

* Correspondence: wxsong@niglas.ac.cn

Academic Editor: Tan Yigitcanlar

Received: 10 March 2017; Accepted: 12 May 2017; Published: 15 May 2017

Abstract: A public health crisis in the process of brownfield land redevelopment (BLR) has frequently appeared in the context of promoting industrial upgrading and de-industrialization in China. Recent discussions on the reasons for this problem centered on the lack of laws, standards, and policies needed to secure the process of BLR. However, we argue that an urban governance approach to BLR can identify the sources of the problem. This paper discusses a case study of a toxic soil event in Changzhou, China, based on the theoretical framework—the Institutional Industry Complex (IIC). Under the pressure of fiscal distress as well as the requirements of economic growth and urbanization, local governments in China are bound with fiscal revenue from land development and land urbanization and have formed a pro-growth alliance with enterprises, property developers, and even the public. The alliance is defined as the pro-growth IIC of land finance regime in this paper. Due to the path-dependence of the IIC, the conventional pro-growth IIC of land finance regime in China has been circulated, and then transformed into a pro-growth IIC of BLR. As a result, the goal of the pro-growth IIC of BLR is maximizing profit in the process of land development, a goal that is the same as the pro-growth IIC of land finance regime. Thus, as the pivotal stockholders of the pro-growth IIC of BLR, local governments, enterprises, and property developers hesitate to pursue a prudent and secure BLR process, which effectively attenuates a series of serious environmental issues and public health crises. That is the root cause of the problem. This study suggests a positive interaction between central and local government, as well as between enterprise and the public to create a sustainable IIC of BLR in future.

Keywords: institutional industry complex; urban governance; toxic soil event; brownfield land redevelopment; Changzhou; China

1. Introduction

After three decades of rapid urbanization and industrialization, China faces the challenge of slower economic growth, along with serious environmental issues. To combat these problems, policies regarding the promotion of industrial upgrading and policies working to “suppress the second industry and develop the third industry” have been applied [1]. As a result, many polluting and energy intensive activities have been required to move out of urban areas to peripheral or rural areas [2]. According to statistical data of 2015, more than 100,000 factories have closed since 2001, and over 2 million hectares of brownfield lands that had been seriously polluted have been left untreated in major cities of China [3].

Furthermore, along with the process of industrial upgrading, the brownfield lands would increase 33–47 thousand hectares a year [3]. Meanwhile, due to limitations on land resources, Chinese local governments have to simultaneously pursue urban development and brownfield land redevelopment (BLR) [4]. Local governments expect that BLR can not only be treated as a part of urban renewal to enhance the capacity of land revenue [5] but also promote industrial upgrading and economic growth.

However, a series of public health crises have been subsequently arising during the process of BLR [6]. Different than the health threats of contaminated arable lands emanating from the food chain [7], the brownfield lands directly impact human health through oral ingestion, particle inhalation, and dermal contact [8]. Moreover, the long-term impact can be more significant in the future due to a constantly rising urban population [9]. Thus, central and local governments in China have to handle the potential environmental and public health risks in the process of BLR [10,11]. Despite central and local governments being aware of the seriousness of the issues, the specific standards and policies are not available on details of directly governing the issues of BLR and effectively implementing the process of BLR [12–14]. More seriously, the national level funding system (similar to the superfund program in the United States (US) [15]) and regulations on identifying the responsibility for soil contamination, and accountability for soil remediation are still undeveloped [14]. It is hard to encourage local governments and the private sector to be proactively engaged in BLR. As a result, many brownfield lands are redeveloped without remediation or complete restoration so that the potential risk from the contaminated soil will continue [11,16].

To cope with the growing threat from soil pollution, the state council of China released the *Action Plan for Prevention and Control of Soil Pollution* on 28 May 2016. The action plan complements two previously released action plans, which focus on the challenge of air pollution (released in 2013), and water pollution (released in 2015). The aim of the action plan is to ensure that 90 percent of contaminated land, including arable land, industrial land, and commercial land, should be used safely by 2020. This percentage must increase to 95 percent by 2030. Despite targets and macro management of soil pollution abatement, the action plan cannot change the situation that with regard to lacking safety standards, regulations and policies [1,14].

More seriously, a success of urban governance of BLR relies on collaboration in a scalar political-economic setting among multiple actors including the central and local governments, private sectors, and the public [17,18]. Furthermore, the collaboration must have a clear distinction between responsibility and accountability [19], and is financed to support government policies for soil pollution abatement, making it feasible to implement BLR in safety. However, the action plan lacks any concrete proposals and details on the sources of special funds and how to “mobilize and attract private funds into the field of prevention and control of soil pollution through Public-Private-Partnership (PPP) programs” [20] (p. 21). Furthermore, due to fiscal distress of local governments as well as requirements of economic growth and urbanization, local governments in China are bound with the fiscal revenue from land development and land urbanization, and have formed a profit driven and pro-growth alliance with enterprises and property developers [21–23]. Due to limited land resources in developed cities of China and the path-dependence, development paths will spill over into the process of BLR. Thus, following the theoretical framework—the Institutional Industry Complex (IIC)—and based on the toxic soil event in Changzhou, China, we will show that the conventional pro-growth IIC of land finance regime in China has circulated and transformed into a pro-growth IIC of BLR. As a result, the goal of the pro-growth IIC of BLR is for maximizing profit in the process of land development, a goal that is the same as that of the pro-growth IIC of land finance regime. Thus, as the pivotal stockholders of the pro-growth IIC of BLR, local governments, enterprises, and property developers hesitate to pursue a prudent and secure BLR process, which effectively attenuates a series of serious environmental issues and public health crises. That is the fundamental causes of frequently occurring toxic soil events during the process of BLR in China.

In Section 2, the land finance regime in China within the background of the tax sharing policy is reviewed with reference to its evolution and limitations against the pro-growth Institutional

Industry Complex (IIC). In Section 3, we state that the conventional pro-growth IIC of land finance regime in China has been circulated and is undergoing transformation into a pro-growth IIC of BLR. Under this scenario, local governments, as the pivotal stockholder of BLR, hesitate to pursue a prudent and secure BLR process, which is the real reason that a series of serious environmental issues and public health crises appear frequently. In Sections 4 and 5, we present a case study based on a toxic soil event in Changzhou, China, in April 2016. In Section 6, we discuss the structure and composition of a successful and sustainable urban governance of BLR.

2. The Pro-Growth IIC of Land Finance Regime in China

2.1. Introduction and Interpretation of IIC

The Techno-Institutional Complex (TIC) is the notion that Unruh [24] described of how “carbon lock-in arises from systemic interactions among technologies and institutions”. The TIC of carbon lock-in resulting in worldwide industrial economies is extremely dependent on a fossil fuel based energy system and in a carbon intensive state. Path dependence occurs in four major classes (including scale economies, learning economies, adaptive expectations, and network economies) with increasing returns [24,25]. The TIC is hard to displace, and the carbon lock-in is difficult to unlock when low emission energy technologies emerged and are even encouraged by some governments. In summary, the process in a co-evolution of technology and institution, which is through path-dependent and driven by increasing returns to scale, will result in industrial economies that begin in some technologies or standards lock-in ending in a TIC [24,26].

From an institutional economic perspective, Wu et al. [27] broadened the notion of TIC to analyze the reason that some local governments in China are involved in the petrochemical industry in a setting of political economy termed as *Institutional Industry Complex* (IIC). The framework of IIC, with TIC at the core, places more emphasis on the spillover effect in local communities from TIC when the TIC has been built in the end of the formation of technologies or standards lock-in. In the literature, the IIC has a dual structured pro-growth coalition, composed of multiple agencies and agents, including local governments, public, and private sectors. When the IIC is built, the dual structured pro-growth coalition is locked-in by the petrochemical industry. The reason for the lock-in is not just due to the local governments’ reliance on the benefit of the petrochemical industry or technology lock-in, but also because the petrochemical industry has been spilled from a techno-economic complex into technological, economic, institutional, and cultural levels [27]. In other words, in the pro-growth IIC of the petrochemical industry, the TIC of the petrochemical industry has spilled over into a broad and structuralized local community [27–29]. The pro-growth IIC of the petrochemical industry, as the actor of urban governance, has powerful capabilities in suppressing anti-growth coalitions.

2.2. The Pro-Growth IIC of Land Finance Regime in China

Local governments in China can gain considerable revenue and promote local economic growth in the process of urban land developments, which refers to land finance [21,22,30,31]. The cause of land finance can be summarized in two parts. Firstly, tax reform in 1994 led to displacement of the “system of fiscal responsibility” (cai zheng bao gan) with a “tax sharing system” (fen shui zhi) in China [22]. Since the reform, revenue share of local governments in total national fiscal revenue has decreased from 80 percent to approximately 45 percent [21]. On the contrary, the expenditure of local governments has increased. As a result, the fiscal decentralization under the “tax sharing system” has severely squeezed the budget of local governments, stimulating local governments’ increase in revenue through land finance. Beyond that, under the background of political centralization, economic growth is the incentive mechanism for performance and results of local governments [23]. Local governments are interested in urban land developments that inspire local economy and urbanization, and meanwhile enhance regional competition in attracting capital and investments [31].

Table 1. Main contents of local governments’ revenue from land finance.

Non-Tax Revenue	Tax Revenue	
Land rents; Land-transferring fees; Fees of new land for construction	Direct Tax Revenue	Indirect Tax Revenue
	Urban land use tax; Housing property tax; Value-added tax of land; Farming land occupation tax; Deed tax	Real estate tax; Construction business tax

Source: Modified from the news “The story behind the land finance of China” [32].

Local governments offset fiscal shortfalls with non-tax revenue and the tax revenue from land finance (details can be found in Table 1), obtaining more political resources through the process of urban land development [21]. Land finance, in turn, probably powers the development of the local economy and the process of urbanization [23]. The association between local governments and land finance is a mutually reinforcing process and can be viewed as a co-evolution. Furthermore, as the rapid urbanization continues to expand the fiscal gap between budgetary revenue and expenditures, the local governments have to fund this gap by relying more on the land finance [33]. Therefore, the local governments have been institutionally locked in by land finance, and, in consequence, cannot get rid of the land finance regime despite the many potential risks. However, from an institutional economic perspective, a pro-growth IIC of land finance regime has been formed after the institutional lock-in of land finance arose through the institutional and governmental co-evolution.

The pro-growth IIC of land finance regime, as an actor of urban governance of land finance, is organized with a dual structured pro-growth coalition so that it tapped an inner strength and thus silenced those who oppose the institutional lock-in of land finance. The core of the IIC is the institutional lock-in of land finance arising through institutional and governmental co-evolution. In order to achieve economic development, realize industrialization, and accelerate urbanization, the institutional lock-in of land finance has to spill over into the local community, a coalition of industrial and commercial enterprises, property developers, and the public (Figure 1).

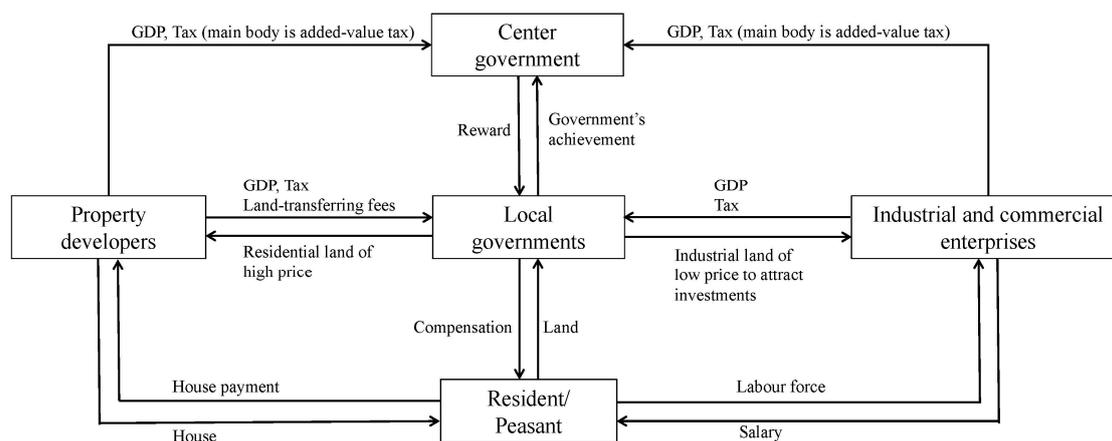


Figure 1. The pro-growth Institutional Industry Complex (IIC) of land finance regime in China.

As illustrated in Figure 1, local governments are supported by the central government to dominate and enforce the policies of land transaction [34,35]. The process not only pushes land urbanization by expanding urban area, but also achieves population urbanization by transferring a significant rural surplus labor force into industrialization and urbanization [36]. Based on that, industrial and commercial enterprises can access a vast and cheap labor supply and industrial land. In addition, local governments also can obtain hefty fiscal revenue to improve public services and government

backed infrastructure investments [37]. This situation takes place among local governments, property developers, residents, or peasants. The local governments can take advantage of leasing land to property developers, while property developers and citizens benefit from the rise of house prices and residential quality in the process of population and land urbanization. As a result, the pro-growth IIC of land finance regime with a dual structured pro-growth coalition has become a pro-growth force to promote land urbanization [27,28].

3. Current Urban Governance of BLR in China

3.1. Process and Issues of BLR under the Background of Deindustrialization

After the 2008 global economic recession, China has been in a situation of high unemployment and lackluster economic growth. To solve this problem, the central government of China accelerated the pace of economic restructuring and tried to abandon its former cheap labor base and export led strategy [38]. As a response to the national strategy of new transition, local governments have kicked off their practices of what is called “tui er jin san” (i.e., to suppress the second industry yet develop the third industry) [39,40]. The local government is expected to take advantage of these practices not only to adjust and upgrade local industrial structure, but also to relieve a shortage of urban land supply [41]. As the result, a mass of high polluting and energy intensive firms were pushed out, and a large number of brownfield lands emerged, mostly in urban areas [42]. Taking Shanghai as an example, since 2007, the government has shut down over 6700 high polluting, energy intensive, and low intellectual capital projects. Four types of industry, including plate glass, ferroalloy, electrolytic aluminum and leather tanning, have completely opted out of the city for the first time in China. All of these practices helped the Shanghai government to reclaim over 80 square kilometers of lands for incremental construction.

However, most of the reclaimed lands were seriously polluted. According to *The Report of Soil Pollution Investigation of China in 2014*, 34.9% of the industrial wasteland and over 29.4% of soil in industrial parks were heavily polluted [43]. In the distribution of soil pollution, the hardest hit areas usually concentrated on “residential, commercial, and other densely populated areas” at urban scale, and “cities in the more developed eastern regions and old industrial cities tended to be more contaminated” at a national scale [9] (p. 27). Furthermore, in the process of BLR, local governments and property developers took enormous irresponsible risks so that many brownfield lands were put on the land market and redeveloped without full soil remediation. This creates a situation where public health may be at risk and leads to public health emergencies appearing more frequently [42,44].

In brief, soil remediation and BLR has been a big hurdle for the local governments [45]. Part of the reason for the situation is absence of regulations in the process of BLR [1,14]. However, as we state, the economic transition and growth driven by urban land reuse are surely much more important.

3.2. The Formation of Pro-Growth IIC of BLR in China and its Potential Risk

The process of urbanization in China is essentially a land development dominated urbanization process [22,46]. During the process, the local governments, as the de facto owner of land, make use of abundant low cost and undeveloped land to enter into an alliance with enterprises and property developers for promoting industrialization and urbanization [47]. The potential value of the low cost and undeveloped land, either from the conversion of rural to urban land or from the land value increment in the process of urbanization [22,48–50], ultimately drove the formation of the pro-growth IIC of the land finance regime and became the basic benefit source of the IIC. Furthermore, along with further development of industrialization and urbanization, the increasing benefits from land value also display the effect of increasing returns to scale [37,51] and strengthen the ties among the IIC [27,28].

However, facing the challenge of urban land scarcity and economic restructure, local government has to involve themselves in regenerating inner downtown areas and pulling down the former industrial zone. As a result, a mass of polluting and energy intensive activities was replaced by commercial buildings or residential communities designed to cash in on the new rent gap [52].

This strategy has significantly enhanced local economic restructuring [36,53]. The pro-growth IIC of land finance regime in China circulates and transforms into a pro-growth IIC of BLR. However, the new IIC has to handle a completely different situation. As bearing the financial burden of BLR is difficult for local governments, the driving force and ties of the alliance are not the potential value or value increment in the abundant low cost and undeveloped land which can be quickly cashed, but the development of brownfield lands that need long term soil remediation.

The new IIC, in which all the members are combined as a profitable alliance, hesitates to afford the huge spending without national financing support. In addition to the economic cost, time cost also triggers fundamental contradictions during the BLR process. Members, including local governments, enterprises, and property developers prefer to ignore the time consuming process of soil remediation in order to maximize revenues through the rapid progression of brownfield lands reuse. The potential risk of serious health problems during the BLR process, even after soil remediation, is borne by the residents or peasants who are the most vulnerable and voiceless in the alliance [11,16].

Amid rapid urbanization, there has been a widening gap between the “potential capital value of ‘the highest and best land use’ and the present capital value of the existing land use constituted a powerful incentive for land redevelopment” in developed cities of China [54] (p. 1254). Thus, the BLR not only fulfills the policy requirements of the central government of China but also meets the pro-growth IIC’s requirements for finding profitable new directions and maximizing the potential profit of lands [29,31]. According to incomplete statistics, over 1000 heavy polluting industries were forced to relocate far from the city centers in Jiangsu, Liaoning, Guangzhou, etc. in China until 2011, and consequently, 200 km² of industrial lands have been reused as commercial and residential lands [55]. Since most of these lands have excellent locational conditions, local governments immediately resold the land-use right to developers for residential and commercial development, leaving most of these brownfield lands untreated [56]. Under this scenario, national policies of soil remediation raise concerns regarding the risks during the BLR process, but cannot solve the fundamental contradictions.

4. Case Study

Changzhou foreign languages school is a key high school in the new north district of Changzhou, Jiangsu province, which is in the eastern coastal developed region of China (Figure 2). In September 2015, about 500 students fell ill after the school moved to the new campus. Their parents attributed the illness to the ambient toxic air and underground water that were polluted during the BLR process near the school. After an unremitting fight and negotiation, CCTV, the biggest TV company in China, reported the incident. The event, as a blasting fuse, evoked public attention on the risk of BLR and soil pollution following the nationwide concerns of air and water pollution in China. In this study, materials and data were collected from the policies of the state council, and documents from Changzhou governments. Other data were collected in May and June 2016 from interviews with local civilians in the residential zone, urban planners, and other officials (see Table A1 in the Appendix A).

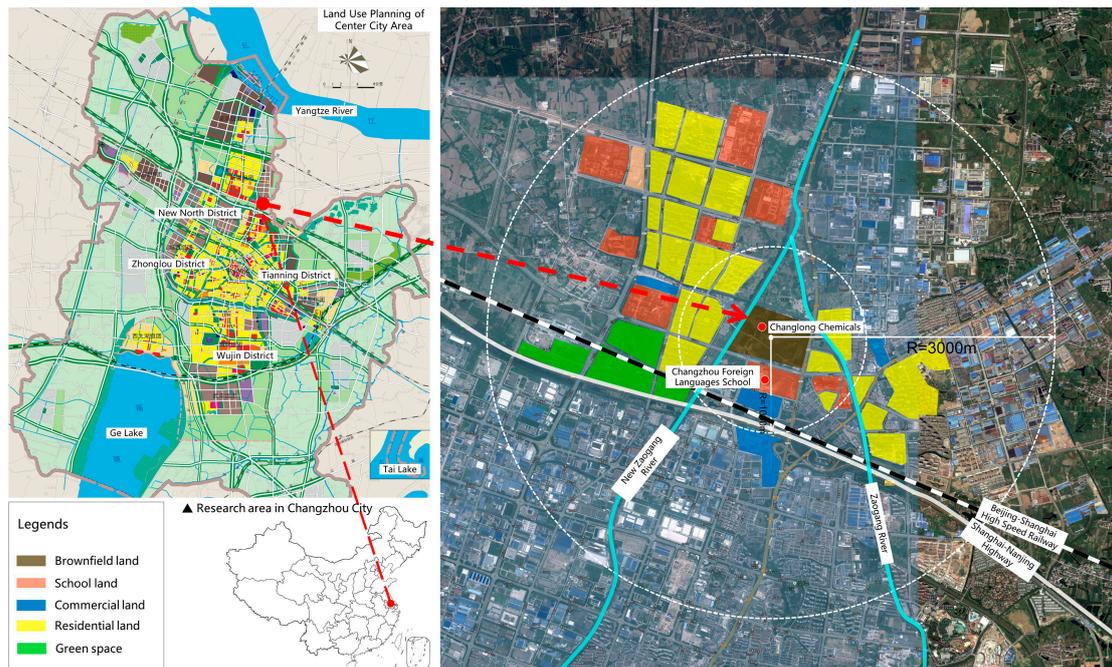


Figure 2. Location of study case.

5. Results

5.1. Industrial Upgrading and De-Industrialization in Changzhou

During the “11th five year plan” (2006–2010), and the subsequent “12th five year plan” (2011–2015), a mass of firms with “three high and one low” (i.e., high involvement, high polluting, high energy consuming, and low profit firms) had been moved out of the main urban area of Changzhou to promote the development of tertiary industry, and advance the proportion of the services sector. As a result, the added value of tertiary industry in Changzhou rose 10.5% to 261 billion yuan in 2015. This is the first time that the proportion of tertiary industry exceeded that of secondary industry. The contribution rate of tertiary industry on economic growth also climbed from 52.7% in 2009 to 68.7% in 2015. Meanwhile, Changzhou government planned to propel new town development in the north and south areas of the main city as needed for further improvement, and an update of industrial structure.

In *The Master Plan of Changzhou (2011–2020)*, the Changzhou government proposed to develop a new downtown by transforming the original industrialized suburbs in the northern area. They also planned to keep intact the old city center where the overcrowding economic actives and population were concentrated. Following the master plan, the government was planning to develop the new north district with three primary capabilities such as a modern residential area, a port of the Yangtze River, and a high end manufacturing base. In the new north district of Changzhou, the second and third type industrial lands were planned to reclaim and transform into first type industrial lands which are pollution-free, and non-harm to surrounding public investment or residential area. As a result, approximately 1.87 square kilometers of second and third type industrial lands were reclaimed until 2015, and all remaining lands will be reclaimed in 2016.

According to this strategy, the Changzhou government is expected to not only avoid the heavy financial burden and social issues, but also gain a huge amount of land revenue through transactions of industrialized land with commercial and residential land in the land market.

5.2. The Formation of Pro-Growth IIC of BLR during the Transition of Economic and Industrial Structure in Changzhou

The polluting factories built on the brownfield land in the case study remained in Changzhou for over three decades. Pollution scandals had been repeatedly exposed even before they moved out. However, because the land is located in the three rivers estuary with specific landscape (Figure 2), the government believed that transforming the industrial lands into commercial lands had great potential benefits, including attracting new investment to drive the increase of land prices around the area. Prior to the public health crisis, this area had been planned to become a HOPSCA (the area contains Hotel, Office, Park, Shopping mall, Convention center, and Apartment) according to *The Urban Design of Three Rivers Estuary of Changzhou*. Following the plan, Changzhou government sold 11 pieces of land in the area to property developers before and during the BLR process. As illustrated in Figures 2 and 3, many tidy and upscale residential neighborhoods were built in the area. A government official (Interviewee A1) commented that, “It led to billions investment in this area, which could increase GDP growth by about 3 percentage points.”



Figure 3. The photograph of the area where the incident took place (the actual distance of the two points in the photo is 150 m).

Moreover, as the rent gap is not just concentrated in economic capital, but can be created from cultural capital that can be transformed into economic capital later, local governments and property developers start to exploit a new rent gap by controlling the distribution of advanced educational resources [57,58]. In this case, in addition to the development of high technology industry and commerce activities, the government intends to introduce high quality educational resources to promote the development of this area’s service industry, then attract more immigrants, and consequently form a new growth pole to achieve the land price premium. The pro-growth IIC of BLR had been formed during the development of the new north district in Changzhou. However, the new location of the Changzhou foreign languages school was set, and the most vulnerable students were directly exposed to the toxic environment [59], even when the environmental risks were mentioned in the Environment Impact Assessment (EIA) report [60].

5.3. Public Health Crisis in the Process of BLR

In fact, all EIA reports, including the EIA report of the relocation of the three chemical plants, report the construction of the new school. The EIA report of polluted land abatement directly pointed out the severity of the pollution in the brownfield lands and its environmental hazards [60,61]. For instance, the EIA report of polluted land abatement suggested that “about 3475 tons’ industrial waste were remained after the factories moved out” and “the soil and groundwater of this land were severely contaminated so that the environmental risks of the land reuse were unacceptable. [As the results,] pollution remediation must be implemented before the commercial redevelopment” [60] (pp. 1–2). However, during the whole process of development of the new north district and BLR, environmental issues had not attracted media or public attention until the toxic school outbreak incident. As a farmer (Interviewee D1) living near the brownfield land said, “No one would care about the soil pollution if the key school had not been moved in here.” No attention does not mean the problem does not exist.

The situation that occurred in the process of soil remediation was even more serious. The process of soil remediation did not obey the preordained solution. Contaminated soil was rampantly disposed and buried in the nearby villages. In addition, the contaminated soil was not properly isolated to avoid secondary pollution on the construction site of the soil remediation. As a result, animals in the nearby village died mysteriously and a pungent odor was present.

“When the factories were here, our village always had pungent smell. This situation had not been improved, but been more serious after the factories moved out . . . many fish were died in my fish’s pond . . . many trucks came here and dumped residue soil during the night in the beginning of last year (January 2015). Despite the environmental protection agency assuring that residue soil was not contaminated soil, but there was a bad smell”, said by the villagers near the brownfield lands (Interviewees D2–D5).

All these indicated that the local government, enterprises, and property developers in the pro-growth IIC of BLR are in a strong position. The whole BLR process was dominated by them and driven by profit. When the profit driven alliance formed, the public has lost the discourse power for the BLR process, and the environmental protection department has also lost its right of supervision. An official in environmental protection department and environmental impact assessment engineers in the environmental consulting company (Interviewees A2, B1 and B5) commented that “the EIA reports must try to evade some sensitive questions to avoid that the reports will negatively affect the economic growth and urban development.” The adults who live and work, or school children in the surrounding area went through a series of public health crises. Furthermore, the incident caused several communal conflicts in Changzhou and a crisis of confidence over the central and local governments’ failure to deal with the soil pollution and remediation.

6. Discussion and Conclusion: How to Conduct a Sustainable and Successful Urban Governance of BLR

6.1. Essential Aspects of Conducting a Sustainable and Successful Urban Governance of BLR

Governance refers to “the process of regulating, coordination and control, including governmental and, increasingly, private actors” [1] (p. 93). In recent research, there were hints of problems that must be overcome to build a sustainable and successful urban governance of BLR which involves two levels. On the one hand, governments fail to create favorable policy environments for removing barriers preventing the public and private sectors from actively participating in the BLR process, such as “legal liability for contamination, uncertain cleanup standards, availability of funding for redevelopment, and complicated regulatory requirements” [62] (p. 287).

In this case, the three chemical plants were moved out in approximately 2008. At that time, few regulations by the central or local government in China identified the responsible parties of the contaminated soil and groundwater. It is hard to hold accountable the three chemical plants with

the principle of “whoever causes pollution shall be responsible for its elimination” [63] (p. 258). As a result, the responsibility for soil remediation had to be transferred from the polluters to local government. In addition, neither laws and or regulated evaluation of pollution levels of brownfield lands and standards of BLR processes. Two reports about impact of the brownfield lands on individual health—one from Changzhou foreign languages school and the other from the parents of the students were radically different.

Another but more important level is that a wider and deeply connected community has not been established for BLR [62,64,65]. Particularly, environmental protection departments should have played a more important role in urban governance of BLR. In this case, the environmental protection departments did not maintain their independence to perform their duty. Under this scenario, they yielded their rights to the local government for economic growth and urban development. However, the strength of legal regulations cannot encourage initiatives in BLR [66]. The urban governance of BLR in developed countries including China is transferred from merely stressing stringent environmental regulations to introducing more flexible regulations and policies to encourage and conduct a collaboration of multiple levels and multiple sectors [17,66,67].

6.2. *The Pro-Growth IIC of BLR: A Major Restriction of BLR in Security*

The pro-growth IIC of land finance regime really boosts economic growth, fiscal revenue and facilitates local capital accumulation [22]. These advantages, however, come with several big drawbacks for local governments in China, such as the loss of arable land [68,69], the disputes on rural property and land rights of rural-urban migration [70,71], and soaring housing prices [72]. More importantly, along with the increasing land prices in China, the cost of land (re)development there has also increased to up to 80% of the earnings from the reclamation and resale of urban lands, while the actual revenues of local governments were less than 20% of the earnings [73]. Given the situation, the economic benefits of the pro-growth IIC of land finance regime have been sharply reduced, which further impedes the adsorption of the additional cost of soil remediation by the pro-growth IIC in the process of BLR. With the gloomy outlook for the pro-growth IIC of the land finance regime, the pro-growth IIC of BLR is also unlikely to last.

The *Action Plan for Prevention and Control of Soil Pollution* was released after the toxic soil event of Changzhou erupted, suggesting that the policy environment for BLR is expected to be gradually improved in China. However, the new law will not tackle the biggest problem: the pro-growth IIC of BLR is a profit-driven alliance that falls short of what a sustainable and successful urban governance of BLR is demanding. Thus, the pro-growth IIC of BLR is the root cause of the frequently occurring toxic soil events during the process of BLR in China.

As locked-in is a matter of co-evolution [74], and locked-in of land finance is a matter of institutional and governmental co-evolution, it is undeniable that the present pro-growth IIC of BLR derives from the institutional lock-in of land finance. To creatively destroy the old patterns and to break the cycle of public health crises in the process of BLR, the local governments need to cut their reliance on land finance, and then create a new local economy. In other words, the “land increment based finance regime” must be changed [50] (p. 42), and the problem of revenue and expenditure between the local governments and the central government in China must be reexamined. In particular, the central government needs to intensify finance support to accelerate the establishment of long-term, stable, and sustainable IIC of BLR. Furthermore, the political incentives of local officials must be changed from merely stressing the importance of economic growth to considering future stability, public health development, and sustainable economic growth from a multi-dimensional perspective [75].

Acknowledgments: The research is supported by the National Natural Science Foundation of China (No. 41671155, No. 41271176, and No. 41201161).

Author Contributions: Chunhui Liu organized the field survey and wrote the manuscript. Weixuan Song is the correspondence author and conceptualized and structured the paper. Chen Zhou revised and constructively commented on the paper.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. List of interviews.

	Venues	Date	Interviewees	Contents
A	Officials			
1	Restaurant	5 May 2016	Official A1 in a department of district government	The Plan of new town development
2	Restaurant	8 June 2016	Official A2 in environmental protection department of district government	The EIA report of the brownfield land redevelopment
3–5	Office	10 June 2016	Officials A3–A5 in bureau of land and resources, Changzhou	The process and problems of lands reclaim in New North district in Changzhou
B	Environmental impact assessment engineers			
1–4	Coffee shop	12 June 2016	Employees B1–B4 in an environmental consulting company	The process and regulation of environmental impact assessment
5	By telephone	12 June 2016	Employee B5 in an environmental consulting company	The EIA report of Changzhou Foreign Languages School
C	Parents of the students in Changzhou Foreign Languages School			
1	Restaurant	21 May 2016	C1–C3 are the parents of the students in Changzhou Foreign Languages School	The child's health problem
2–3	By telephone	22 May 2016	C4–C6 are the parents of the students in Changzhou Foreign Languages School	The EIA report of Changzhou Foreign Languages School
D	Residents around the brownfield land			
1–5	In the village they live in	25 June 2016	Five residents who live in the village nearby the brownfield lands	The environmental impact on their village before the three chemical plants relocation and during the process of BLR.

References

- Zielke, P.; Waibel, M. The urban governance of brownfield restructuring in China: The case of Guangzhou's t.I.T creative industry zone. *Asia Pac. Viewp.* **2016**, *57*, 91–105. [CrossRef]
- Yang, H.; Flower, R.J.; Thompson, J.R. Industry: Rural factories won't fix Chinese pollution. *Nature* **2012**, *490*, 342–343. [CrossRef] [PubMed]
- Liu, X. Soil Heavy Metal Pollution and Abatement of China. Available online: http://www.mlr.gov.cn/xwdt/jrxw/201510/t20151029_1385762.htm (accessed on 11 May 2017).
- Zhu, Y.; Hipel, K.W.; Guo, P. Anova-based stakeholder analysis of brownfield redevelopment projects in China. In Proceedings of the 2010 IEEE International Conference on Systems Man and Cybernetics, Istanbul, Turkey, 10–13 October 2010.
- Wu, Y.; Zhang, X.; Skitmore, M.; Song, Y.; Hui, E.C.M. Industrial land price and its impact on urban growth: A Chinese case study. *Land Use Policy* **2014**, *36*, 199–209. [CrossRef]

6. Yang, H.; Huang, X.; Thompson, J.R.; Flower, R.J. Soil pollution: Urban brownfields. *Science* **2014**, *344*, 691–692. [[CrossRef](#)] [[PubMed](#)]
7. Khan, S.; Cao, Q.; Zheng, Y.M.; Huang, Y.Z.; Zhu, Y.G. Health risks of heavy metals in contaminated soils and food crops irrigated with wastewater in Beijing, China. *Environ. Pollut.* **2008**, *152*, 686–692. [[CrossRef](#)] [[PubMed](#)]
8. Luo, X.S.; Ding, J.; Xu, B.; Wang, Y.J.; Li, H.B.; Yu, S. Incorporating bioaccessibility into human health risk assessments of heavy metals in urban park soils. *Sci. Total Environ.* **2012**, *424*, 88–96. [[CrossRef](#)] [[PubMed](#)]
9. Luo, X.S.; Yu, S.; Zhu, Y.G.; Li, X.D. Trace metal contamination in urban soils of China. *Sci. Total Environ.* **2012**, *421–422*, 17–30. [[CrossRef](#)] [[PubMed](#)]
10. Cao, K.; Guan, H. Brownfield redevelopment toward sustainable urban land use in China. *Chin. Geogr. Sci.* **2007**, *17*, 127–134. [[CrossRef](#)]
11. Ren, W.; Geng, Y.; Ma, Z.; Sun, L.; Xue, B.; Fujita, T. Reconsidering brownfield redevelopment strategy in China's old industrial zone: A health risk assessment of heavy metal contamination. *Environ. Sci. Pollut. Res.* **2015**, *22*, 2765–2775. [[CrossRef](#)] [[PubMed](#)]
12. Wu, H.; Chen, C. A pilot case study of brownfield high-density housing development in China. *Int. J. Hous. Mark. Anal.* **2010**, *3*, 119–131. [[CrossRef](#)]
13. Xue, B.; Zhang, L.; Geng, Y.; Mitchell, B.; Ren, W. Extended land-use coding system and its application in urban brownfield redevelopment: Case study of tiexi district in shenyang, China. *J. Urban Plan. Dev.* **2015**, *142*. [[CrossRef](#)]
14. Chiang, S.Y.D.; Gu, Q. Brownfield sites remediation technology overview, trends, and opportunities in China. *Remediat. J.* **2015**, *25*, 85–99. [[CrossRef](#)]
15. Greenstone, M.; Gallagher, J. Does hazardous waste matter? Evidence from the housing market and the superfund program. *Q. J. Econ.* **2008**, *123*, 951–1003. [[CrossRef](#)]
16. Ren, W.; Xue, B.; Geng, Y.; Sun, L.; Ma, Z.; Zhang, Y.; Mitchell, B.; Zhang, L. Inventorying heavy metal pollution in redeveloped brownfield and its policy contribution: Case study from Tiexi district, Shenyang, China. *Land Use Policy* **2014**, *38*, 138–146. [[CrossRef](#)]
17. Day, J.N.; Johnson, L. Clean sites and toxic burdens: The evolution and legacy of new jersey's mandatory toxic waste cleanup program, 1976–1993. *J. Policy Hist.* **2004**, *16*, 239–267. [[CrossRef](#)]
18. Brady, W.M. Territorial development, planning reform and urban governance: The case of Ireland's second-tier cities. *Eur. Plan. Stud.* **2016**, *24*, 2217–2240. [[CrossRef](#)]
19. Garau, C.; Balletto, G.; Mundula, L. A critical reflection on smart governance in Italy: Definition and challenges for a sustainable urban regeneration. In *Smart and Sustainable Planning for Cities and Regions: Results of Sspcr 2015*; Bisello, A., Vettorato, D., Stephens, R., Elisei, P., Eds.; Springer: Cham, Switzerland, 2017; pp. 235–250.
20. GIZ. Action Plan for Prevention and Control of Soil Pollution in China. Available online: http://danishsoil.org/media/test_sites/uploads/Soil%20Ten%20Plan.pdf (accessed on 12 May 2017).
21. Qun, W.; Yongle, L.; Siqi, Y. The incentives of China's urban land finance. *Land Use Policy* **2015**, *42*, 432–442. [[CrossRef](#)]
22. Lin, G.C.S.; Yi, F. Urbanization of capital or capitalization on urban land? Land development and local public finance in urbanizing China. *Urban Geogr.* **2011**, *32*, 50–79. [[CrossRef](#)]
23. He, C.; Zhou, Y.; Huang, Z. Fiscal decentralization, political centralization, and land urbanization in China. *Urban Geogr.* **2016**, *37*, 436–457. [[CrossRef](#)]
24. Unruh, G.C. Understanding carbon lock-in. *Energy Policy* **2000**, *28*, 817–830. [[CrossRef](#)]
25. Arthur, W.B. *Increasing Returns and Path Dependence in the Economy*; University of Michigan Press: Ann Arbor, MC, USA, 1994.
26. Unruh, G.C. Escaping carbon lock-in. *Energy Policy* **2002**, *30*, 317–325. [[CrossRef](#)]
27. Wu, Q.; Zhang, X.; Li, H.; Chen, H.; Li, Z.; Shang, Z. Pro-growth giant business, lock in, sustainable urban development and effect on local political economy: The case of petrochemical industry at nanjing. *J. Clean. Prod.* **2015**, *107*, 324–332. [[CrossRef](#)]
28. Wu, Q.; Zhang, X.; Shang, Z.; Li, Z. Political-economy based institutional industry complex and sustainable development: The case of the salt-chemical industry in Huai'an, China. *Energy Policy* **2015**, *87*, 39–47. [[CrossRef](#)]

29. Wu, Q.; Zhang, X.; Sun, J.; Ma, Z.; Zhou, C. Locked post-fossil consumption of urban decentralized solar photovoltaic energy: A case study of an on-grid photovoltaic power supply community in Nanjing, China. *Appl. Energy* **2016**, *172*, 1–11. [[CrossRef](#)]
30. Lin, G.C.S. China's landed urbanization: Neoliberalizing politics, land commodification, and municipal finance in the growth of metropolises. *Environ. Plan. A* **2014**, *46*, 1814–1835. [[CrossRef](#)]
31. Tao, R.; Su, F.; Liu, M.; Cao, G. Land leasing and local public finance in China's regional development: Evidence from prefecture-level cities. *Urban Stud.* **2010**, *47*, 2217–2236.
32. Guan, Q. The Story behind the Land Finance of China. Available online: <http://www.bwchinese.com/article/1023995.html> (accessed on 5 March 2007).
33. Wang, W.; Ye, F. The political economy of land finance in China. *Public Budg. Financ.* **2016**, *36*, 91–110. [[CrossRef](#)]
34. Liu, M.; Tao, R.; Yuan, F.; Cao, G. Instrumental land use investment-driven growth in China. *J. Asia Pac. Econ.* **2008**, *13*, 313–331. [[CrossRef](#)]
35. Lin, G.C.S. Reproducing spaces of Chinese urbanisation: New city-based and land-centred urban transformation. *Urban Stud.* **2007**, *44*, 1827–1855. [[CrossRef](#)]
36. Meng, X. Labor market outcomes and reforms in China. *J. Econ. Perspect.* **2012**, *26*, 75–102. [[CrossRef](#)]
37. Collier, P.; Venables, A.J. Urban infrastructure for development. *Oxf. Rev. Econ. Policy* **2016**, *32*, 391–409. [[CrossRef](#)]
38. Hong, Y.; Wang, W. Embracing communication: China's post-2008 economic restructuring and labor. In *The Routledge Companion to Labor and Media*; Maxwell, R., Ed.; Routledge: New York, NY, USA, 2015; pp. 107–117.
39. Long, H.; Li, Y.; Liu, Y.; Woods, M.; Zou, J. Accelerated restructuring in rural China fueled by 'increasing vs. Decreasing balance' land-use policy for dealing with hollowed villages. *Land Use Policy* **2012**, *29*, 11–22. [[CrossRef](#)]
40. Hannan, K. *Industrial Change in China: Economic Restructuring and Conflicting Interests*; Routledge: New York, NY, USA, 2012.
41. Liu, Y.; Fang, F.; Li, Y. Key issues of land use in China and implications for policy making. *Land Use Policy* **2014**, *40*, 6–12. [[CrossRef](#)]
42. Xie, J.; Li, F. *Overview of the Current Situation on Brownfield Remediation and Redevelopment in China*; World Bank: Washington, DC, USA, 2010.
43. Ministry of Land and Resources; Ministry of Environmental Protection. Report of Soil Pollution Investigation of China in 2014. 2014. Available online: <http://www.zhb.gov.cn/gkml/hbb/qt/201404/W020140417558995804588.pdf> (accessed on 30 April 2017). (In Chinese)
44. Xie, J.; Li, F. *The Remediation and Redevelopment of China's Brownfield Sites*; World Bank: Washington, DC, USA, 2010.
45. Liu, Y.; van Oort, F.; Geertman, S.; Lin, Y. Institutional determinants of brownfield formation in Chinese cities and urban villages. *Habitat Int.* **2014**, *44*, 72–78. [[CrossRef](#)]
46. Chen, H.; Wu, Q.; Cheng, J.; Ma, Z.; Song, W. Scaling-up strategy as an appropriate approach for sustainable new town development? Lessons from Wujin, Changzhou, China. *Sustainability* **2015**, *7*, 5682–5704. [[CrossRef](#)]
47. Zhu, J. Local growth coalition: The context and implications of China's gradualist urban land reforms. *Int. J. Urban Reg. Res.* **1999**, *23*, 534–548. [[CrossRef](#)]
48. Tan, R.; Qu, F.; Heerink, N.; Mettepenningen, E. Rural to urban land conversion in China—How large is the over-conversion and what are its welfare implications? *China Econ. Rev.* **2011**, *22*, 474–484. [[CrossRef](#)]
49. Lichtenberg, E.; Ding, C. Local officials as land developers: Urban spatial expansion in China. *J. Urban Econ.* **2009**, *66*, 57–64. [[CrossRef](#)]
50. Wu, Y.; Luo, J.; Zhang, X.; Skitmore, M. Urban growth dilemmas and solutions in China: Looking forward to 2030. *Habitat Int.* **2016**, *56*, 42–51. [[CrossRef](#)]
51. Sorensen, A. Taking path dependence seriously: An historical institutionalist research agenda in planning history. *Plan. Perspect.* **2015**, *30*, 17–38. [[CrossRef](#)]
52. Smith, N. Toward a theory of gentrification a back to the city movement by capital, not people. *J. Am. Plan. Assoc.* **1979**, *45*, 538–548. [[CrossRef](#)]
53. Wei, Y.H.D.; Liefner, I. Globalization, industrial restructuring, and regional development in China. *Appl. Geogr.* **2012**, *32*, 102–105. [[CrossRef](#)]

54. Zhu, J. From land use right to land development right: Institutional change in China's urban development. *Urban Stud.* **2004**, *41*, 1249–1267. [CrossRef]
55. Jin, M. Toxic land's striking harm ringing the environmental alarm. *Ecol. Econ.* **2012**, *10*, 18–23.
56. Gao, S.; Wang, K. A Large Number of Brownfield Lands Were Replaced as Residential Lands: The Official Hidden Data. Available online: <http://finance.sina.com.cn/china/20120604/101312215880.shtml> (accessed on 1 May 2017).
57. Wu, Q.; Zhang, X.; Waley, P. Jiaoyufication: When gentrification goes to school in the Chinese inner city. *Urban Stud.* **2015**, *53*. [CrossRef]
58. Wu, Q.; Zhang, X.; Waley, P. When Neil Smith Met Pierre Bourdieu in Nanjing, China: Bringing Cultural Capital into Rent Gap theory. Available online: <http://www.tandfonline.com/doi/full/10.1080/02673037.2016.1228849> (accessed on 14 May 2017).
59. Committee on Environmental Health. Ambient air pollution: Health hazards to children. *Pediatrics* **2004**, *114*, 1699–1707.
60. Changzhou Environmental Science Research Institute. *The Technology Proposal of Project Acceptance about Soil Remediation on the Site of the Former Changzhou (Huada, Changyu) Factory*; Changzhou Environmental Science Research Institute: Changzhou, China, 2016.
61. Changzhou New North District Environmental Protection Agency. *The Environmental Report about the New Construction Project of New North Campus of Jiangsu Changzhou Senior Middle School*; Changzhou New North District Environmental Protection Agency: Changzhou, China, 2013.
62. McCarthy, L. The brownfield dual land-use policy challenge: Reducing barriers to private redevelopment while connecting reuse to broader community goals. *Land Use Policy* **2002**, *19*, 287–296. [CrossRef]
63. Glaeser, B. The environmental impact of economic development: Problems and policies. In *The Geography of Contemporary China: The Impact of Deng Xiaoping's Decade*; Cannon, T., Jenkins, A., Eds.; Routledge: New York, NY, USA, 1990; pp. 249–265.
64. Thornton, G.; Franz, M.; Edwards, D.; Pahlen, G.; Nathanail, P. The challenge of sustainability: Incentives for brownfield regeneration in Europe. *Environ. Sci. Policy* **2007**, *10*, 116–134. [CrossRef]
65. Nijkamp, P.; Rodenburg, C.A.; Wagtendonk, A.J. Success factors for sustainable urban brownfield development: A comparative case study approach to polluted sites. *Ecol. Econ.* **2002**, *40*, 235–252. [CrossRef]
66. Adams, D.; De Sousa, C.; Tiesdell, S. Brownfield development: A comparison of north American and British approaches. *Urban Stud.* **2010**, *47*, 75–104. [CrossRef]
67. Dull, M.; Wernstedt, K. Land recycling, community revitalization, and distributive politics: An analysis of EPA brownfields program support. *Policy Stud. J.* **2010**, *38*, 119–141. [CrossRef]
68. Tan, M.; Li, X.; Xie, H.; Lu, C. Urban land expansion and arable land loss in China—A case study of Beijing–Tianjin–Hebei region. *Land Use Policy* **2005**, *22*, 187–196. [CrossRef]
69. Gar-On Yeh, A.; Li, X.I.A. Economic development and agricultural land loss in the Pearl River Delta, China. *Habitat Int.* **1999**, *23*, 373–390. [CrossRef]
70. Mullan, K.; Grosjean, P.; Kontoleon, A. Land tenure arrangements and rural-urban migration in China. *World Dev.* **2011**, *39*, 123–133. [CrossRef]
71. Xun, L.; Xianxiang, X.; Zhigang, L. Land property rights and urbanization in China. *China Rev.* **2010**, *10*, 11–37.
72. Deng, Y.; Gyourko, J.; Wu, J. Land and House Price Measurement in China. National Bureau of Economic Research Working Paper Series 2012, No. 18403. Available online: <http://www.nber.org/papers/w18403> (accessed on 27 February 2017).
73. Xinhuanet.com. The Treasury: More Than Four-Fifths of over Four Trillion Yuan of Land Transfer Income Was Used for Land Resettlement Compensation in Last Year. Available online: http://news.xinhuanet.com/fortune/2015-03/24/c_1114749875.htm (accessed on 1 May 2017). (In Chinese)
74. Geels, F.W. Processes and patterns in transitions and system innovations: Refining the co-evolutionary multi-level perspective. *Technol. Forecast. Soc. Chang.* **2005**, *72*, 681–696. [CrossRef]
75. Cohen, B. Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability. *Technol. Soc.* **2006**, *28*, 63–80. [CrossRef]

