Assessing Urban Environmental Management Practice with a Scalar Approach. The Shanghai Case

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Abstract

Shanghai's urban environmental management in the past three decades has been focused primarily on the environmental problems at the intra-urban level. While this 'end of pipe' approach greatly mitigated domestic and industrial pollution, progresses were much slower in dealing with environmental impacts both at a smaller (i.e., those related to people's daily activities) scale and at a larger (i.e., those related to inter-urban/regional or global issues) scale.

Urban environmental management policies in Shanghai and China should prioritize and address urban environmental impacts at continuous geographic scales to achieve long-term 'triple bottom line' sustainability.

Keywords: Urban Sustainability; Scalar Approach; Shanghai; China; Environmental Management

1. Urban Environmental Management Strategies

As cities become larger and wealthier, the driving forces and the manifestations of environmental burdens are also changing rapidly and becoming increasingly complex (Satterthwaite 1999). Thus, urban environmental management strategies must be adjusted accordingly. Shanghai's environmental problems have received extensive attention in the literature. The research topics range from overall environmental quality and management issues (Tu 2006), specific environmental threats such as water and air pollution (Kan 2004), environmental policies and management instruments (Gu 2005), to simulation and prediction of future land use and environmental conditions (Zhang 2011).

The analytical scale of the existing studies, however, was largely limited to the intra-urban level. Few have systematically analyze urban environmental problems in Shanghai in a continuous geographic space scaling down from global (e.g., estimating global greenhouse gas emission) to micro-social and individual (e.g., choices of mode of transportation for daily activities of residents.

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Edited by: ISTEI - *University of Milan-Bicocca* ISSN: 1593-0319

Tu Wei, Assessing Urban Environmental Management Practice with a Scalar Approach. The Shanghai Case, Symphonya. Emerging Issues in Management (symphonya.unimib.it), n. 2, 2011, pp. 60-74

http://dx.doi.org/10.4468/2011.2.06tu

Aiming at bridging this gap in the literature, this study provides an assessment of Shanghai's urban environmental issues and policies at three geographic scales: intra-urban, inter-urban/regional, and global. As such, the rest of this paper has been organized into five sections. Section two is a brief literature review of the scalar approach in urban sustainability studies. Section three is an account of Shanghai's urban environmental management practices in the past four decades. Section four is a discussion of the opportunities and challenges of formulating a scalar environmental policy.

2. Why a Scalar Approach is Critical to the Assessment of Urban Sustainability?

Spatial scale refers to the unit or level of analysis in space. Both the importance and relationship between macro-, meso-, and micro-scale phenomenon and processes have been discussed extensively in geography and environmental studies literature (Wilbanks 1999). In this paper, the micro-, meso-, and macro- scale correspond to the intra-urban/region, inter-urban/regional, and global scale, respectively. At the intra-urban/region scale, the central concern is environment impacts on residents living in a city or region; at the inter-urban/regional level, the focus is on the environmental impacts of a city or region on its hinterland, ecosystems, and neighboring regions; at the global level, the emphasis is on the relationship between urban metabolism, distant resource depletion, and worldwide environmental processes such as global warming. A scalar approach is essential to understand and assess urban environmental issues to ensure long-term 'triple bottom line" sustainability due to four reasons.

First, urban environmental burdens are continuous in space. Macro-scale environmental problems tend to converge in micro-scale localities. Problems at micro-scale localities, in turn, cumulatively contribute to the macro-scale conditions (Wilbanks 1999). For example, the rising sea level can be sensed by coastal residents as beaches are eroding away; Household greenhouse gas emission, on the other hand, is often cited as one of the major leading causes behind the global warming.

Second, the severity of urban environmental burdens at various geographic scales is interrelated, although not necessarily positively correlated. Reducing local pollution may either improve or worsen regional conditions (McGranahan 2005). Reclaiming land from sea, for example, will create more arable land at the cost of disturbing coastal ecological systems.

Third, urban environmental burdens at different geographic scales are featured by different characteristics. Local burdens, usually more acute and immediate, tend to generate short-term threats to a limited population in a small area that are usually easier to be fixed. The regional/global burdens may be less obvious and urgent, but are likely to last longer, pose long-term threats to the current as well as the future generations, potentially affect larger areas, and be more difficult to deal with.

Fourth, because pollution does not respect administrative boundaries, pollution usually goes beyond its own boundary to impact a much larger geographical region. In addition, pollutants generated in one place may also be exported and deposited in another.

Last, geographic scale is also a critical factor that will impact the results of

environmental assessment. The choice of scale will provoke notably differing analyses, with different conclusions and policy implications. For example, while a measure of environmental change at multiple geographic scales can provide a more complete and unbiased assessment, local governments, in reality, may prefer an assessment only at the intra-urban level to avoid problems beyond the city/region boundaries.

In summary, due to the scalar nature of environmental problems, examination of environmental issues at only one geographic scale often leads to the neglect of problems at other scales and a lack of or inadequate analyses of the connections of problems across different scales. Thus, a scalar assessment of urban environment burdens that allows a s*imultaneous* analysis of issues at the micro, meso, and macro scales will not only deepen our understanding of environment challenges in one particular locality and their connections with other localities but will also provide a holistic perspective for policy- and decision-making makers to aim at long-term urban sustainability.

3. Shanghai's Environmental Problems and Policies

3.1 Pre-Reform Shanghai

By 1936, Shanghai has become the world's seventh largest city and China's premier industrial and trading center. Despite the severe damage caused by the Sino-Japanese war and the following civil war between the communists and the nationalists, Shanghai remained to be China's most important seaport, trade center, and light manufacturing base by the end of the 1940s.

Shanghai's economy structure was radically transformed after Mao took over the country in 1949. The more 'productive' heavy manufacturing sectors, such as petrochemicals and machineries, were encouraged to develop. In contrast, the 'less productive' sectors, such as light industrial and service sectors were substantially suppressed. Copying the economic system of the former Soviet Union, the main function of major Chinese cities was determined as the producers of industrial products for the country. Thus Shanghai was rapidly transformed into China's largest production city, contributing approximately 17 percent of country's total annual revenue in the three decades after 1949 (Yeung 1996).

The cost of the overly developed production function greatly restrained the development of Shanghai's service sectors and sacrificed the service functions of the city. In the 1930s, Shanghai's urban infrastructure, at least inside the International Settlement and French Concession, have reached standards comparable to many European counterparts (Wu 2000). In contrast, the condition of urban infrastructure in Shanghai was even inferior to those of many other economically less productive Chinese cities by the mid-1980s (Wu 2000).

3.2 Post-Reform Shanghai

Since the late 1970s, the unparalleled economic development and the rapid urbanization in Shanghai occurred in the context of China's massive economic privatization and political decentralization. Local governments such as Shanghai have gained much more power to determine the timing, pace, and spatial

configuration of urban development. At the same time, because of the declining revenues from local State-Owned Enterprises (SOEs) and a reduced support from the central government, local governments had to seek new revenue sources to fund their own development (Han 2000). As a consequence, economic development zones were increasingly used as a development instrument to collect land rent, attract foreign direct investment (FDI) and stimulate urban redevelopment (Deng 2003). In May 1990, the central government announced a trans-century development plan to remake Shanghai into a world economic, financial, and trade center. Pudong, the east side of the Huangpu River, was designated as the focal point of this unprecedented national development plan and four development zones (functional areas) were established to assume the different roles of urban development (Walcott 2000).

The economic and urban development in Shanghai has been extraordinary. Per capita GDP increased from $500 in 1978 to more than $11,500 in 2009, the highest among all Chinese cities (SSB 2010). The growing wealth in Shanghai has been clearly reflected in the changing consumption patterns. Compared to the level in 1980, the total consumption in 2009 was more than 10 times higher. In addition, housing markets have been maturing with the rapid formation of a land rent gradient and skyrocketing real estate prices.

In addition, the transition from a highly planned to a market-oriented economy has fundamentally transformed the structure and spatial pattern of the urban land use in Shanghai. There has been a rapid growth of specialized manufacturing zones, economic development areas, and science parks in the urban outskirts. There has also been a mushrooming of upscale residential and commercial districts, as well as a maturing of the central business districts (CBDs). Urban land use has become much more functionally differentiated. Industrial pollution has been effectively controlled and the urban built environment has become much more diversified, environmentally friendly and attractive. In short, the urban redevelopment process in post-reform Shanghai are featured by a large-scale investment on urban infrastructure projects, redevelopment of the old city, economic restructuring and relocation, and pollution abatement. The solid investment in environmental affairs has been crucial to ensure the significant improvement of Shanghai's environmental conditions at the intra-urban level. The total investment on environmental protection accounted for more than three percent of the city's total GDP in 2009, the share was 0.9 percent in 1991.

3.3 Urban Environmental Management in Shanghai since the Late 1970s

After decades of neglect, urban environmental issues finally became one of the top priorities of Shanghai Municipal Government (SMG) in the late 1970s. The Shanghai Environmental Protection Bureau (SEPB) was founded in 1979. A series of city ordinances and regulations were enacted to tackle severe industrial pollution and other environmental nuisances that had been accumulating during Mao's era. An environmental monitoring network was established to systematically collect data for checking environment quality and to enforce environmental standards. The industrial pollution was the main target of environmental management at this stage.

The 1990s witnessed the most dramatic urban redevelopment process in Shanghai's more than a thousand year history. This decade was featured by large-scale construction of urban and environmental infrastructure, industrial pollution

mitigation, and urban beautification. Both industrial and domestic wastes were systematically collected and treated, heavily polluted rivers were rehabilitated, and urban green space was created all over the city. More significantly, the role of Shanghai as the nation's primer production center was reexamined and a service-oriented urban development goal was reestablished and endorsed by the central government. Shanghai Land Use Master Plan (1997-2010) was adopted by the SMG as a planning instrument to transform the residence-industry-business mixed land use pattern into a new land use pattern featured by various functional zones, high environmental standards, and attractive urban amenities (Wu 2000). In 1999, SMG formulated China's the first local action plan under the national blueprint of Agenda 21, indicating the concept of sustainable development was formally integrated into the urban management system in Shanghai.

3.4 An Assessment of Urban Environmental Burdens and Management

3.4.1 Intra-Urban

3.4.1.1 Water Quality

Water pollution has been the most visible environmental problem in Shanghai because water surface covers about 11 percent of the city's total area. For centuries, Huangpu River, the city's mother river, and its tributaries, served as the city's primary source of drinking water, transportation pathways, and sinks for wastes. The worsening water quality of the Huangpu and its tributaries, especially Suzhou Creek, Huangpu's largest tributary, has long been one of the most immediate health, environmental, and aesthetic concerns of Shanghai.

The major measures to improve the water quality include economy restructuring, establishing zones for different types of land use, constructing sewage systems, tightening wastewater discharge regulations, and requiring environmental impact assessments (EIA) for all the major development projects (Abelson 2000). As a result, the total industrial wastewater discharge decreased 67 percent from 1990 to 2009 and 98.2 percent of the discharged industrial wastewater satisfied the discharge standards in 2009. Consequently, water quality in downstream Huangpu and Suzhou Creek has been improving since 1995.

The impacts of the surface water quality are more important in overall economic and aesthetic considerations and the quality of drinking water has more direct effects on human health. Examining the two major portable drinking water sources in Shanghai, one in upstream Huangpu and the other in the Changjiang River Estuary, the Changjiang inlet is of relatively good quality (Wu. G. 1998), the inlets on the Huangpu, are increasingly threatened by pollution from domestic, industrial, and agricultural sources. According to a recent study, water in Minghang waterworks failed to meet Class IV of the national environmental quality standard for surface water (Bai X 2006). In addition, the worsening water quality in upstream Huangpu River may indicate the declining water quality in Dianshan Lake and Tai Lake, the headwater of the Huangpu (Cha 2007) caused mainly by non-point sources pollution in the region.

3.4.1.2 Air Quality

Shanghai's air pollution comes from three main sources: the industrial and household coal combustion, energy consumption in transportation, and suspended

particulates from construction sites. The commonly monitored air pollutants include SO_2, NO_X, CO, lead, and Total Suspended Particles (TSP). Main approaches to improve air quality include restructuring economy, restructuring energy portfolio, promoting energy-saving technologies, tightening emission standards, improving public transportation, and limiting private vehicles.

After the central government repositioned Shanghai to become 'international economic, financial and trade centers in 1992, the share of the service sectors increased significantly from around 30 percent in 1990 to over 50 percent in 2006. At the same time, highly-polluted industries (e.g., textiles) were gradually phased out. Thousands of manufacturing plants were either closed or relocated to specialized industrial development zones in urban outskirts. Between 1999 and 2005, the share of oil consumption in the total energy consumption increased 8.2 percent, compared to an 8.1 percent decrease of the coal consumption. In addition, the energy efficiency has also been improved substantially. Between 1990 and 2010, Shanghai's total GDP increased more than 20 fold, compared to a less than 300 percent increase of total energy consumption.

SMG also worked hard to curb the growth of private-owned automobiles. License plates for privately owned vehicles are available only through public auction according to an urban regulation. An average successful bid for a plate was about $8000 in 2010. In addition, since the first metro line has been put into use in 1999, Shanghai has made its metro system the fourth busiest in the world by 2011. The public transportation system (including subway, bus, and company commuting vehicles) is now carrying over 95 percent of the total passengers. Compared to Beijing, Shanghai has far fewer privately-owned automobiles, both by absolute and per capita measures, although Shanghai has a larger population and a higher level of per capita GDP.

Despite these efforts, however, the number of motorized vehicles in Shanghai increased more than 12 times between 1990 and 2009. At the same period of time, motor vehicle-related NO_X and CO emission became 3.5 times and 3.7 times higher, respectively. The NOx pollution index increased constantly from 0.8 in 1990 to about 1.4 in 2005. In addition, the automobile ownership in Shanghai has already exceeded the levels of Seoul and Tokyo when they were at the same per capita GDP of Shanghai decades earlier. Thus the transportation-related air pollution has become an increasingly important environmental burden in Shanghai (Dhakal 2004).

3.4.1.3 Land Use

The rapid urbanization is probably the most noticeable feature of Shanghai's land use change in the past four decades. Urbanized area, for example, increased from 585.5 km^2 in 1979 to 1815.5 km^2 in 2008. The rate of urbanization has been accelerating, with growth rates of 2.43 percent (1979 to 1987), 4.12 percent, (1987 to 1997), and 8.67 percent (1997 to 2008), respectively (Zhao 2006). Moreover, the land use change was characterized mainly by increasing urban area and decreasing cropland and forest/shrub land.

Moreover, the extensive urbanization process has also greatly impacted the spatial pattern of land use in Shanghai. The industrial-commercial-residential mixed land use pattern has been rapidly replaced by a new land use pattern featured by the specialization of land use with multi-nucleation, functional districts and multiple economic development zones. The grand urban redevelopment process, praised as

'… one of the great urban renewal stories of all time', has resulted in a greatly improved urban infrastructure, housing and living conditions, and urban amenities (Wu 2000). On the other side, the most notable environmental consequences of the massive urbanization include surface water pollution (Yin 2005), loss of ecological heterogeneity (Kong 2003), and increased level of energy/materials input and output (Gao 2006).

3.4.2 Inter-Urban/Regional

Similar to all the other major cities in the world, Shanghai's urban and economic development has been dependent on its hinterland to obtain natural resources, to dispose wastes, and to gain lands for expansion. The frequent and large-volume exchange of energy and material flows between Shanghai and its hinterland determines that environmental burdens will spill over to a much larger geographic area than the city itself. At the regional level, these burdens are reflected most clearly in water and air pollution and the disturbance of ecosystems (Decker 2000).

3.4.2.1 Water

Domestic and industrial wastewater, especially untreated or under-treated, is the major environmental threat to the marine environment of the Changjiang River Estuary and East China Sea. Shanghai generated 2.35 billion tons of wastewater from both industrial and domestic sources in 2009. Part of the wastewater was collected by a centralized urban sewage system and discharged into the south branch of Changjiang River Estuary through four main deep-water outlets. All the discharges flow through a multi-ascending pipe diffuser under the river after being pretreated except at Shidongkou outlet (Liu 2003).

Many recent studies associated the pollution of Changjiang River Estuary and East China Sea with the wastewater discharge from Shanghai. For example, one study found that the water body near Zhuyuan and Bailonggang outlets was in a serious eutrophication status with high concentrations of nitrogen, phosphorus and COD. The same study also reported that the level of eutrophication in Changjiang River Estuary, although was overall much less severe, has been increasing. Moreover, the phase III of Shanghai Sewage Project (SSP III) will add 0.5 million m^3 discharge per day into the estuary after completion. The large volume of wastewater will unavoidably impact water quality in Changjiang River Estuary as well as Hangzhou Bay to the South if wastewater is only preliminarily treated before discharge. Although heavy metal (Fe, Zn, Ni, Mg, Co, Mn, etc.) concentrations in the coastal and estuary sediments currently remain at relatively low levels thanks to diluting effects of runoff and sediment flows of Changjiang and a relatively short period of industrialization in Shanghai and China (Chen 2004), the long-term impacts, however, are far from certain.

Non-point pollution from urban runoff, agricultural and aquacultural activities, animal husbandry farms, and small industries in rural areas, although much less studied, also contributes a considerable amount of pollutants to the urban hinterland. One research reported that about 145 short tons of pesticides in 2000 and an annual average of 18,530 short tons of nitrogen entered into the environment from the farmlands between 1996 and 2000 (Mao 2002). Another study estimates that about 292,112 short tons of COD_{Cr}, 97,003 short tons of BOD_5 and 14,330 tons of NH_3 were contributed by the non-point pollution sources in 2002 (Xu 2003). The

longer term regional environmental burden from non-point sources has also been investigated. For example, the concentrations of dichloro diphenyl trichloroethane (DDTs) and hexachloro-cyclohexane (HCHs) are fairly high in suspended matter of the Changjiang River Estuary and along Zhejiang coastal area, although the applications of the two pollutants peaked between the 1960s and the 1980s (Chen 2002).

In addition, as the world's busiest port, the Port of Shanghai handled a total of 29.05 TEUs in 2010. With the opening operation of the new Yangshan deep-water port in 2006 (Asia Times 2006), the potential oil contamination associated with busy water transportation may become a new concern to the regional water environment.

3.4.2.2 Air Pollution

Similar to water pollution, air pollution is also subject to the impact of cross-scale effects. The scale effects of air pollution are in fact more difficult to identify and manage because the difficulty in defining individual 'airshed'. According to one study, the mean concentration of NO, NO_X, SO_2 and CO in the six selected sites in the Changjiang River Delta region were all much higher than their background levels, indicating the regional atmospheric environment has been contaminated by anthropogenic pollutants (Wang 2003). With a total of 1,070 billion m^3 waste gas emission in 2009, Shanghai is apparently one of the major air pollution sources in the region. Changjiang River Delta region is a heat island relative to its adjacent regions and Shanghai is an urban heat sub-island inside Changjiang River Delta region (Chen 2006). In addition, research also found the link between the SO_2 emission in Shanghai and the increasing acid rain events in the Changjiang River Delta region (Bashkin 2003). Air pollution-related economic loss was also reported. For example, it was estimated that the winter wheat yield in the Yangtze River Delta region between 1999 and 2000 declined about 20-30 percent due to the exposure to ambient ozone (Wang 2005).

3.4.2.3 Urbanization

About 62 percent of the land area of Shanghai was obtained from land reclamation and close to 80 km^2 of land were reclaimed in the past 50 years (Li 1998). The urbanization induced regional environmental impacts are mainly reflected in the damage of the vulnerable wildlife habitat and wetlands, reductions in biodiversity, and coastal erosion (Shi 2001). In the Sheshan area, based on one research, the number of plant species has fallen from 535 in the 1980s to 254 by the end of the 1990s (Xu 1999). On Dajinshan Island, plant species declined rapidly from 254 in the 1980s to 145 in 2000 (Yang 2002). The population of whistling swans wintering in the Chongming Island decreased from a few thousands in the 1980s to a few dozen at the beginning of 2000s (Yuan, James 2002). Moreover, the significant increase of urban green areas has come together with the increasing number of alien species and the loss of landscape heterogeneity.

3.4.3 Global

At the intra-urban and inter-urban levels, the analyses of urban environmental impacts emphasize on the burdens caused by urban economic activities on the city and its surrounding regions. At the global level, the focus is on the worldwide

environmental consequences and resource depletion that are more closely related to urban settlers' lifestyle and consumption. The analyses at global level are especially important to more affluent urban settlements considering their relatively high levels of energy/material use and waste production(McGranahan 2005). As Shanghai grows larger and becomes wealthier, the environmental impacts of the city at the global scale become increasingly significant. For example, one study reports that per capita CO_2 emission (to provide goods and services for city residents) in Shanghai in 1997 was near the level of Tokyo in 1995 (Dhakal 2004).

With a total population of about 23 million and rapidly increasing per capita consumption, Shanghai's ecological footprint (EF) and ecological deficiency (ED) increased 136 percent and 145 percent, respectively, between 1980 and 2003 (Gao 2006). A more recent report indicates that Shanghai's per capita EF was 3.8 gha in 2008, the second among all the provinces and province-level municipalities in China. This number has been more than double compared to that of 1985. Furthermore, it is almost certain that both Shanghai's total population and its per capita consumption will continue to increase (Peng 2005). As a result, Shanghai's EF and ED will keep growing and the only solution to balance the ED is to import carrying capacity from other regions in the world. In other words, the continuous economic and population growth and urban development in Shanghai will exert increasing environmental impacts globally. However, these global impacts have not been explicitly addressed in Shanghai's current environmental initiatives.

3.4.4 Summary

An environmental agenda focused mainly on the problems within the city boundary has brought Shanghai with better water and air quality and more environmentally friendly and economically efficient urban land use. At the same time, regional environmental problems received only minimal attention at the best. The limited and piecemeal measures on regional issues has resulted the progressive relocation and dispersion of environmental burdens from the city to the suburban, the urban hinterland, coastal ecosystems, and the entire Changjiang River Delta region. Moreover, Shanghai's current environmental agenda remain the least concerned with the global environmental processes and non-local resource depletion despite the rapid increasing EF and ED in the past 10 years.

In addition, the history of environmental management in Shanghai over the past 40 years could be understood in the contexts of both the pro- and post-reform political, economic, social and institutional changes in China (Mao and Hills 2002). First, to take an 'end-of-pipe' approach and to follow a local-regional-global sequence to deal with environmental problems seems to be the only logic and realistic choice for city managers facing severe and immediate pollution threats accumulated during Mao's era and the mounting environmental burdens as brought by the unprecedented urban and economic growth.

Second, the overlapping of sectoral (between various governmental agencies at different administrative levels) and regional (between administrative units) authorities and responsibilities on environmental affairs have made environmental management beyond administrative boundaries far more difficult. For instance, the Changjiang River Estuary is under a joint administration of Shanghai, Jiangsu Province, and Zhejiang Province based on a regional division; it is also under the supervision various levels of the Oceanographic Administration and the

Environmental Protection Administration based on a sectoral division. It is thus not hard to imagine the complication of any attempts to coordinate all the bureaucracy, power struggles, and regional/sectoral interests. In addition, the decentralization of power has made local governments more likely to formulate and implement inconsistent or selective environmental policies in favor of short-term economic growth than long-term sustainability (Gan 1999).

Lastly, Shanghai's experience in environmental management clearly reflects the legacy of China's centralized authoritarian political and command economic system. Under a hierarchical administrative system characterized by 'bureaucratic and administrative centralism', the government dominates almost every stage in environmental decisions and policy-making (Lo 2000). This government-centered management style has unfortunately led to a focus on the intra-urban level issues. The local and short-term economic growth and improvement in environmental conditions are indeed the things that matter the most to the promotion of officials.

4. Toward a Scalar Urban Environmental Policy

Shanghai's environment management in the past 40 years has been marked by a fairly successful mitigation of industrial pollution within the urban sphere, limited and passive environmental policy at the intra-urban/regional level, and a lack of vision and action plans to address global-level issues. An environmental agenda following a local-regional-global sequence seems to be unavoidable for urban managers considering China's political and socioeconomic conditions. However, it does not seem to be unlikely that this approach would lead Shanghai to the path of sustainable development. If Shanghai is going to create an environmental miracle comparable to the economic one it has realized, the current environmental agenda has to be realigned and reprioritized based on the internal links and interactions of environmental burdens at a continuous geographical scale. In fact, Shanghai is having great opportunities but also facing tough obstacles to adopt a scalar urban environmental policy.

4.1 Opportunities

Since the late 1970s, China has been lurching between a continuous booming economy and a rapidly degrading environment (Liu 2005). While it is world's second largest economy and has a growth rate of more than two times the world average in 2011, its environmental sustainability index (ESI) positioned only 133 among 146 countries that had been ranked (SEDAC 2007). Facing the pressures to confront serious environmental problems from both domestic and international communities, the central government has made it a national policy to balance economic prosperity, social equality, and environmental sustainability. This policy has been illustrated clearly in such national-level actions as the implementation of Agenda 21 in 1997 (Gan 1999) and the new Environmental Impact Assessment (EIA) Law that came into effect in 2003 (Stender et al. 2003). China has been taking a 'learning by doing' approach with its social and economic reforms in the past four decades. It is almost certain that Shanghai will receive unreserved support from the central government to pioneer a scalar environmental management model in the country.

Despite many problems, Shanghai's environmental management practice has laid a solid foundation to address intra-urban/regional and global environmental burdens and encouraging changes have been made in the past few years. For example, a nature reserve was scheduled to be established in the Chongming Island to protect the wetland and wildlife habitat (SEPB 2007). In addition, Shanghai was also one of the first Chinese cities/regions to promote and experiment the concept of the Circular Economy (Jiang 2005).

In addition, one commonly recommended strategy to local governments to solve some critical global issues is to 'think globally, act locally' (Betsill 2001). That is to say, it is possible to tackle global problems by addressing local issues. In fact, some recent policies have reflected this thinking. The city policy to limit the quality of motorized vehicles by auctioning license plates for private vehicles and the national regulation on the production and use of plastic shopping bags (The State Council, China 2007) are two good examples. Although these polices intended to deal with local issues, they also indirectly contribute to the global level problems.

Furthermore, the management experiences in some European cities indicate that the adoption of new planning tools such as strategic planning processes will help strengthen collaboration through the varied institutional and social entities at different levels (Gazzari 2004). Strategic Environmental Assessment (SEA) has been required in regional plans since The Environmental Impact Assessment Law of the P.R. China was put into effect on September, 1 2003 (Bao et al. 2004). Shanghai will be an ideal Chinese city to launch a systematic pilot SEA on urban planning to accumulate experiences in SEA theories, methods, management systems, and laws and policies for the successful implementation of SEA in other Chinese cities and regions.

4.2 Obstacles

Considerable obstacles also exist that may prevent Shanghai from implementing a scalar environmental agenda. Most of these obstacles have been briefly discussed in an early section. The first concerns the impacts of the post-reform political economy on environmental governance. Because the current Chinese political system is still dominated by a submissive political culture of 'rule of persons' (as opposed to 'rule of law' in a democratic system), the long-term environmental goals are often compromised for short-term political and/or economic objectives. Moreover, non-government stakeholders remain marginal in environmental policy- and decision-making processes. The second obstacle comes from the difficulty in both sectoral and regional coordination over cross-boundary environmental issues, which could be further complicated by the regional protectionism exacerbated by the decentralization.

The third obstacle is funding. Shanghai has probably one of the best funded programs for environmental protection among all the provincial level governments. However, most of the environmental projects are very costly and do not produce short-term political and economic returns. In addition, because policy incentives have not been established to internalize regional environmental costs, funding to projects that do not directly benefit Shanghai may become a significant problem to projects beyond the city limit.

5. Conclusions

With a main goal to rapidly alleviate severe industrial pollution, improve overall environmental quality, and upgrade urban amenities within the city boundary, Shanghai's urban environmental management in the past four decades has been focused primarily on the environmental problems at the intra-urban level. This 'end of pipe' approach seems to be quite effective in mitigating domestic and industrial pollution that were either accumulated during Mao's era or generated in post-reform era development frenzy. However, little has been done to deal with the environmental impacts at either the inter-urban/regional or global levels. More specifically, neither the spillover effect of Shanghai's environmental burdens nor the impact of Shanghai's production and consumption on global environmental processes and distant resource exploitation have been carefully evaluated and discussed.

It seems that SMG does not have a better option than following this local-regional-global sequence to formulate and implement environmental policies considering the political economy in post-reform China. However, the much delayed or even ignored environmental policies in dealing with the environmental issues at other two geographic scales has led to the relocation of pollution and the mounting EF and DF in the past four decades. Thus the major problem with urban environmental management in Shanghai is neither the lack of interest and support of the central government, nor the scarcity of capital and resources, but the lack of motivation, vision, and expertise of the local government to establish and implement a scalar urban environmental policy that can address and assess urban environmental impacts at a continuous geographic scale.

China is currently lurching between a continuous economic growth and accelerating resource consumption and environmental damage. Thus the transformation of Shanghai's environmental management style from a singular scale to a multiple scale will help Shanghai and other Chinese cities and regions to better gauge their development goals to achieve the 'triple bottom line' sustainability. The support and cooperation from the central government, other local governments, other governmental agencies, and the international communities are essential to assist Shanghai to overcome considerable political, institutional, and financial barriers to develop and carry out such policies. Standing at the forefront of China's reform and open policies, the success or failure of Shanghai's environmental policy are critical to the future environment of the city and beyond.

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