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Same Longitude, Different Latitudes: Institutional Change in Urban Water in China, North and South

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ABSTRACT *The problem of bringing sufficient water of adequate quality to urban areas and treating it once used is becoming increasingly complex, requiring and eliciting innovative political and institutional responses in all parts of China, wet as well as dry. The focus here is on a range of recent institutional innovations in Beijing, in the dry Hai River basin, and in major municipalities of the water-rich Pearl River Delta, in the areas of cross-boundary interactions, retail water pricing and the establishment of urban-based water services bureaux* (shuiwu ju). *Genuine institutional change, while necessary, is often difficult to achieve, due to a political system that, for all its accomplishments in promoting growth, inhibits the development of economic pricing, administrative integration, or social capital.*

Growth in Urban Regions During the Reform Period

Accompanying China's phenomenal economic growth over the past two decades has been an equally astounding growth in its cities that is not expected to abate for decades. Infrastructure has expanded commensurately, but often more for development than to meet environmental needs. In particular, as the cities have grown, the problem of supplying them with water, and disposing of wastewater, has expanded as well, both geographically and across sectors. Stresses are most pronounced in the north, where an event such as the 2008 Beijing Olympics can pose difficult problems for water planners. Yet, increasingly, conflicts over water are becoming salient as well in the boom megalopolises of the Pearl River delta, especially in the face of recent prolonged droughts (Luo & Liu, 1997; Li, 1999; Lin, 2001; Gu, 2002). As this article demonstrates, integration of environmental considerations into water policy-making and, to a lesser degree, implementation, is firmly established, at least in principle and in rhetoric. Given the lingering influence of centralised

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uniform policy making, it is no surprise that institutional responses have often been similar. At the same time, there is little wonder that they exhibit important differences in practice, reflecting in part differences in water scarcity. Institutional change, while critical to China's economic success, is often slowed or stopped altogether by the inertia of the larger administrative and political framework. After providing an overview of the two areas under investigation, we examine three examples of institutional change and the problems seen in their implementation in practice.

Beyond Infrastructure

As in many countries, the conventional approach to urban water supply in China has been project-oriented and largely built and operated by 'the state', an imagined entity that in effect unbundles into ill-coordinated congeries of territorial bureaucracies and vertically- and horizontally-segmented administrative boundaries. Environmental problems, which almost by definition are 'external' to conventional decision-making, have posed a fundamental challenge to this system, as their solution requires both coordination across boundaries and internalisation (or integration) of environmental factors into each decision-maker's calculus. Yet the achievement of greater policy coordination and integration, widely recognised as a key principle of sustainable development, informs the contemporary debates about Environmental Policy Integration both internationally (Lenschow, 2001; Lafferty & Hovden, 2003) and in China.

Reliance on a project culture that frames the problem as one of increasing supply to meet existing shortages or 'needs' has become increasingly untenable as the costs of adding new supplies and rehabilitating aging structures have escalated while different uses or users, including the environment, have come to compete for the existing sources. Conflicts, especially those over quality, watershed management, and maintaining environmental flows, have made imperative the need to find new mechanisms that facilitate negotiation across bureaucratic and administrative borders, including between private and public parties (Nickum, 1999).

For example, there is an enduring complaint, especially from the Ministry of Water Resources, that 'too many dragons manage the water' (*duolong guanshui*) (Luo & Liu, 1997). In the context of the urban water cycle, 'The water source does not manage water supply, water supply does not manage discharge, discharge does not manage pollution control, pollution control does not manage reuse' (Beijing Shi Renmin Zhengfu, 2001: 10). Thus, water, understood in its most generic form and measured in terms of its volume, is managed by the Ministry of Water Resources (through the river basin commissions) in association with local governments. Problems of water pollution, most of which could be traced to land-based sources, fall largely but not entirely under the ambit of the State Environmental Protection Administration (SEPA).[1] Soil erosion is a separate matter of concern to the

Ministry of Agriculture and the State Forest Administration. The administration of hydropower stations is shared between the State Power Company and regional authorities (Gu, 2002). Urban water supply and sewerage have been the traditional domain of the Ministry of Construction. Water prices are set by separate pricing bureaux that are usually more concerned about social stability than cost recovery. In a nutshell, the current institutional arrangement does not map well onto either the hydrological cycle or the ecosystem and is overly complex and prone to rivalries and inefficiencies. China's policy makers appear to be in an active search for a better set of institutions.

Significant changes are being made in transforming the rights regimes and permissible transactions across administrative barriers. Most dramatically, there has been a major policy shift to market-oriented urban water enterprises (*chengshi shiye*) since 2003. At the same time, urban areas are engaged in establishing water services bureaux that, it is hoped, may serve better to integrate many functions of water management than the former sector-bound approach. By 2004, 52 per cent of China's local-level jurisdictions (including county-level governments) and a somewhat smaller 31.4 per cent of its 663 designated cities had reportedly established water services bureaux (Shuilibu Shuiziyuansi, 2004; Wu, 2004). Nonetheless, because of the expanding complexity of water and the degree to which its management is complementary to other activities, it may not be realistic to expect one agency to be able to handle everything (Biswas, 2004). Even when bureaux are merged, they may only internalise conflict, not solve it. Negotiation across bureaucratic and administrative borders is unavoidable.

The Dry and the Wet: Same Longitude, Different Latitudes

Our interest here is to explore the degree to which institutional reform in China's urban growth engines appears to be coping with pressures on their water resources. Our focus is on two quite different parts of China's high-growth coastal areas – Beijing Municipality in the Hai river basin and the Pearl River Delta. We begin with an overview of the two sites, at roughly the same geographical longitude but at quite different latitudes. Then we explore the course of institutional reform in three problem areas.

Beijing

China's capital region is located in the middle reaches of the Hai river basin, the most water-stressed in the country, with 1.5 per cent of China's water resources (on a highly variable average) but with 10.1 per cent of its population, 11.2 per cent of its farmland, and 11.3 per cent of its GDP. Per capita water resources average 350 cubic metres per annum (Wang *et al*., 2005), one-eighth of the national average and about the same as the desert country of Jordan. Administratively, Beijing Municipality consists of a core urban area of about 8 million people and a large, still mainly rural periphery of roughly

6 million. The municipality lies in the midstream of the Hai basin, so its surface water is affected by what happens in the poor but relatively sparsely populated upper watershed, while its own use affects the more developed downstream areas of Hebei Province and, especially, coastal Tianjin Municipality, which has even less water per capita than Beijing for its over 10 million people. The province of Shanxi to the west, one of the most water-short in China, also includes some of the upper reaches of the Hai, and has recently become a source of occasional interbasin water transfers to Beijing.

Because of its location at the northeastern edge of the alluvial North China Plain, Beijing has relatively favourable groundwater conditions and some of the best sites in the Hai basin for water storage. According to the Beijing Municipal Water Resource Bureau (*Beijing Shi*, 2002), in a median (P = 50 per cent) year, Beijing receives 2.2 billion cubic metres in surface water and 2.5 billion cubic metres of groundwater inflow. Since much of the ground water comes from the surface, there is some double counting, and the net average annual water resource is 3.5 billion cubic metres.[2] Thus in a normal year, the municipality should have roughly comparable magnitudes of surface and groundwater available. Since surface water is more variable, however, and does not linger, there has been a tendency to draw down the aquifers, in drought years by as much as an average of 1 metre.

Two large reservoirs have dominated Beijing's surface water supply. The Guanting Reservoir, visible from the popular Badaling section of the Great Wall, was built in 1954 primarily for flood control, and secondarily to provide supplementary surface water to Beijing, which relied at the time on groundwater and springs for its supply. The dam and most of the reservoir are in Hebei Province, while the catchment area is located in Hebei, Shanxi and Inner Mongolia as well as Beijing. Subsequent upstream construction of dams in these provinces to meet their own water demands led to a dramatic drop in the inflow of water to the Guanting. They did not halt the silt, however, that has progressively reduced the storage capacity of the reservoir, while urban, industrial and agricultural wastes eventually degraded the stored water in places to the lowest level, sub-grade V (*lie V lei*), rendering it unusable for any purpose. In 1997, the Beijing municipal government stopped drawing water from the Guanting for urban supply (*Beijing Shi shuihan zaihai*, 1999; Peisert & Sternfeld, 2005).

The Leading Group for the Protection of Guanting Reservoir was set up in 1972, in what was considered to be the beginning of Chinese environmental politics. A regulation drafted by this group to create zones in the catchment and regulate pollutant discharge was ratified by Beijing, Hebei and Shanxi in 1985, but was not well implemented because of disagreements among the parties over who would be financially responsible for the cleanup (Sternfeld, 1997; Peisert & Sternfeld, 2005).

The Miyun Reservoir to the north, built shortly after the Guanting during the Great Leap Forward, originally provided water to agricultural areas downstream, including Tianjin and Langfang County in Hebei, and was not

directly connected with the municipal area of Beijing. The State Council gave Beijing exclusive rights over this water in the early 1980s, and provided more limited alternative supplies to Tianjin. Miyun now provides most of Beijing's surface water, and has become the primary source of drinking water as the city switched away from its overdrawn aquifer for this purpose in the 1980s and 1990s. Unlike Guanting, the Miyun and its immediate catchment lie within Beijing Municipality, which has relied on zoning to control (with mixed success) tourism and economic development, including agriculture and fishery, in critical areas. Nonetheless, over two-thirds of the water flowing into the Miyun comes from upstream in Hebei. Inflow has dropped precipitously during recent drought years (including 1999, 2001 and 2003), due both to low rainfall and to the development of reservoirs in the upper catchment. A few wet years would help relieve some of the pressure, as will a large-scale diversion of water from the middle Yangtze, due to begin in 2010. If all goes according to plan, this diversion will increase Beijing's annual water supply by 1.0 billion cubic metres, or almost 30 per cent in an average year (and much more in drought), but at a high economic cost that is expected to result in a considerable increase in end-user charges.

In the meantime, the 2008 Olympics have given greater urgency to addressing problems of both quantity and quality before the arrival of this source of relief. On the hardware side, with central government legitimisation and financial support and coordination by the Ministry of Water Resources, up to 410 million cubic metres of water per year are to be diverted to Beijing from neighbouring provinces, notably Shanxi and Hebei, until the Yangtze water arrives. The central government and Beijing municipal government have allocated 22 billion yuan for the projects, including compensation (*China Daily*, 3 Oct. 2003)[3]. Also, Beijing has turned back to groundwater, opening up large well fields in the suburban areas.

At the same time, there is widespread recognition that the Yangtze water will not be a panacea, and that a more long-run and less crisis-driven solution will require significant changes in the ways water resources are developed, used, paid for, managed, and disposed of. Addressing pollution and ecological concerns is imperative. A number of new sewage treatment facilities are expected to increase the treatment capacity from 22 per cent in 1999 to 58 per cent in 2004 and 90 per cent in 2008. On the quantity side, the focus is on various forms of demand management and on allocating water to its highest value uses. Changes in the structure of production, cutting back on water-using agriculture and relocating heavy industrial users such the Shougang Iron and Steel Plant, are on the table. There is talk of capping the population of Beijing, but it is difficult to see that as a politically realistic option. Of greatest interest for present purposes, however, are the efforts in Beijing, as elsewhere in urban China, to deal with increasingly knotty institutional coordination problems between functional bureaucracies and across administrative boundaries.

The history of the development of Beijing's water economy until the past decade has been covered in authoritative detail in Sternfeld (1997) and, to a

lesser degree, in Nickum (1994). Each decade after the water-rich 1950s has brought a crisis. The *Beijing Sustainable Use Plan (2001–2005)* (Beijing Shi Renmin Zhengfu, 2001) sums up the responses as follows:

> We made it through the urban water supply crisis of the mid-1960s by digging the Jing-Mi diversion that brought in Miyun Reservoir water [to the urban area]; we made it through the water supply crisis of the 1970s by drawing down the aquifer; and we made it through the water supply crisis of the early 1980s by relying on a Central Government policy shift to reserve the water of the Miyun exclusively for Beijing, cutting off Tianjin and Hebei, as well as on developing planned water use and water saving.

More recent information may be found in Peisert and Sternfeld (2005). We refer the reader to those sources for details, especially about the earlier years, and limit ourselves to a brief overview of three key institutional and political issues of the past decade that, as we will show in the Pearl River Delta (PRD), reflect a more general situation of urban water politics in China than just the politically pampered capital. These issues, discussed after an overview of our southern case study, are transboundary problems, retail water pricing, and integration of functions in a cross-sectoral water bureau.

Pearl River Delta Region

Nowhere else in China is urban growth more spectacular than that observed in the Pearl River Delta region in the past two decades (Lee, 2002). Administratively, the PRD region consists of the cities of Guangzhou, Shenzhen, Dongguan, Foshan, Jiangmen, Zhongshan, Zhuhai and the urban areas of Huizhou and Zhaoqing – home to a total population of 42.88 million in 2000,[4] more than doubling the corresponding figure of 20.57 million recorded in 1982.[5] Not counting the Hong Kong and Macau Special Administrative Regions (SARs), the PRD houses 45 per cent of the total population in Guangdong Province but accounts for 75 per cent of the province's total GDP, 87 per cent of its FDI, and manufactures 94 per cent of its exports (*South China Morning Post* (*SCMP*), 14 October 2002).

With some rather substantial variations in absolute terms, all the cities in the PRD region have recorded phenomenal economic growth figures since the early 1980s (Enright *et al*., 2005). These economic gains have come with a price: a commensurately high rate of growth of the volume of wastewater generated from agricultural, industrial and domestic sources (Luo & Liu, 1996; Lin, 2001). Although the water quality of the Pearl River Basin as a whole is still considered the best among the seven major river basins in China, rapid population and industrial growth have led to a sharp decline in overall surface water quality in the delta region since the early 1990s (Zhu *et al*., 2001; Liu, 2002). Moreover, even though the annual costs of economic losses attributed to

water pollution in the Pearl River Basin were estimated to reach RMB 3 billion in the late 1990s (Xue, 1998), this is well below 1 per cent of total gross domestic production and therefore it has had a minimal economic impact.

Only a very small proportion of the domestic wastewater in most PRD cities, including Guangzhou, Shenzhen, Dongguan, Foshan, and Zhuhai, was treated before discharge. For instance, in 2000 only about 14 per cent of Guangzhou's domestic wastewater was treated prior to disposal. Cities such as Jiangmen, Huizhou and Zhaoqing did not operate any domestic wastewater treatment facilities at all. With the provision of municipal wastewater treatment facilities lagging far behind the expansion of water supply networks in the PRD region's rapidly growing cities – a phenomenon commonly found throughout the rest of urban China – the rapid deterioration in water quality has become an increasingly salient issue, particularly among populations residing in downstream jurisdictions (Jin *et al*., 2001; Zhu *et al*., 2001). The rapid increase in the total volume of wastewater discharged into the delta's midstream waterways – those of the Dongjiang in particular – has led to a noticeable decline in the overall quality of surface water bodies, effectively reducing the amount of clean water supply for downstream jurisdictions (Ye, 1998; Yuan, 1999; Jin *et al*., 2001; Liu, 2002).

Between 2002–2005, the problem of declining water quality in the PRD region was compounded by drought – a perennial problem in the north but an extremely rare phenomenon in the relatively water abundant coastal provinces in southern China (*SCMP*, 14 December 2004). Three consecutive years of drought in the upper reaches of the tributaries of the Pearl river basin led to serious saline tides in early 2005 that threatened urban water supply systems in several coastal cities, prompting jurisdictions in southern China to look into a bundle of policy strategies that have long been pursued by cities in the north – such as water price reform, water conservation measures, and long-distance water diversion projects (*SCMP*, 8 February 2005).

Hong Kong and the Dongjiang

Contributing around 80 per cent of the total flow, the Xijiang is the main tributary of the Pearl River basin, with a catchment that covers an area of 45,500 square kilometres extending through the provinces of Yunnan, Guangxi, Guangdong, and Jiangxi (Zhao & Kuang, 2003). The much smaller Dongjiang is, however, the focal point of recent controversies over water resources management in the PRD region since it provides at least 80 per cent of water supplied to the downstream megacities of Hong Kong and Shenzhen (Lee, 2006; *Renmin Ribao*, 25 January 2005).

About 80–85 per cent of the water demand in the Hong Kong Special Administrative Region (SAR) is met by the Dongjiang, with the remainder provided by rainwater collected by local catchments and stored in reservoirs (Works Bureau, 1998). The Dongjiang water has been delivered to Hong Kong at a cost of more than HK$2 billion a year (Lung, 2001) via a transfer system

of pumping stations and open aqueducts from Dongjiang to Shenzhen Reservoir and then transmitted to a reception point at the Muk Wu Pumping Station in Hong Kong. This arrangement was made under the 1965 Dongshen (Dongjiang–Shenzhen) Water Supply Scheme, a formal agreement instituted between the then colonial government and the Guangdong government to secure a steady and stable source of fresh water for Hong Kong to counter the periodic droughts that had plagued the city in the early 1960s (*SCMP*, 15 March 2001).

The first signs of public concern in Hong Kong over the water quality of the Dongjiang were brought on by a 1993 Hong Kong Water Supplies Department finding that the quality of the Dongjiang's water did not meet Class 2 of China's 1983 national surface water quality standards – in other words, it was considered degraded but potable, barely (*SCMP*, 15 March 2001).[6] From then on, and increasingly so for the remainder of the 1990s, Hong Kong's mass media dwelt on the continuing deterioration of the Dongjiang's water quality.

As a reaction to repeated requests made by the Hong Kong government, Guangdong authorities reportedly undertook several engineering works towards the end of the decade to assure the quality of the Dongjiang's water. First, the water intake point on the Dongjiang was relocated in September 1998 to another point a few hundred metres upstream where the water quality was considered better and where the contamination from an inflowing tributary could be avoided. Secondly, a bio-nitrification plant was installed in the Shenzhen Reservoir in December 1998 to lower the ammonia content and to increase the dissolved oxygen content of the raw water (Works Bureau, 1999a). Finally, the Guangdong authorities also proposed enclosing the existing open aqueduct to protect the water from being polluted by domestic and industrial wastewater in transit (Works Bureau, 1999b).

In a major effort to allay public concerns, the post-1997 Hong Kong government responded by providing an interest-free loan of HK$2.36 billion to the Guangdong government to pay for about half of the HK$5 billion total cost of constructing an 83-kilometre concealed aqueduct from the Dongjiang to the Shenzhen Reservoir (*SCMP*, 4 April 1998). This scheme was hailed by some observers as 'a new chapter of co-operation' between Hong Kong and the Guangdong authorities that could serve as a forerunner of many other cross-border and trans-border infrastructure projects (*SCMP*, 31 March 1998).

The Hong Kong SAR government and the Guangdong provincial government, the two principal proponents of this engineering solution, which was completed in 2003, argued that it would help improve the quality of untreated water delivered to Hong Kong (*SCMP*, 20 November 1998). Critics, mostly Hong Kong-based environmental NGOs and academics, argued that this scheme shied away from the need to confront the fundamental problem of preventing and reducing pollution in the Pearl River Delta region in the first place (*SCMP*, 21 September 1999). They claimed that the proposed aqueduct would not only fail to improve the water quality but could exacerbate the

problem because the enclosed aqueduct would lead local officials to downplay the seriousness of addressing pollution. Worse yet is the possibility that pollutants will continue to wash back into the aqueduct at high tide (Lung, 2001). They thus insisted that a more sensible way for Hong Kong and Guangdong to spend their money on an engineering solution would be on a comprehensive waste-water treatment system along the Dongjiang (*SCMP*, 11 May 2000).

Recent Trends

It goes almost without saying that institutional reform has driven the Chinese economy in recent decades, but that abiding rigidities continue to work against the success of many innovations. In the urban water sector, the pace of institutional change has stepped up recently in response to the growth of the market economy and mounting resource pressures. Here we focus on three domains: transboundary problems; intersectoral coordination; and the use of end-user water charges to promote water saving. This is, of course, not an exhaustive list of relevant institutional reforms.

Dealing across Boundaries

Since the nation's leaders rely on its water, Beijing is well situated both politically and geographically to deal with many of its transboundary problems. The reallocation of the water of the Miyun was followed in 2001 with a municipal sustainable water plan for Beijing that obligated upstream provinces to protect the water supply of the capital (Beijing Shi Renmin Zhengfu, 2001). In both cases, the Central Government smoothed the way with financial allocations to the affected neighbours. The short-term diversions mentioned above, beginning with a 20-day shot of 50 million cubic metres from the Cetian Reservoir in Shanxi in September 2003,[7] would appear to have been enabled by the plan.

Nonetheless, the water disputes between provinces and municipalities sharing the most water-short river basin in China are notorious for their frequency, especially during the recent drought. Recently reported instances include a 2003 quarrel between Hebei and Beijing over the latter's plan to intercept additional water from the midstream of the shared Juma River, and between Beijing and Tianjin over the latter's construction of a dam on the upper reaches of the Juhe River, which is the principal source for the Haizi Reservoir in Beijing. Underlying the disputes, as in the case of the failure of the 1985 Guanting regulation, are different views over the allocation of costs and compensatory payments. The Water Resources Committee of the Hai River, affiliated with the Ministry of Water Resources, has been given the responsibility for 'coordinating' water management between administrative units, but it has been criticised on the one hand for lacking authority and on the other for its lack of 'democratic consultation' (*China Daily*, 26 February 2004, 27 July 2004).

In the Pearl River Delta, transboundary disputes have centred mostly on quality, not quantity. In 1999, in an attempt to allay public concern – primarily, if not exclusively, as expressed in Hong Kong – over the quality of water supplied by Dongjiang, the Guangdong provincial authorities said that they had closed down more than 130 polluting industries up to 1996 and had since then barred new factories from locating along the Dongjiang and Dongshen channels (*SCMP*, 11 May 2000). Furthermore, about 1.2 million pigs had been removed from pig farms located on the banks of a section of the Dongjiang to help curb a major agricultural source of water pollution (*SCMP*, 31 August 2000).

Despite all these efforts, however, by mid 2000, 70 per cent of the effluent discharged into Dongjiang was still untreated (*SCMP*, 11 May 2000). As we saw in the case of Beijing and its neighbours, underlying this problem has been a failure of the financing institutional mechanisms. While the Guangdong provincial government has long said it would improve water treatment facilities along the Dongjiang where it draws water to supply Hong Kong, local officials are reluctant to act because they claim that they do not benefit from the water sales and cannot finance the treatment plants on their own (*SCMP*, 7 August 2000). Moreover, local jurisdictions addicted to the project culture have consistently turned to the engineering approach to resolve their water supply problem. For instance, Shenzhen has recently completed a pipeline to tap a cleaner supply of fresh water at a point 50 km further upstream from Hong Kong's source (*SCMP*, 19 June 2000). Several vocal environmental NGOs based in the SAR argued that Shenzhen's pipeline would further degrade the quality of water supplied to Hong Kong because the reduction in water volume would diminish the ability of the Dongjiang to dilute pollutants. They continued to point out that, in response to the rapidly deteriorating water quality in the Pearl River region, many cities were trying to obtain water from new intake points located as far upstream as possible. All of these billion-dollar water delivery infrastructure projects, however, were planned and conducted without any co-ordination among local jurisdictions in the region, much less any thorough evaluation of the aggregate impacts of the projects.

Water Pricing

The need for economic pricing of water and wastewater treatment has long been recognised in principle and in law in China as a means of promoting water saving and recovering costs. Indeed, on paper, Beijing's policy makers are very much exponents of neoclassical economic principles. For example, the *Beijing Sustainable Use Plan (2001–2005)* (Beijing Shi Renmin Zhengfu, 2001) notes that the excessively low water and sewerage prices have discouraged water saving, source protection, and the optimal allocation of water resources and forced the respective utilities to rely on limited government subsidies for operations. One consequence is that funds for investment are extremely limited, water is wasted, and shortages are aggravated. In addition, it forces the

government to rely on a quota-based allocation system, at least for industry, but this is only feasible where measurement is possible, and until recently the quotas have been too lenient to provide an effective constraint. The Sustainable Use Plan provided for a significant increase in water fees by the year 2005, to 6 yuan/cu.m. on average and 4.5 yuan/cu.m. for household users, including sewerage as well as water supply. However, despite the efforts by the government to push through water price reform measures in recent years, the water fees in Beijing were only raised to an average level of 3.7 yuan/cu.m. in late 2004 (*Xinhua she*, 23 December 2004). Yet even the target level remains too low (1–2 per cent of disposable income) to have a significant impact on household water use behaviour or to make operations attractive to private investors. The sewerage charge, initially levied in 1996, is far from adequate to cover operations and maintenance, much less the large number of new facilities that will be required to bring sewerage coverage over 90 per cent by the time the Olympic torch is lit in 2008 (Han, 2004).

In order to balance efficiency and fairness, Beijing proposed instituting block pricing in 2005, where higher uses are charged at increasing rates, but action on this has been postponed, perhaps because of continuing incompleteness of metering in residential areas. Prepayment systems using IC (integrated circuit) cards have not been extended from other utilities to water yet, again possibly because of metering complexities.

The idea of block pricing has also been floated in major cities in the Pearl River Delta in 2004 but, as in Beijing, it has yet not to be implemented because of resistance coming from both the water producers and consumers. In Guangzhou, for instance, water supply plants complained that it was unreasonable for them to be asked to pay for the entire costs of installing water meters in the city's residential buildings – reportedly reaching 5 billion yuan – and argued that the users should also be asked to bear half of these expenses (*Jinyang wan*, 17 December 2004). In Dongguan, an early 2005 government proposal to increase the water fees from 1.0 yuan to 1.2 yuan/cu.m. met strong objections from resident representatives in a public hearing (*Dongguan Daily*, 30 March 2005). In an effort to help dampen Guangzhou's inflationary pressures in early 2005, the city government decreed a freeze, for a period of three months, on the fee levels of public utilities including water charges (*Xinkuai Bao*, 26 March 2005), even though residents in Guangzhou were consuming on a per capita basis one of the largest volumes of water among the country's major cities but were paying the lowest water fees level – at 0.9 yuan/cu.m. (excluding wastewater treatment fees), as compared with the highest level of 1.9 yuan paid by residents in Shenzhen – in the entire Delta region. Yet, even in Shenzhen, where water supply is charged at the highest level in Southern China, water fees still account for only 0.22 per cent of an urban household's disposable income on a per capita basis (*Nanfang Ribao*, 24 March 2005).

Even though water price reform measures have been introduced by the central authorities since the early 1990s and the water fees in half of the

country's cities have since been increased, implementation at the local level is extremely uneven in terms of the extent of price increases (*Xinhua she*, 23 December 2004). Generally speaking, cities in northern China have imposed the highest levels of water fee increases whereas residents in cities in the south have mostly been spared the pain of paying higher fees. For example, whereas the water prices in Beijing were raised nine times during the 1990–2004 period (*Xinhua she*, 17 December 2004), water prices in the city of Dongguan in the PRD have remained unchanged since 1999 (*Dongguan Ribao*, 30 March 2005). To some extent this reflects differences in the relative scarcity of water.

Thus, due mostly to institutional constraints and political considerations, water prices in urban China, despite repeated increases, are still being held down at levels that are financially unviable for water supply plants. Water fees, on average, still account for not more than 1 per cent of urban households' disposable income. As a consequence, the average urban resident has remained non-receptive to the message that water is a scarce commodity and water utilities, including wastewater treatment facilities, remain under-financed and continue to rely on public finance to subsidise their operations.

Water Services Bureaux

As in north China, engineering solutions continue to be seen in the PRD as central features of water strategy, in part because they are simpler from a transactional point of view – and they have large economies of scale. At the same time, also as in north China, it is increasingly recognised that engineering solutions alone, such as ever longer diversions, are not by themselves adequate for addressing medium-term water supply issues. Demand (including the use of public waters for discharge) has to be brought under control, and the water bureaucracies need to be coordinated better. Pricing is an important part of demand management. Water services bureaux (WSBs) are efforts to improve the bureaucratic end of things.

Although coordination is severely lacking among jurisdictions, some cities in the Pearl River Delta have led the way in seeking a functional coordination of water management. Reportedly modelled after the water services department in Hong Kong, China's first city-level water services bureau was established by the Shenzhen government in July 1993 to help fight the twin problems of drought and flooding that have hit the city particularly hard since the early 1990s. In 1991, the volume of daily water supply was sharply reduced by 30 per cent as a consequence of a partial shutdown of the city's water supply plants for maintenance purposes, causing major disruptions to economic and social lives and resulting in an estimated total economic loss of RMB 1.2 billion. In 1993, Shenzhen lost another RMB 1.4 billion to damages caused by two major rain storm-fed floods. In order to avert similar and further economic damages, the Shenzhen city government then decided in 1993 to transform the city's water resources bureau (WRB) into the country's first water services bureau (Wu, 2003). The latter differs from the former in two major ways. First, the

WSB was accorded a higher level of bureaucratic status in the city's hierarchical structure than the WRB, with a commensurately higher level of authority to re-distribute and manage water resources effectively across the urban–rural divide thorough the city's entire jurisdiction. Secondly, unlike the rural-oriented WRB, the WSB was asked to focus on accomplishing two urban-centred tasks: establishing a modern, reliable urban-based water supply system and building an effective urban flood-control mechanism (Wu, 2000). Of these two objectives, the articulation of the urban and rural water supply systems into one single network was billed as the first step toward building an integrated water management structure for the rapidly burgeoning city-region (Wu, 2004). In practice, however, WSBs have made their presence felt more in flood control, a more southern concern.

Shenzhen's urban-based integrated water management structure was gradually replicated elsewhere and effectively instituted, by the end of 2003, in 50 per cent of country's city and county-level jurisdictions (Wu, 2004). There were, however, substantial variations in the level of services provided by these newly created WSBs: while 96 per cent of them have assumed the flood control function, only 68 per cent were running the water supply networks, with 37 per cent managing the drainage facilities and an even smaller portion – 28 per cent – overseeing the wastewater treatment plants (Wu, 2003). It is also interesting to note that the majority of the jurisdictions in the Pearl River Delta have not yet opted for the WSB model (Kong & Bian, 2000).

Accomplishments in terms of major financial gains in scale economies in constructing city-wide integrated water supply projects, improved efficiency in water allocation as well as reduced tensions between territorial and functional sectors competing for water have been claimed by cities – such as Shenzhen and Shanghai – that have established the WSBs (Wu, 2003). These urban-based offices have also been credited with the strengthening of the institutional basis for the introduction of price reform measures and commercialisation schemes in the water sector, at least in areas such as water supply and sewerage, where, as noted, the WSBs are least likely to exercise direct control, although they have responsibility for integrated water resource management (Zhang, 2004).

Despite such initial claims of success, some researchers are quick to point out that the effectiveness of the WSBs is severely constrained by the lack of consistency and urgency in the implementation of this institutional form at a nationwide level. Beijing did not establish a WSB until March 2004. With only a minority of the country's designated cities embracing the integrated water management structure, old and new systems continue to coexist, and the nation's vertical hierarchy and horizontal bureaucracy relating to water resources management are plagued by confusion and sometimes contradictions in administrative 'property rights' (*guanli zhineng*), organisational goals and project objectives. These problems are aggravated by the ineffectual design and half-hearted implementation of politically sensitive reform measures such as price hikes in water fees and wastewater treatment charges (Wang *et al*., 2004). Hence, almost without exception, water supply and wastewater treatment

enterprises throughout urban China have remained money-losing entities and continue to rely on substantial subsidies paid for from municipal budgets (Jin, 2003; Hu, 2004). As it has become increasingly imperative to turn to external, largely international, sources of funds and management such as the World Bank or international water companies, pressure has been building for a continuing progressive increase in water charges until they reach economic levels.

Concluding Observations

As our title indicates, the Hai and Pearl river basins share much of the same geographical longitude, and both are coastal areas with rapidly growing urban economies. At the same time, they are at quite different geographical latitudes, resulting in quite different hydrological 'latitudes' for action. In many ways this leads to clear differences – in the north, there is a lot more emphasis on policies that elicit water saving, including changes in industrial structure, and perhaps more emphasis on economic instruments such as block pricing or water markets between administrative units, Hong Kong's purchase of Dongjiang water, initiated in colonial times, being a notable exception. In the PRD, Shenzhen is quite water-short, but in most cases, the problem is one of quality.

In both north and south, rapid urbanisation has seen rapid construction of urban infrastructure. In most cases, water shortages are due to infrastructure lags, but these have not apparently increased in relative magnitude over time. What may have increased is deterioration in the quality of existing supplies, often necessitating a reach across basins for supplemental sources, or the construction of expensive treatment plants or, in the case of Hong Kong, the enclosure of the delivery system. Wastewater treatment has lagged behind needs, but in part because there was so little before. Serious problems remain in funding both water supply and sewerage facilities, in part because prices remain too low to attract private investors or to provide adequate recurrent funds for operations and maintenance.

Major water conflicts in the north tend to be between administrative jurisdictions, although there are serious problems of coordination among functional units as well. In the south, the large cities are scrambling for clean and adequate water from the same upstream source, but conflicts between bureaux are more salient. The river basin commissions affiliated with the Ministry of Water Resources have responsibility for coordination and conflict resolution, but usually have inadequate competence or resources to be effective. Metropolitan Water Services Bureaux, which began in the south, are a more urban-based approach to integration that sometimes operate in multiple basins but only in a part of any one basin. These bureaux have had some reported successes, but are rarely given authority over the full water cycle in cities, and, being less than universal, lead to a lot of bureaucratic confusion in China's centralised system.

There does appear to be a serious commitment to administrative reform to meet growing environmental challenges to urban water, in the context of an increasingly marketising economy. Nonetheless, there is little evidence of a commitment to widening stakeholder participation to include non-governmental organisations. China's administrative system, in water as elsewhere, still operates with a weak level of social capital, which is kept frail. The consequent lack of trust leads to serious problems of enforcement, and, together with inadequate funding mechanisms (themselves due in part to a lack of trust), may explain in part the continuing lags in the application of economic instruments and more market-based institutional forms when most seem to agree on their utility. Enduring and often worsening water quality and watershed problems will ensure that at least those parts of the environment will force their way into policy making and implementation. So far, China's major urban areas appear to have muddled or muscled their way through, but not necessarily by means of institutional reform.

Notes

1. The Water Resources Bureau's basin commissions monitor water quality in the river but are not responsible for its control. SEPA monitors point-source discharges from urban land sources, but does not have the capacity to monitor non-point sources, for example, fish ponds. Basically, there is no monitoring of water quality in agricultural areas. Interview with Wang Jin, Zhujiang Commission, 17 March 2005.
2. This works out to 250 cu.m./capita in an average year, a much lower figure than that given more recently by Wang *et al*. (2005), despite a continuing string of drought years that should if anything have lowered the median. Hydrological statistics are like that. According to the 2004 *Zhongguo Shuili Nianjian* (Yearbook of China Water Resources, 2004), the year 2003 brought only half the average amount of water to Beijing, putting per capita water availability at Bedouin levels.
3. At http://www2.chinadaily.com.cn/en/doc/2003-10/03/content_269165.htm (viewed 2 August 2005).
4. This figure is the actual population as measured by the Fifth Population Census in 2000. Subsequent population figures, such as those reported in the annual statistical yearbooks, are based upon official residence, and are not comparable.
5. These figures were published in the 1991 and 2001 *Guangdong Statistical Yearbooks*, the results of the 3rd and the 5th population censuses conducted in 1982 and 2000.
6. Surface water quality in China is graded into 6 classes, with Class 1 denoting the best quality and sub-Class 5 being the worst, unusable for any human activity and often incapable of supporting any form of life. Water classified from Class 1 to Class 3 is considered as potable water; Class 4 water is used for industrial purposes, and Class 5 water is only good for agricultural use.
7. It was estimated that only about half of the water would actually make it the full 157 kilometres. http://www2.chinadaily.com.cn/en/doc/2003-10/03/content_269165.htm (viewed August 1, 2005).

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