The Status of the South to North Water Transfer Plans in China

James E. Nickum
Professor of International Relations, Tokyo Jogakkan College
jengsr@inter.net

1. *Introduction*

The North China (Huang-Huai-Hai) Plain area contains about one-third of China's population producing one-third of its GDP and cultivating two-fifths of its farmland. This activity is supported by less than 8% of the nation's water. In an average year, nature provides this region with 500 cu.m./cap of water, with frequent and often consecutive drought years cutting even this limited amount. Schemes for large-scale diversions from the water-abundant Yangtze River (Chang Jiang) have been under consideration for over half a century, but because of their cost, complexity, and concerns over their adverse environmental effects, and the higher priority given to addressing flooding concerns on the Yangtze and Yellow River through large dam building, a full commitment to their construction has only recently begun. As in the case of the dams, these mass diversion are something of a high-risk, high-cost gamble. The biggest challenges confronting them are probably not ones of engineering or environmental effects, but of institutional capacity to finance and operate the diversions in a way to ensure that water of adequate quality actually makes it to the end of the line.

2. *A brief history of the project and its current status*

In October 1952 Chairman Mao said "The south has a lot of water, the north little. If possible, it is ok to lend a little water." This statement is considered the origin of the south-north transfer project, although the term itself (nanshui beidiao) did not appear until a Great Leap era Political Bureau directive of 1958 and a project planning office was not established in the Ministry of Water Resources until December 1979. (Zhang Yue, 2004: 207) Studies by Chinese and international experts assessing the potential benefits and costs of the transfer were subsequently carried out, including those reported in Biswas et al, 1983.

South-North Water Transfer refers to three sets of diversions, the Eastern, Middle and Western routes, each serving separate areas, with the exception of the coastal city of Tianjin, which will receive water from both the Eastern and Middle routes. The Eastern and Middle routes will pass under the Huang He, while the West routes will directly replenish the Huang.

Parts of the eastern route up to the Yellow River have already been constructed by Jiangsu Province and to some extent Shandong in order to bring Yangtze (Chang Jiang) river water into their territories (lying in the lower Huai basin). Driven in part by a perceived need to relieve unsustainable water use situations in the Hai River basin, especially in Beijing and Tianjin, construction has begun on key components of the remainder of the east route through and to the north of the Yellow River, and on the source of the middle route, the

Danjiangkou Reservoir (which needs to be raised). Construction on the difficult west routes is still in abeyance.

Feasibility and environmental impact studies were carried out in the early 1990s. (Shao et al., 2003: 9). The overall program was approved in principle by the State Council on 23 August 2002.[1]

3. Present status

Construction was formally launched on the eastern route in December 2002 (ZGSLNJ 2003: 53). A few projects were initiated in 2003, with the scale of work apparently growing steadily after the setting up of the South-North Water Diversion Project Construction Committee directly under the State Council in August of that year.[2] Construction began on the middle route in December 2003.[3] Work started in August 2005 on one of the key components of the middle route, excavating two 3.5-km long tunnels under the Yellow River and is expected to be finished in late 2009.[4] Construction in the first stage (to 2010) was expected to peak in the years 2005 and 2006.[5]

Construction of the water transfer projects is divided into three stages, perhaps reflecting the state economic and investment planning cycle, which is based on five-year plans. The first stage of the water transfer runs to 2010, to be followed by a second stage the following decade (2010-2020) and a somewhat vaguer long-range phase from 2020-2050. The Eastern and Middle routes are intended to be finished by 2020. The long-range phase is to be devoted almost entirely to the very expensive and technically challenging Western Routes. (Qian and Zhang, 2001: 244). This schedule may have been accelerated at the time of approval. While I have not found direct evidence of this, it is indicated by official statements that water is expected to begin flowing in 2007 in the Eastern Route, and in 2010 in the Middle,[6] and that construction on the first phase of the western route, originally set for 2020, is scheduled to begin in 2010.[7]

4. Details of the water transfers

a) Routes

Eastern Route. This route expands an existing diversion beginning near Yangzhou in Jiangsu Province using the Grand Canal and some parallel riverbeds. South of the Yellow

---

[1] http://www.yellowriver.gov.cn/lib/top2/2003-08-26/jj_16474035222.html, citing *China Daily.*

[2] http://www.yellowriver.gov.cn/lib/top2/2003-08-07/jj_09133234422.html.

[3] http://www.yellowriver.gov.cn/lib/top2/2005-04-07/jj_095455112833.html

[4] http://www.yellowriver.gov.cn/lib/top2/2005-08-02/jj_08100211834.html.

[5] "Nanshuibeidiao danhua shichang rongzi qianyi touzi fengxian caizheng doudi?" (With slack market financing for South-North transfer, do we have the whole truth about the billions in investment risk finance?), at http://www.qianlong.com/ 2004-06-23 13:09:50.

[6] http://www.yellowriver.gov.cn/lib/top2/2003-10-12/jj_21282437061.html, citing *CCTV*,

[7] http://www.yellowriver.gov.cn/lib/top2/2003-03-28/jj_08552529236.html, citing *People's Daily.*

River it uses a number of existing lakes as regulating reservoirs and requires a total lift head of 65 m from 13 pumping stations on the main stem to raise the water 40 m. Then it is to cross under the Yellow River via an inverted siphon (the component posing the greatest technical challenge) and travel by gravity across the Hai River plain to Tianjin, using five expanded or newly created regulating reservoirs.

An apparent add-on to the Eastern Route from earlier plans is a West-East Water Transfer scheme to direct about 85-90 cms to the northern part of the desperately water-short Shandong peninsula. (Qian and Zhang, 2001: 232-233). This appears on some recent maps of the scheme.

The trunk canal will be about 1150 km long, 660 km of which is south of the Yellow. Branch channels will have a total length of about 740 km. Only about 12% of the total length will require entirely new channels, while an additional nearly 40% will require some enlargement of capacity.[8]

Middle Route. The middle route is the largest water diversion project ever built in China. It takes water from the Danjiangkou Reservoir on the Han River in Hubei and diverts it through Hubei, Henan, and Hebei before reaching Beijing and Tianjin. In addition to the canal, which unlike much of the Eastern Route must be newly dug, a key component of the project is the heightening of the Danjiangkou dam by 15 meters. This work began in September 2005 and is expected to take about five years. Construction is about to begin on the northernmost 307-km long section between Beijing and Shijiazhuang, initially linking four reservoirs in Hebei with Beijing to provide an emergency supply of water as early as 2007, one year before the Olympics.[9]

The central trunk canal of the Middle Route will be 1241 km long, not counting a 142 km offtake trunk canal to supply Tianjin.[10] A figure of 1427 km has recently been cited as well, without detailed breakdown.[11]

Western Routes. Currently, three diversions are being considered, all from the upper reaches of the Chang Jiang into the upper reaches of the Yellow River. The service area would includes parts of six arid northwestern provinces and autonomous regions (Qinghai, Gansu, Ningxia, Shaanxi, Inner Mongolia and Shanxi).[12] Proposed diversions are over relatively short distances but all via tunnels (131 km, 158 km and 28.5 km long) through the earthquake-prone Bayankala Mountains.[13]

b) Amount to be diverted

[8] Figures for the length of canals vary slightly from report to report, probably indicating that not all details of routing have been worked out.
[9] http://www.yellowriver.gov.cn/lib/top2/2005-12-12/jj_084737125748.html
[10] http://www.yellowriver.gov.cn/lib/top2/2002-12-21/jj_08422824875.html.
[11] http://www.yellowriver.gov.cn/lib/top2/2005-06-15/jj_103252116163.html, citing *China Daily*.
[12] http://www.yellowriver.gov.cn/lib/top2/2002-12-21/jj_08244524873.html.
[13] http://www.yellowriver.gov.cn/lib/top2/2002-12-21/jj_08244524873.html.

Recent reports cite a total transfer from all three routes of 44.8 cu.km/ann. by 2050.[14] This is the equivalent of a second Yellow River.[15] The first phase of the eastern diversion will pump 9 cu.km./ann from the Chang Jiang, increasing to 19.12 cu.km. in 2020 and eventually to 26 cu.km. The same source indicates a net increase in water supply of 14.33 cu.km. to receiving areas.[16] The average annual transferable volume of the Middle route is 14.14 cu.km., and about 11.0 cu.km. during dry years (P=75%).[17] In the near term (first phase?) it is expected to divert 9.5 cu.km./ann. (Shuilibu 2004: 37). About 20 cu.km./ann. may be transferred in three western diversions (10 cu.km. from the Tongtian River, and 5 cu.km. each from the Yalong and Dadu rivers).[18]

c) Map (appended)

5. Projected water use in the receiving areas

The main purpose of the *Eastern Route* is to supply water to the major coastal metropolis of Tianjin, which now relies on recurrent emergency diversions from the Yellow River, and to other cities in the delivery area. Agriculture is lower in priority although perhaps not in quantity, projected to receive 7.68 out of 14.33 cu.km./ann, with the remaining 6.66 cu.km. going to urban, industrial and navigation uses. In 2020, about 180 cm (3.09 cu.km./ann) is expected to reach Tianjin out of an initial diversion of 1000 cm (19.15 cu.km./ann). In the longer term, this is expected to reach 250 cm (4.5 cu.km/ann.) out of 1400 cm (26 cu.km./ann).[19]

The *Middle Route* is to supply an additional 6.4 cu.km. for urban (daily living) and industrial uses and 3.0 cu.km. for agriculture in Beijing, Tianjin, Henan and Hebei provinces.[20]

Most (55%) of the water from the *Western Routes* would be intended to develop an irrigated area of about 2 million hectares in western China. The remaining 9 cu.km. would go to supply urban and industrial uses.[21]

Economically, the benefits accrue overwhelmingly to industrial and urban users. Of a projected 30 billion yuan RMB per annum in benefits, 27.7 billion yuan would go to these

---

[14] E.g., Shao et al., 2003:10. .

[15] http://www.yellowriver.gov.cn/lib/top2/2005-09-27/jj_083954121087.html. An earlier projection of the ultimate maximum transfer from all three routes together was 80-90 billion cu.m./ann (80-90 cu.km/ann). (Qian and Zhang, eds., 2001: 232).

[16] http://www.yellowriver.gov.cn/lib/top2/2002-12-21/jj_10435324901.html. These figures indicate some adjustment, apparently upward, from earlier projections, which estimated eventual diversion at 18 cu.km./ann, half of which would cross the Yellow River, with 1.6 cu.km./ann going to the Shandong peninsula (Ning and Zhang, 2001: 180)

[17] http://www.yellowriver.gov.cn/lib/top2/2002-12-21/jj_08422824875.html.

[18] http://www.yellowriver.gov.cn/lib/top2/2002-12-21/jj_08244524873.html.

[19] http://www.yellowriver.gov.cn/lib/top2/2002-12-21/jj_10435324901.html. See also Qian and Zhang, 2001: 232.

[20] http://www.yellowriver.gov.cn/lib/top2/2002-12-21/jj_08422824875.html.

[21] http://www.yellowriver.gov.cn/lib/top2/2002-12-21/jj_08244524873.html.

sectors, 2 billion yuan to irrigation, and nearly 0.5 billion yuan to flood protection.[22] These figures may refer specifically to the Middle Route, but if so, are likely to be of similar proportions for the Eastern Route as well.

6. *Adequacy of the diversion*

No one expects the water transfers to be a panacea. All three diversions, operating at full capacity, would together only provide an additional 100 cu.m./ann per capita to the existing population of north China. Even strong proponents of the projects acknowledge that other measures, especially demand management ("water saving agriculture" in particular) are and will be necessary.[23] In particular, while water charges have increased significantly in recent years, in most cases they remain too low to either provide effective water-saving incentives or allow full recovery of even operating costs, even in urban and industrial uses.

7. *Potential impacts of the diversion*

a) Reduction in flow of Yangtze River (Chang Jiang)

The prospective total transfer of 44.8 cu.km./ann is less than 5% of the annual average flow in the Chang Jiang (951.3 cu.km./ann, of which 890 cu.km. flows into the sea). (Qian and Zhang, eds., 2001: 231-232).

The Eastern Route in particular may be expected to have very little impact in normal years on the Chang Jiang, as its intake is on the mainstream near the estuary. In particularly dry years, it might have some effect on saltwater intrusion in the delta area, but this could be mitigated by reducing the amount diverted during those relatively exceptional periods (Zhang et al, 1999: 52).

The Middle Route, providing water ultimately to Beijing, is more problematic, as it would draw water from the Danjiangkou Reservoir on the Han River, the second largest tributary of the Chang Jiang. Flow in the Han is highly irregular, with a four to one differential between wet years and dry years. (Qian and Zhang, eds., 2001: 231). While withdrawals would have a minimal impact on the mainstream of the Chang Jiang, they could affect navigation, water quality, wetlands, fish species diversity, and offstream uses in the middle and lower reaches of the Han. Eutrophication is of particular concern. A diversion is being considered from the mainstream of the Chang Jiang to the Han River to compensate in part for the water lost to the South-North Water Transfer (Shao et al., 2003:11).

b) Social impact: focus on displaced persons

According to official estimates, between 300,000 and 400,000 people will be displaced by the projects, mostly along the Middle Route. For some who formerly lived in the Danjiangkou

[22] Liu Shuyun et al., 2005.

[23] At a south-north water transfer forum in September 2000, former Prime Minister Zhu Rongji insisted that the initial stage of the transfer project follow the following guideline: "First save water, then transfer it; first clean up the pollution, then let the water flow by; first protect the environment, then use water." (Zhang Yue, 2004: 203)

reservoir area, this will be their second displacement. In April 2005, the central government issued a provisional regulation on land requisition, compensation and resettlement for the project. Zhang Jiyao, director of the Construction Committee, vowed to ensure no repeat of the embezzlement and corruption scandals that were notorious in the relocation of over 1 million people for the Three Gorges Project.[24]

c) Cultural relics

According to the State Administration of Cultural Heritage, at least 788 cultural heritage sites will be affected by the diversions. The central government has so far approved 50 million yuan (US $6 million) to protect 45 sites along the eastern and middle routes.[25]

d) Polluted inflows and return flows

Surface waters, especially in the intensively farmed populated areas of north China, have rarely been pristine. As in most countries, recent industrial and agricultural development and urban growth have had priority over the construction and operation of wastewater treatment and sewerage systems. Despite an impressive amount of progressive legislation and often dramatic cleanup campaigns against the most egregious polluters, indications are that the quality of surface waters in China is deteriorating further (Economy, 2004).

Chinese Vice-Premier Zeng Peiyan has said that pollution control is the key to the success of the south-north water transfer.[26] The south-north transfer of urban and industrial pollution has become the primary environmental concern in particular along the Eastern Route, which uses an existing artificial waterway, the Grand Canal, that has become a sink for untreated wastewater, especially in the poor areas of northern Jiangsu Province and western Shandong Province. One-third of the budget for the route, or 24 billion yuan, is earmarked to 379 pollution control projects, including wastewater treatment plants and wastewater recycling facilities.[27] Lower figures were given in a report two months later, i.e., 13.6 billion yuan for 260 projects, but also one-third of the budget, to be built in two phases over the next five years.[28] In addition, major sources of industrial pollution such as paper mills are being shut down. In Shandong Province, where only two of the 10 water-quality monitoring sections meet minimum standards for drinking water, and two are unfit for any use, the goal is to bring water quality up to where fish can be found in the water anywhere along the diversion route.[29]

On the Middle Route, land degradation, industrial development, agricultural wastes, and domestic wastewater and dumping of solid wastes in the watershed above the diversion are of serious concern. Some parts of the mainstem of the Han River fall below drinking water standards for ammonia. Twenty-five percent of the storage capacity of the 38 major

[24] http://www.yellowriver.gov.cn/lib/top2/2005-04-07/jj_095455112833.html.
[25] http://www.yellowriver.gov.cn/lib/top2/2005-11-16/jj_083037124307.html.
[26] http://www.yellowriver.gov.cn/lib/top2/2005-11-04/jj_082915123666.html.
[27] http://www.yellowriver.gov.cn/lib/top2/2003-08-15/jj_09134734767.html.
[28] http://www.yellowriver.gov.cn/lib/top2/2003-10-17/jj_08200837337.html, citing *China Daily*.
[29] http://www.yellowriver.gov.cn/lib/top2/2005-09-01/jj_080915119631.html.

reservoirs along the Han River has been lost to siltation.[30]

e) Environmental impacts

Although only a small share of Chang Jiang water would be diverted, the strong possibility that each transfer would generate a range of negative impacts on local and regional environments has long been recognized (Biswas et al, 1983). The Eastern Route might aggravate saltwater encroachment in the estuary, and endanger aquatic life both there and along the transfer route, as well as add to sediment deposits in the lower Chang Jiang. The spread of schistosomiasis and secondary salinization of the soil are possible along the transfer routes (see box)[31]. As noted, the Middle Route may aggravate eutrophication in the lower Han River and will have significant social impacts because of land requisition and resettlement. The Western Routes might upset the fragile ecosystems of the upper reaches of the Chang Jiang.

These problems are widely acknowledged by all sides, and together with economic, financial and institutional feasibility, are the bases for critics of the projects. Supporters of the diversions hold that engineering or operating solutions can mitigate many of the adverse effects and that the risk of adverse effects is more than outweighed by the probability that a massive influx of water into North China will make considerable restitution for past environmental sins, in particular by providing relief to the heavily overdrafted aquifers and, one hopes, to the severely polluted surface and shallow groundwaters of North China.

Two possible problems along the way

Schistosomiasis. Schistosomiasis, borne by snails, is a significant parasitic disease in the Chang Jiang region. Its transmission northward along the Eastern Route is a remote possibility, although studies to date have indicated that snails cannot survive in colder latitudes (Yao and Chen, 1983: 329-330, Shao et al, 2003: 11-12).

Secondary salinization. During the Great Leap Forward of the late 1950s, a number of diversions from the Yellow River onto the Hai River plain resulted in significant secondary salinization problems along their routes. Although the subsequent drawing down of the aquifer throughout the North China Plain has largely replaced this concern with one of replenishing depleted groundwater reserves, it is still a possibility on both the Middle and Eastern routes (Shao et al., 2003:11).

f) Energy

The Middle Route diversion will reduce hydroelectric generating capacity along the Han River by 900,000,000 kwh/ann. The Western Routes will similarly reduce power generating

[30] Liu Shuyun et al., 2005.
[31] Liu Jian and Wan Jun, 2001.

capacity on the respective tributaries of the Chang Jiang, but should increase that in the Yellow River (Zhang Xiuzhen et al., 1999: 51-52).

8. Costs, committed and prospective

Projected costs in yuan terms (and dollar terms, given the almost fixed yuan-dollar peg of recent years) have tended to increase, reflecting inflation and perhaps the addition of unforeseen costs, such as for pollution control along the Eastern Route and for the preservation of cultural and historical relics.

Shortly before the diversions were approved, the total estimated cost for all three routes, to the end of construction in 2050, was 314-354 billion yuan (about $40 billion), using 1995 prices:

Estimated costs ca 2000 (using 1995 prices)

	Stage I (2000-2010)	Stage II (2010-2020)	Long-range (2020-2050)
Eastern Route	17.9 billion yuan	11.3 billion yuan	---
Middle Route	23.4 billion yuan	31.5 billion yuan	---
Western Route	---	0-20 billion yuan	230-250 billion yuan
Total	41.3 billion yuan	42.8-62.8 billion yuan	230-250 billion
Source: Qian and Zheng, 2001: 244			

More recently, a total cost figure of 486 billion yuan (nearly $60 billion) has been cited,[32] but I have not yet found a source indicating in what year's prices. This is twice the cost of the Three Gorges Dam, but spread over a longer period and concentrated in later years, with the Western Routes being particularly costly. Since inflation has been modest in recent years, this is probably a higher figure in real terms than the 2000 estimates. One indication of this is that the cost of the first stage alone has been cited at a much higher RMB 124 billion ($14.9 billion).[33]

a) Economic impacts and cost recovery

The estimated benefits of all projects together range from 30 to 80 billion yuan ($4 to $10 billion) per annum,[34] implying a relatively short payout period. Internal rates of return have been calculated at 18% for the first stage of the Eastern Route (Ning and Zhang, 2001: 182), 16.6% for the Middle Route (Wen et al, 2001: 198), and 12% and 19% for different portions of the Western Routes (Tan, 2001: 231). Nonetheless, financing the project, and particularly, recouping some of the benefits from potential users to pay for the project, looms as a significant problem. Of the

[32] For example, in http://www.yellowriver.gov.cn/top2/2003-08-15/ jj_09134734767.html.
[33] http://www.yellowriver.gov.cn/lib/top2/2003-12-29/jj_08470640724.html.
[34] http://www.yellowriver.gov.cn/lib/top2/2003-08-29/jj_08351835309.html (for 80); Liu Shuyun et al., 2005 (for 30). The smaller figure may be for the Middle Route only.

RMB 124 billion for the first stage, only RMB 24.8 billion was originally slated to come from the state budget, with 55.8 billion from bank loans and 43.4 billion from unspecified "other financing channels." Almost immediately, the central government found it necessary to increase its contribution.[35] A consortium of seven Chinese banks provided 48.8 billion yuan, the largest amount ever supplied to a water project. Four legal entities were created to be responsible for construction, operations and management, and repayment of loans for the water source and main routes of the eastern and middle routes.[36] Current policy favors water charges on an ability-to-pay basis, but it remains to be seen whether adequate surcharges will actually be levied, and if levied, collected. Despite recent increases in water and sewerage charges in Beijing, the level remains too low to significantly induce water-saving behavior or to attract private investors into building and operating water and sewage (Han Xiangyun 2004). Adding an adequate charge for South-North transfer may be even more problematic.

9. Views of concerned regions and Chinese NGOs

The region that is most immediately concerned about a negative impact of diversion appears to be the Xiangfan area of Hubei, which is downstream of the Danjiangkou Reservoir on the Han River. Except in this one locality, Chinese NGOs have not been significantly engaged in opposition to the diversion, perhaps because of its high political profile.

10. Other information

If they succeed, the diversions can help right the imbalance between China's relatively water-rich south and its parched north. Even after decades of study, however, they remain something of a high-risk gamble. The biggest challenges to the diversions are probably not ones of engineering or environment, but of institutions. These include the need to coordinate numerous provinces in an unprecendented way, the need to find an appropriate balance between public and private sectors while this is in flux nationwide, the politically charged nature of increases in water charges to cost recovery levels, ensuring adequate finance, and, more generally, the very real possibility of simultaneous market and government failures (Nickum, 1983, and Shao et al. 2003: 12-13).

REFERENCES

Biswas, Asit, Zuo Dakang, James E. Nickum and Liu Changming, eds., 1983. *Long Distance Water Transfer in China* (Dublin: Tycooly International). Chinese edition: Zuo Dakang, Asit Biswas, Liu Changming and James E. Nickum, eds., 1983. *Yuan juli diaoshui* (Beijing: Kexue Chubanshe).

Economy, Elizabeth C., 2004. *The River Runs Black* (Ithaca: Cornell University Press).

Han Xiangyun, 2004. "Beijing Shi shuijia gaige yuanyin ji xiaoying fenxi" (An analysis of the principles and effects of water charge reform in Beijing Municipality), *Zhongguo Shuili*, 20:48-49.

Liu Jian and Wan Jun, "Environmental Impact of the South-to-North Water Transer Project in

[35] http://www.yellowriver.gov.cn/lib/top2/2003-12-29/jj_08470640724.html.
[36] Xie Minying et al, 2005.

China," presentation at World Water Congress 2001. Abstract at http://scitation.aip.org.

Liu Shuyun, Wang Li and Jin Tian, 2005. "Nanshui beidiao shuiyuanqu huanjing dai buchang" (No compensation for the environment yet for the source region of North-South water transfer), *Jingji Cankaobao*, 23 May, as reproduced at http://jjckb.xinhuanet.com/www/Article/200552310437-1.shtml.

Nickum, James E., 1983. "Institutions and China's Long-Distance Water Transfer Proposals," in Biswas et al.: 181-191.

Ning Yuan and Zhang Xiaohua, 2001. "Nanshui beidiao dongxian gongcheng ji youguan wenti yanjiu" (A study of the Eastern Route project of South-North water transfer and some relevant problems), in Pan and Zhang, eds., 2001: 173-185.

Pan Jiajing and Zhang Zezhen, eds., 2001. *Zhongguo beifang diqu shui ziyuan di heli peizhi he nanshui beidiao wenti* (The rational allocation of water resources in North China and the issue of South-North water transfer)(Beijing: Zhongguo Shuili Dianli Chubanshe).

Qian Zhengying and Zhang Guangdou, eds., 2001. *Zhongguo kechixu fazhan shui ziyuan zhanlue yanjiu zonghe baogao ji ge zhuanti baogao* (A consolidated report and specialized reports on strategic research on China's sustainable development of water resources) (Beijing: Zhongguo Shuili Dianli Chubanshe).

Shao Xuejun, Hong Wang and Zhaoyin Wang, "Interbasin transfer projects and their implications: A China case study," *International Journal of River Basin Management,* 2003, v. 1, no. 1, pp. 5-14.

Shuilibu Guihuaihuasi (Planning Office, Ministry of Water Resources), ed., 2004. *Shuili kechixu fazhan zhanlue yanjiu* (Strategic studies in the sustainable development of water resources) (Beijing: Zhongguo Shuili Shuidian Chubanshe).

Tan Yingwu, 2001. "Nanshui beidiao xixian gongcheng" (The Western Route projects of South-North water transfer), in Pan and Zhang, eds., 2001: 201-237.

Wen Fubo, Yu Dengsheng and Qiu Zhongen, 2001. "Nanshui beidiao zhongxian gongcheng" (The Middle Route project of South-North water transfer), in Pan and Zhang, eds., 2001: 186-203.

Xie Minying, Zhang Yuanjiao and Deng Jie, 2005. "Nanshui beidiao gongcheng yintuan daikuan xin changshi" (The new attempt at consortium finance for the South-North transfer project). *Zhongguo Shuili*, #14: 41-42, 45.

Yao Bangyi and Chen Chunhuai, 1983. "Some aspects of the necessity and feasibility of China's proposed South-to-North water transfer," in Biswas et al.: 321-331.

Yellow River Conservancy Commission website (www.yellowriver.gov.cn), various releases ("hot topics").

Zhongguo Shuili Nianjian (ZGSLNJ: Yearbook of China Water Resources) 2003. (Beijing: Zhongguo Shuili Shuidian Chubanshe, October).

Zhang Xiuzhen, Luo Shuliu and Yue Dengsheng, eds. 1999. *Nanshui beidiao—Zhongguo kechixu fazhan di zhicheng gongcheng* (South-North Water Transfer—A project that is the mainstay of China's sustainable development)(Beijing: Zhongguo Shuili Shuidian Chubanshe)

Zhang Yue, "Nanshui beidiao shui ziyuan guanli zenma gai" (How should we change our water resource management with South-North Transfer," *Beijing Qingnian bao,* March 2001, in Zhang Yue, 2004: 201-207.

Zhang Yue, 2004. *Zhongguo shuili fazhan zhanlue wenji (1996-2004)* (Collection of China's Water Development Strategies (1996-2004). Beijing: Zhongguo shuili shuidian chubanshe, 2004).