

1 Objective

The overall objective of the project was to improve and assure the (ground-) water and environmental protection in Haikou, a coastal city in China with a population of 850,000. The project included improved drinking water supply and improved wastewater management.



2 Context

BMZ-Nr.: 1994 65 956

Support to project planning and implementation 1995 – 1999; construction 1997 – 1999, training of staff 1997 – 1999; start operation treatment plant 1999 (start sludge digestion and biogas production 2005); final evaluation 2007

	Project area	China
Target group / population	850,000 (urban)	1.3 billion (2007)
Under 5 mortality rate (per 1,000)		21 (2006)*
Population below poverty line		8% (2006)*
Population growth p.a.		0.6% (2008)*
GDP per capita at official exchange rate	2.226 EUR (2007)***	1,723: EUR (2007)**
Per capita HH income	1,400 EUR (2006 est.)	1,284 EUR**** (2006)
% connection to sewer system	70% (after project)	
% sewage treated	none (before project) 100% (after project)	
% of agricultural reuse of sludge	100% (after project)	
Energy generation from biogas	Yes (after project)	

* CIA The World Fact Book, July 2008

** <http://siteresources.worldbank.org/DATASTATISTICS/Resources/GNIPC.pdf>; 2,360 USD; exchange rate 1.37

*** <http://en.wikipedia.org/wiki/Haikou> 3,049 USD; exchange rate EUR 1.37

**** <http://english.mofcom.gov.cn/article/subject/davos/lanmuaa/200708/20070805037588.html>

Water pollution is one of the big environmental problems of China. This was also the case in Haikou, the capital of Hainan Island province. Before the project, the wastewater polluted the sea and endangered the entire ecosystem of the Haikou Bay, the city's main tourist attraction. Furthermore, the increase in water consumption had lowered the groundwater level and increased the risk of saltwater infiltration to the groundwater.

3 Project approach

Investment/Technology:

The project included a drinking water component providing treated surface water, thus ending the overexploitation of ground water sources. The sanitation component supported the extension of the sewer system (120 km new sewer lines, 4 pumping stations) and the construction of a mechanical-biological wastewater treatment plant with sludge digestion and a 1.4 km marine outfall to discharge the treated water into the sea. The present document deals in the following only with the sanitation component.

The capacity of the treatment plant is 300,000 m³ per day. The treatment plant serves more than 70% of the urban population of Haikou and the local industries. Industries account for roughly 30% of water sales in 2005 (down from 65% of water sales in 1994). Presently, the treatment plant operates almost at full capacity and the upgrading to a capacity of 400,000 m³ per day is ongoing.

Institutional concept / support activities:

The project executing agency is Haikou Water Service Group Ltd (HWSG). HWSG is responsible for the operation of the water supply system and the wastewater treatment plant. This group is a fusion of the former Haikou Water Supply Company and Haikou Sewage Treatment Company. This fusion was a great step towards an integrated management of water supply and wastewater. Only the operation of the sewer network remained with the Haikou Sewage Company. HWSG is a commercial semi-autonomous enterprise. In 2007, a 49% share has been sold to Veolia (France) for over 90 million EUR, thus attracting private capital for the further investment. The municipality still has to approve tariffs and investments.



1 Wastewater treatment plant Haikou

Operation and maintenance concept

Since the start of operation the effluent quality has been very good. The average concentration of BOD₅ is 15 mg/l, nitrogen 5 mg/l and phosphorus 1 mg/l. The Environmental Protection Bureau controls regularly the water quality close to the outfall. The sludge is stabilised in a digestion tower, where biogas is produced. The generated electrical energy covers 20-30% of the energy consumption of the wastewater treatment plant and the pumping stations. A local fertilizer plant buys the digested and dewatered sludge (40 t per day) for its fertilizer production.

The wastewater treatment plant is operated efficiently with 107 staff members. They follow maintenance routines including regular replacements. During implementation a special training program was carried out including several block seminars and visits to Germany and other Chinese treatment plants.

4 Costs and financing

Roughly half of the infrastructure investment was for the upgraded and additional sewer lines, the other half for the wastewater treatment plant and four pumping stations. The costs per inhabitant equivalent (126 EUR in 2006 prices) are rather low for the high treatment standard reached.

The project was financed by the Chinese Government, the City of Haikou, an infrastructure fund and a loan of KfW Entwicklungsbank, subsidised by the German Development Cooperation. The Chinese Government covers the debt service of the loan. Thus HWSG is only in charge of depreciation (replacement).

The wastewater tariff is 0.06 EUR/m³ for households and 0.08 EUR/m³ for industrial clients. This is sufficient to fully cover the operation cost. For water supply, the household tariff is 0.16 EUR/m³,

commercial and industrial clients pay 0.26 EUR/m³. The water tariff fully covers operation and capital costs of the water supply. The collection efficiency of water and wastewater fees is over 90%.

Based on the average per capita water consumption (170 l per day) the annual wastewater fee is around 4.20 EUR per person. This corresponds to 0.3% of the average income (1.400 EUR in 2006). The combined water and wastewater fees are around 1.4% of the average income. The project is economically and ecologically sustainable. Further tariff increases to fully cover capital cost of the wastewater component might further reduce the water consumption and thus reduce pressure on water resources.

	Project (sanitation component)	per inhab. equiv. (30% industry)
Infrastructure investment	105 million EUR	123 EUR
Training of operation staff, consultant	2.3 million EUR	3 EUR
KfW loan (to Central Government of China)	15.3 million EUR	
KfW grant (0.3m EUR) + subsidy value of loan	approx. 3.6 million EUR	
Investment contributions Central Government of China and City of Haikou	total investment cost	126 EUR
Investment contribution of beneficiaries	none	
Operation cost p.a. (2006 prices)	3.6 million EUR	
LRMC p.a. (2006 prices)		16 EUR
LRMC as % of local per capita GDP		0,7%
Annual HH user fees for sewer services		4.20 EUR
Annual HH user fees as % of HH income		0.4%
Collection efficiency	90%	
Coverage of operation cost	> 100%	

* Population growth estimate 0.9% p.a.; useful lifetime in average 30 years; discount rate 5%; 70% of population connected; 30% of water sales to industrial clients

5 Experiences / lessons learnt / critical aspects

Due to the reasonable treated waste water quality at the sea outfall, water quality measurements of the Environmental Protection Bureau in the bay of Haikou revealed a significant improvement, gives a positive momentum for the tourism along the coast.

The sludge has good quality (very low contamination with heavy metals) and can therefore be used in agriculture. Haikou is one of the first wastewater treatment plants in China, where sludge is used in agriculture and has become a model for environmental sustainability.



2 Digestion tank