

China, PR: Qingdao Sewage Disposal

Ex-post evaluation

OECD sector	14020 / Water supply and sanitation– large systems	
BMZ project ID	1992 65 620	
Project-executing agency	Municipality of Qingdao	
Consultant	Otto Oeko Consult GmbH / Institut Preussner	
Year of ex-post evaluation	2004	
	Project appraisal (planned)	Ex-post evaluation (actual)
Start of implementation	Q 4 1992	Q 4 1992
Period of implementation	57 months	79 months
Investment costs	EUR 30.68 million	EUR 42.43 million
Counterpart contribution	EUR 17.90 million	EUR 29.65 million
Financing, of which Financial Cooperation (FC) funds	EUR 12.78 million	EUR 12.78 million
Other institutions/donors involved	None	None
Performance rating	4	
• Significance / relevance	4	
• Effectiveness	4	
• Efficiency	3	

Brief Description, Overall Objective and Project Objectives with Indicators

The fast economic and demographic development in the port city of Qingdao in Shandong Province and the related continuously increasing volume of sewage are threatening the ecological balance in the nearby Jiaozhou Bay and in the southern coastal region and are potentially hampering the health of the population and the existence and development of important industries (e.g. fishery and tourism). In order to mitigate this threat a sewage treatment plant with a capacity of 100,000 m³/d was constructed. The plant purifies the sewage of the southwestern part of the city, which were hitherto discharged into the sea without treatment, in an environmentally friendly manner. In addition a service water treatment plant with a capacity of 40,000 m³/d was financed that cleans pre-treated water so that it can be reused industrially or for the irrigation of greens.

The overall objectives were to contribute to the reduction of the sewage-induced pollution of natural resources (especially the marine fauna and flora and the beaches of Qingdao) and to alleviate the expected drinking water shortage through the substitution of freshwater with treated waste water for special purposes. Project objectives were to avoid the discharge of untreated sewage into the sea through sufficient treatment and control as well as the provision of the treated wastewater for industrial usage and for the irrigation of greens.

Originally the indicators for the achievement of the project objectives were the capacity utilisation of the Tuandao treatment plant (approx. 100,000 m³ per day), the conformity of the quality of the

treated wastewater with Chinese standards and the volumes of treated wastewater made available (approx. 40,000 m³ per day). No indicators were defined at the time of the project appraisal to measure the achievement of the overall objective.

On the occasion of the final inspection the reduction of pollutant loads flowing into the treatment plant (BSB₅, CSB and solid matter) was defined as at least 85% of the indicator for the overall objective. On the other hand, the indicator for the capacity utilisation was reduced to 70,000 m³ per day. This was due to the fact that at the time of the project appraisal the seasonal fluctuations in drinking water consumption had not been sufficiently taken in to account and, according to German experience, a capacity utilisation of 70% was an adequate achievement after a period of operation of three years.

Project Design / Major Deviations from the original Project Planning and their main Causes

After the completion of the Tuandao sewage treatment plant the urban sewage treatment infrastructure in Qingdao reached a total capacity of 360,000 m³/day. Currently the sewage from the central city area is being treated in four treatment plants. The construction of a fifth plant with a treatment capacity of 100,000 m³/day is planned.

The project comprised the following six main measures:

- Provision of land for building at the site of Tuandao treatment plant (approx. 17 ha.);
- Construction and installation of the Tuandao sewage treatment plant including a mechanical and a biological treatment stage and sewage sludge drainage (capacity of 100,000 m³/d);
- Construction and installation of a plant for follow-up treatment with a capacity of 40,000 m³/day for the reuse of treated wastewaters for industrial usage and for the irrigation of greens;
- Renewal of the sewage pumping station and extension of the sewer network by approx. 7.5 km;
- Supply of measuring and control instruments to monitor the sewer network;
- Supporting German consulting measures during the planning and construction stages and further training for the personnel at the treatment plants to be implemented in the context of a cross-project training measure.

Essentially all measures laid down during the project appraisal were implemented. In deviation from the original planning, however, the plant for industrial and service water was built at another site because this site was closer to the business locations of potential consumers.

A substantial deviation from the original planning occurred with regard to investment costs, which increased by approx. 70 % as compared with the original planning. While the foreign exchange costs financed from FC were in line with the original planning, the domestic costs financed from Chinese counterpart funds increased considerably. On the one hand the inflation rate rose disproportionately in the years 1993 – 1995 (between 15 – 20% annually) as compared with the project planning made at the beginning of the 1990s, on the other hand the costs for the provision of land and compensation payments for commercial enterprises which had to be relocated increased.

The implementation of the project was delayed by around two years as compared with the original planning. The reasons were problems with obtaining the construction permit, temporary

financing bottlenecks on the Chinese side, increased expenses for the preparation of land for building and delays in the relocation of commercial enterprises.

Key Results of the Impact Analysis and Performance Rating

The on-site ex-post evaluation revealed that the Tuandao treatment plant was in a good operating condition. The volume of sewage treated at the plant was unobjectionable and the discharge values met Chinese discharge standards.

In the course of the implementation of the project, as a result of both the economic structural change and the introduction and implementation of Chinese environmental legislation, many wastewater-intensive commercial enterprises in the catchment area of the treatment plant ceased or switched production or installed their own wastewater pretreatment facilities. In consequence, the volume of industrial wastewater in the catchment area of the treatment plant did not, as forecast upon project appraisal, increase by 10% annually until the year 2000, but on the whole decreased by approx. 35 %. Over the same period the volume of non-industrial wastewater (from households, service enterprises etc.) increased from 21,000 m³/day to currently about 30,000 m³/day. This means an average increase of approx. 5% annually (the forecast increase was 8% annually). Thus, the volume of wastewater of 45,000 m³/d that occurred in the city area covered remained almost constant and did not rise to the volume forecast for the year 2000. The respective indicator for the achievement of the project objective, i.e. a capacity utilisation of 70%, was clearly missed. To be able to ensure an adequate capacity utilisation of the treatment plant in the future, intensive efforts were made in the last three years (construction of a new pumping station with a capacity of 50,000 m³/d and of a 3-km sewer) in order to also connect the neighbouring city districts to the sewage network of Tuandao treatment plant. According to information provided by the operator, the completion of the works is to be expected for 2005 at the earliest and an improvement in the capacity utilisation only after 2007. However, the Chinese partners could not provide any specific information on the additional wastewater volumes to be expected.

The de-watered and digested sewage sludge from Tuandao treatment plant and from all other treatment plants in Qingdao was initially deposited on a dump for residential and commercial waste. The authorisation by the competent environmental protection agency for this type of sewage sludge disposal had been granted. However, said dump was closed when a new dump was opened in 2002. The deposit standards of the new dump require a dry matter content of at least 60%. The de-watered and digested sewage sludge of the Tuandao plant, however, has a dry matter content of only about 18-20% and for this reason may not be deposited at the new dump. Since the old dump was closed the municipal administration and the authority in charge of sewage elimination in the city of Qingdao have tried to find an environmentally friendly and sustainable concept to discharge the sewage sludge produced by all treatment plants in Qingdao, but so far only with moderate success. The digested sludge was partly discharged into the sea. Currently the sludge is temporarily deposited on rented areas, but the storage capacity will be exhausted in a few months. In the context of a measure financed under a project preparation fund the existing possibilities for a sustainable sludge disposal were being examined. It will, however, take some time before a solution can be expected.

The plant for industrial and service waters is used only to a limited extent. Instead of the planned volume of 40,000 m³, the daily volume of treated water produced is only about 7,000 m³ on average. One reason for the low use of the plant is the commissioning of a new long-distance freshwater pipeline that helped to alleviate the problem of water scarcity. In addition, the price to be paid for the treated water is only marginally lower than the price for drinking water and in consequence there is little economic incentive to use the treated water.

In Qingdao sewage fees are charged together with drinking water fees by the “Qingdao Water Supply Company”. The sewage fee for household consumers currently amount to RMB 0.30 per m³ of water consumed and, thus, are relatively low in comparison with other FC projects in China. The sewage fees are charged for 100% of the water consumptions actually measured, even though currently only about 50% of the sewage are actually treated in plants. A tariff increase which had been planned in the year 2001 did not materialise due to the public opposition from water consumers in the context of a public hearing. In the last few years the total revenue from sewage fees amounted to around RMB 60 to 80 million. Since the sewage administration of Qingdao is operated by a municipal company, which does not require separate accounting, the question whether the sewage fees are adequate to fully cover all sewage-related costs cannot be answered conclusively. Given the operating costs of the Tuandao plant of RMB 0.75 per m³ of treated sewage this assumption is not very likely in particular bearing in mind that the costs produced by the other plants will be in the same range and that the maintenance of the canal system is another major cost item. Moreover, there is substantial need for action in the field of tariff policy if the further expansion planning for the sewage infrastructure is taken into consideration.

In summary, it has to be said that the project objectives have not been achieved to the extent expected. While the average volume of sewage treated in the plant in the last few years was only 40 to 45% of the planned volume of 100,000 m³/day (indicator for the project objective: 70%), all Chinese discharge standards (for BSB₅, CSB, solid matter and total nitrogen) have been met without exception since the start of operation of the plant. Unfortunately it was not possible to acquire a sufficient number of new industrial consumers of treated service water. Currently the capacity utilisation of the service water treatment plant amounts to only 20% of the planned 100%. It is uncertain whether improvements can be achieved here in the future. Due to the fact that two of three indicators for the achievement of the project objective were clearly missed we classify the project's **effectiveness as slightly insufficient (rating 4)**.

From today's perspective the project concept was adequate to solve the problem and suited to contribute to water pollution reduction and to mitigate the shortage of drinking water. On principle, the project's relevance is given. Still, the achievement of the overall objective, which is naturally a consequence of the achievement of the project objective, did not meet expectations. Neither the contribution to reducing water pollution nor the contribution to alleviating the shortage of drinking water meet the targets set at the time of project appraisal. Moreover, the problem regarding the discharge of sewage sludge still needs to be solved. Overall, we consider the project's **relevance and significance as slightly insufficient (rating 4)**.

The specific investment costs are markedly higher than expected, though they are still moderate overall. The operating condition of the financed treatment plant is good, though the operation partly required a higher resource input (personnel) than had been planned. Overall we judge the production efficiency to be sufficient. The tariffs are clearly too low and presumably do not even cover the operating costs of the sewage system. So far, all efforts to adjust tariffs failed due to the opposition from consumers and it is currently not predictable what the development will be in the future. Thus, the allocation efficiency is insufficient. But due to the fact that the sustainable operation of the financed plants does not seem to be jeopardized (subsidisation by the city of Qingdao), we consider the **efficiency of the project still to be sufficient (rating 3)**.

After weighing the above mentioned developmental sub-criteria for the evaluation of project success, we classify the project's **developmental effectiveness as slightly insufficient (rating 4)**.

General Conclusions

In the event that the sewage treatment plants are operated as force-account works it would be advisable upon project appraisal to see to it that the operation is conferred to a municipally-owned operator in order to ensure the necessary transparency in terms of efficiency and profitability.

Often the sustainable discharge of sewage sludge is one of the most sensitive aspects when implementing sewage disposal projects. Thus, this aspect should be given special attention.

High consumption growth rates assumed (in this case for water consumption) at the time of project planning should always be considered very critically.

Legend

Developmentally successful: Ratings 1 to 3	
Rating 1	Very high or high degree of developmental effectiveness
Rating 2	Satisfactory developmental effectiveness
Rating 3	Overall sufficient degree of developmental effectiveness
Developmental failures: Ratings 4 to 6	
Rating 4	Overall slightly insufficient degree of developmental effectiveness
Rating 5	Clearly insufficient degree of developmental effectiveness
Rating 6	The project is a total failure

Criteria for the Evaluation of Project Success

The evaluation of the "developmental effectiveness" of a project and its classification during the ex-post evaluation into one of the various levels of success described in more detail above concentrate on the following fundamental questions:

- **Are the project objectives reached to a sufficient degree (aspect of project effectiveness)?**
- **Does the project generate sufficient significant developmental effects (project relevance and significance measured by the achievement of the overall development-policy objective defined beforehand and its effects in political, institutional, socio-economic and socio-cultural as well as ecological terms)?**
- **Are the funds/expenses that were and are being employed/incurred to reach the objectives appropriate and how can the project's microeconomic and macroeconomic impact be measured (aspect of efficiency of the project conception)?**
- **To the extent that undesired (side) effects occur, are these tolerable?**

We do not treat **sustainability**, a key aspect to consider for project evaluation, as a separate category of evaluation but instead as a cross-cutting element of all four fundamental questions on project success. A project is sustainable if the project-executing agency and/or the target group are able to continue to use the project facilities that have been built for a period of time that is, overall, adequate in economic terms, or to carry on with the project activities on their own and generate positive results after the financial, organisational and/or technical support has come to an end.