# Non-economic benefits of standards

# Shenzhen Water Resources Bureau, China

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# Table of contents


1 **Objective and organization of the case study** ..... 3

- **1.1** Objective ..... 3
- **1.2** Timeline of the case study project ..... 3
- **1.3** River management industry ..... 3
- **1.4** Methodology ..... 4

2 **Introduction to the selected organization** ..... 6

3 **Attitude of the organization towards standardization** ..... 8

4 **Analysis of the value chain** ..... 11

- **4.1** Industry value chain ..... 11
- **4.2** River management value chain ..... 12
- **4.3** Key value drivers ..... 13

5 **Scope of the case study** ..... 14

6 **Standards used in the river management value chain** ..... 14

7 **Definition of operational indicators to measure the impacts of standards** ..... 16

8 **Impacts of standards** ..... 17

9 **Approach in the assessment and the quantification of the results** ..... 18

- **9.1** Conduction of a questionnaire survey ..... 18
- **9.2** Use of the Contingent Valuation Method (CVM) ..... 18

10 **Calculation of the non-economic benefits of standards** ..... 20

- **10.1** Job creation ..... 20
- **10.2** Water quality ..... 20
- **10.3** Public awareness ..... 20
- **10.4** Estimated total environmental benefits of standards ..... 22

11 **Conclusions** ..... 25

**Annex 1** ..... 26

# 1 Objective and organization of the case study

## 1.1 Objective

The key objective of this case study is to determine in a quantitative manner the non-economic benefits that companies/organizations can derive from the use of standards in their business. Such knowledge is useful for demonstrating the advantages of participating in standards development initiatives and/or in the use of standards. While many companies/organizations realize the importance of using standards, and have analyzed the economic benefits for their business, few have quantified the non-economic benefits.

## 1.2 Timeline of the case study project

The case study on non-economic benefits in China was conducted from June to August 2013 and the report was finalized in September 2013. Led by the Standardization Administration of the People's Republic of China (SAC), the case study was carried out by the Standardization Application Research Centre of the Shenzhen Institute of Standards and Technology (SIST), the Shenzhen Water Resource Bureau (SZWRB), the Shen Shui Water Affair Consulting Co., Ltd., the Shenzhen branch of the Hunan Hydro & Power Design Institute and with the guidance of the ISO Central Secretariat.

## 1.3 River management industry

This study focuses on the non-economic impact of standards on river management. River management includes the following aspects: dike slope protection, river cleaning, river dredging, hydrologic monitoring, water quality monitoring, ecology landscape maintenance, ancillary facility maintenance, emergency relief work, etc. The

major standard used in Shenzhen for river management is the local standard of Shenzhen SZDB/Z 24-2009, *Technical Specification for River Maintenance and Protection*, which was developed by the Shenzhen Water Resource Bureau. The standard was published in November 2009 and implemented in January 2010.

In order to evaluate the benefits of standards in qualitative and quantitative ways, a self-designed questionnaire was applied to investigate the degree to which the 200 residents near a river in Shenzhen which was in the focus of the assessment, were satisfied with the management of the river, whether they would be willing to participate in support of river management and whether they would be willing to pay for river management.

## 1.4 Methodology

The ISO methodology has been used in assessing and quantifying the non-economic impacts of standards from the perspective of the selected organization and the residents near the river. The methodology has been applied in four key steps explained below.

In order to quantify benefits and services derived from functional river management – a service for which no prices exist in the market – the Contingent Valuation Method (CVM) was used to quantify the benefits that result from the use of the key standard SZDB/Z 24-2009. This is a new approach to quantifying non-economic benefits of standards.

**Step 1 : Understand the value chain**

Desk research was undertaken on the value chain of river management. The value chain was determined and assessed for the water works and also for the selected organization.

**Step 2 : Analyze value drivers**

Value drivers are crucial organizational capabilities for the success of the water works. In this assessment, value drivers specific to the selected organization are mapped for each segment of the value chain. In doing so, the value chain, represented by the various key business functions, is analyzed with the help of key operational indicators.

**Step 3 : Identify impact of standards**

Following identification of relevant value drivers and key operational indicators, the relevant standards are described and their impact on each of the activities of the business functions is mapped through a series of interviews with the department head of the Shenzhen Water Resource Bureau.

In order to quantify the impact, an analysis is carried out to examine whether the social and environmental impact can be measured after the introduction of standards. The quantification is done on an annual basis. The impact of the standards, in particular that of SZDB/Z 24-2009, started with their implementation in 2010, which amounts to a period of around three years during which steady improvements could be observed. After this period, the use of the standards became part of the normal operating procedures in river management and maintenance in Shenzhen.

**Step 4 : Assess and consolidate results**

After quantifying the impact of standards, the non-economic impacts of standards in river management are aggregated. This is done on the basis of social and environmental effects of the standards applied. Important qualitative impacts of the standards are also included.

## 2 Introduction to the selected organization

Founded in 1993, the Shenzhen Water Resources Bureau (SZWRB), is one of the first water resources bureaus established in China and one of the departments in the administration system of the Shenzhen government. It is responsible for the development and protection of water resources, flood control, water supply, water saving, waste water management, soil and water conservation, clean-up of polluted water, recycled water utilization, sea water utilization and other activities. It is also responsible for providing guidance concerning district and street water works and the management of all the water resource companies in Shenzhen. The structure and administrative functions of the Shenzhen Water Resources Bureau can be seen from the organizational chart shown in **Figure 1.**

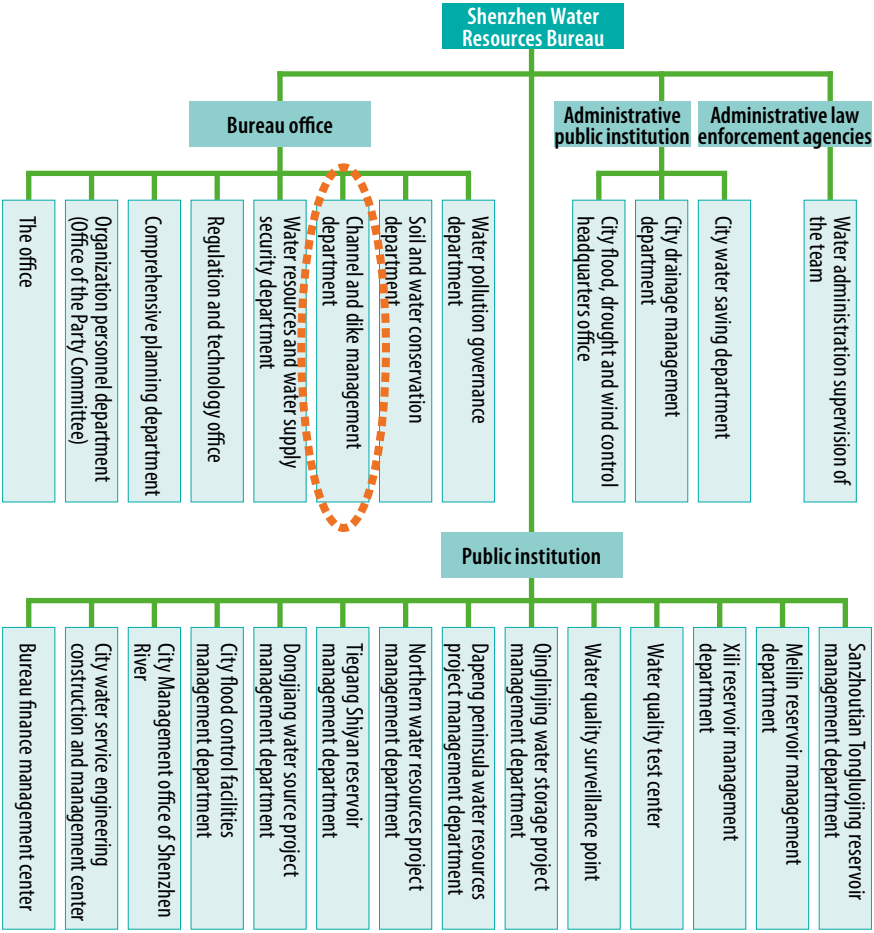


**Figure 1** – Department of the Shenzhen Water Resources Bureau

As illustrated in **Figure 1,** SZWRB consists of 8 offices, 3 administrative public institutions, 1 administrative law enforcement agency, and 14 public institutions. This case study on non-economic benefits of standards is conducted on the Channel and Dike Management Department under the " Bureau office ". The main responsibilities of the Channel and Dike Management Department include : organizing and coordinating the construction and management work of channels in

the city ; maintenance of flood retention basins, sea wall, estuarine tidal flats ; undertaking comprehensive treatment on the channels and supervising the daily maintenance of the water engineering facilities in the channels ; undertaking hydrologic network construction work and collecting hydrological monitoring data.

## 3 Attitude of the organization towards standardization

SZWRB has been committed to the guidance of industrial normative development, and has been the first to explore the use of standards in water works. The specific situation with respect to standardization work is as follows :

1. Establishment of a group leading the work on standardization. The group was founded in early 2008, and is clearly guided by the *Implementation Guidelines of Shenzhen Standardization Strategy*. Its goal is to achieve a standards-based, detailed management approach in Shenzhen's water works. A complete system with technical specifications on water works with modern water work features has been established, and a work plan to ensure that the level of standardization in the city's water service remains at the top among large and medium-sized cities in China. According to work needs, the standardization group and its membership were reorganized in 2012.
2. Setting up a technical committee of experts on water works. Founded in early 2009, the technical committee on water works was among the first technical committees for standardization established in the city. It consists of 17 committee members who are responsible for technical standardization of water works.

3. Development of a Standardization System for Water Works in Shenzhen. Completed in 2009, the system comprises 12 sub systems : basic standards, the development and utilization of water resources, urban water supply, drainage, water conservation, flood control and drought relief, channel management, soil and water conservation, engineering construction and management, use of information systems, administrative law enforcement, and comprehensive management. It provides programmatic guidance for the water standardization work in the city. The specific standard framework is shown in **Figure 2.**

4. Formulation and implementation of several standardization documents on water work technology. Since 2009, the bureau has published 13 technical specifications and guidance documents including *Shenzhen service specification for the water supply industry* (SZDB/Z 21-2009), *Technical specification for river maintenance and protection* (SZDB/Z 24-2009) and others. They cover water supply, water saving, drainage, soil and water conservation, river management, etc., and provide strong support for the construction and management of water works. Fourteen standards, including technical specifications for urban water supply and water quality inspection are currently being drafted.

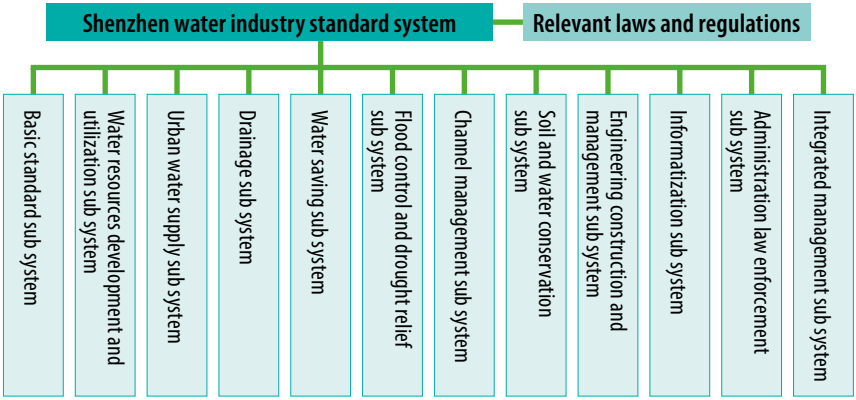


**Figure 2** – Shenzhen water industry standards system

Owing to the large amount of detailed research work conducted by SZWRB in water work standardization, and the establishment of a team experienced in standardization work of high quality, as well as the organization's achievements in standardization work in recent years, the case study project group considered that engaging the Shenzhen Water Resources Bureau in the evaluation of the non-economic benefits of standards would lead to reliable and relevant results.

# 4 Analysis of the value chain

The ISO Methodology is based on the value chain approach. The value chain is an analysis tool developed by Michael Porter to study the competitive advantage of enterprises, which comprises a sequence of activities that generate a certain output, a product or a service. The traditional model developed by Porter is geared mainly to manufacturing enterprises. In this case study, the value chain has been used to analyze the social and environmental benefits of a government sector.

## 4.1 Industry value chain

The ISO methodology defines the industry value chain as the various stages of production, services, and the network of suppliers and customers that are characteristic for an industry sector. The water works industry can be segmented into water supply and drainage, hydropower, water supply engineering, pipeline network construction, water conservation, sewage treatment, and the production of related equipment, etc. Therefore, the complete value chain of the water works industry shown in **Figure 3** includes water and soil conservation, water supply construction, pipeline network construction, sewage treatment, operations management and service providers, etc.

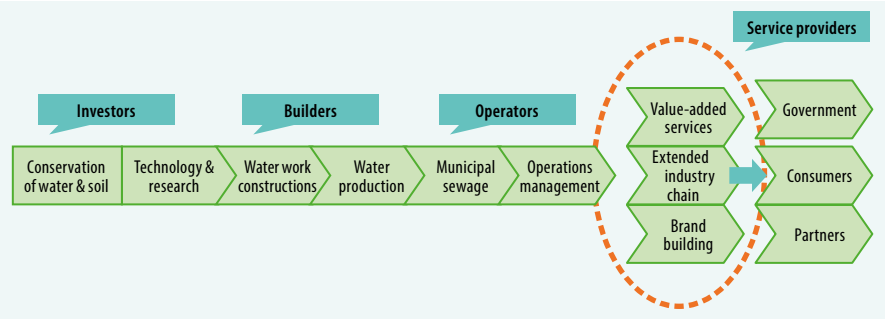


**Figure 3:** The value chain of the water works industry

## 4.2 River management value chain

River management is part of the upstream segment of the water works industry, and mainly involved in soil and water conservation and water construction. Designing the value chain for river management activities requires an analysis of the administration and management of the channel and the dike management department, to determine the specific implementation sector affecting river management.

The value chain of river management in Shenzhen is given in **Figure 4.** SZWRB, responsible for the formulation of technical specifications and implementation details as well as the general supervision of the work, has chosen three organizations to take charge of the management and maintenance of the four rivers in Shenzhen :

- Shenzhen Water Affair Technical Service Co., Ltd., responsible for the management and maintenance of the Maozhou River,
- Shenzhen Guang Huiyuan Water Investigation and Design Co., Ltd., in charge of the Guanlan and the Pingshan River, and
- Hunan Hydro & Power Design Institute Shenzhen branch, responsible for the Longgang River.

The above-mentioned three companies are supervised by the district water resource bureau, authorized by SZWRB. Each district water resource bureau reports to SZWRB on whether their work abides by related regulations. If the river management work does not meet the standards, its work is reviewed and may be subject to change.

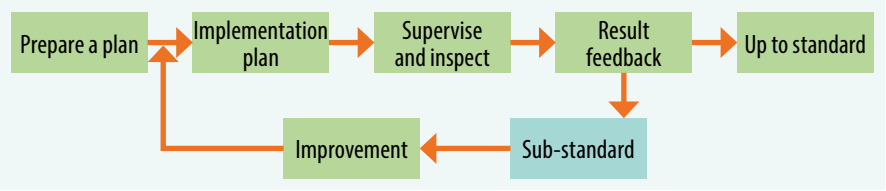


**Figure 4** – The value chain of river management in Shenzhen

## 4.3 Key value drivers

The ISO methodology defines value drivers as crucial capabilities of an organization that give this organization a competitive advantage. As a government department, Shenzhen Water Resource Bureau's key value drivers, at the social level, relate to performing the missions entrusted by the state in the water works field, and to promoting sustainable development of society. Additionally, a combination of organizational management, labor practices, environmental attitudes, fair operating practices, consumer issues and community involvement, as outlined in ISO 26000:2010, *Guidance on social responsibility*, are important and have also been confirmed through many interviews with senior management of the Shenzhen Water Resource Bureau (see **Table 1)**.

| Key value drivers | Description |
|---|---|
| **Environment** | Improvement of the water environment of Shenzhen :<br>• Protection of water resources environment<br>• Pollution prevention of water resources<br>• River flood control, and governance and custody<br>• Soil and water conservation, and<br>• Biodiversity protection, etc. |
| **Community involvement and development** | Provide sports and entertainment venues for the community residents |

**Table 1** – Key value drivers of SZWRB

## 5 Scope of the case study

This case study is limited to the activities of the channel and dike management department in the Shenzhen Water Resource Bureau and focuses on river management.

**River management**

As mentioned in section 1.3, the scope of the river management includes dike slope protection, river cleaning, river dredging, hydrologic monitoring, water quality monitoring, ecology landscape maintenance, ancillary facility maintenance, emergency relief work, etc.

## 6 Standards used in the river management value chain

Through interviews with senior leadership of SZWRB, the project team learned that a river management company with a maintenance unit is allocated to every pilot river. The maintenance unit consists of 302 staff members responsible for security and daily maintenance. The daily management of the river is completed by the security personnel, whose main activities include the following : Dealing with common illegal incidents and emergencies, abnormal water quality, management of river flooding, emergency rescue, and handling of complaints and suggestions, etc. The daily maintenance of the river is completed by maintenance personnel, whose activities include the river cleaning for sanitary purposes, landscape greening and landscape maintenance and improvement.

The standard SZDB/Z 24-2009, *Technical specification for river maintenance and protection*, which was prepared by the Shenzhen Water Resource Bureau, covers the functions and requirements of the daily management and maintenance. At the same time, it simplifies treatment procedures for abnormal cases, such as water pollution

requiring detection by professional means (this standard requires abnormal cases to be reported to the detection departments by the maintenance unit). Compared with some highly targeted and specialized standards in the water works field, SZDB/Z 24-2009 is more general and practical for the daily management and maintenance of rivers. While there are a few standards on river management and maintenance, SZDB/Z 24-2009 is the operational standard used for routine activities. Details are shown in **Table 2.**

| No. | Activities | Standards | Name |
|---|---|---|---|
| 1 | Dike slope protection | SZDB/Z 24-2009 | Technical specification for river maintenance and protection |
| | | SL171-96 | Design specification for levee project management |
| 2 | River dredging | SZDB/Z 24-2009 | Technical specification for river maintenance and protection |
| 3 | Water quality monitoring | GB 3838-2002 | Environmental quality standards for surface water |
| | | SZDB/Z 24-2009 | Technical specification for river maintenance and protection |
| 4 | River cleaning | SZDB/Z 24-2009 | Technical specification for river maintenance and protection |
| 5 | Ecological landscape maintenance | SZDB/Z 24-2009 | Technical specification for river maintenance and protection |
| | | DB 440300/T6 | Technical specification for landscaping management |
| 6 | Ancillary facilities maintenance | SZDB/Z 24-2009 | Technical specification for river maintenance and protection |

**Table 2** – Standards used in river management

## 7 Selection of operational indicators to measure the impacts of standards

The objective of the study is to quantify the non-economic impacts of standards on river management. In order to do so, a set of operational indicators are applied to measure the impact before and after the introduction of the standards. These operational indicators have been carefully chosen on the basis of a series of interviews with the SZWRB. At the same time, the project team also analyzed 6 relevant activities of river management, and determined key operational indicators of social and environmental benefits that are relevant for river management, as shown in **Table 3.**

| ID of Indicator | Operational Indicators | Standards | Definition of the indicators |
|---|---|---|---|
| 1 | Ecological safety | SZDB/Z 24-2009 Technical specification for river maintenance and protection | Increased security of embankment revetement, stability of riverbed, and protection of affiliated facilities |
| 2 | Water quality monitoring | GB3838-2002 Environmental quality standards for surface water | Improvement of the water quality of the river |
| 3 | Ecological landscape | DB 440300/T6 Technical specification for landscaping management | Undertaking of ecological and green construction projects |
| 4 | Community satisfaction | SZDB/Z 24-2009 Technical specification for river maintenance and protection | Satisfaction of local residents with the river management |
| 5 | Satisfaction by the river management | SZDB/Z 24-2009 Technical specification for river maintenance and protection | Satisfaction of the management department in the Water Resource Bureau of Shenzhen with the river management. |
| 6 | Creation of new jobs | SZDB/Z 24-2009 Technical specification for river maintenance and protection | Promotion of employment status |

**Table 3** – Operational indicators applied in the assessment

## 8 Impacts of standards

Since the publication and implementation of SZDB/Z 24-2009, *Technical specification for river maintenance and protection*, and in accordance with the principles of attaching equal importance to construction and management, SZWRB has made efforts to establish an institutionalized and standards-based river management system. Moreover, it has also developed evaluation methods for river management in Shenzhen. SZWRB has conducted monthly, quarterly and annual assessments of the river management and maintenance work. The management of the rivers is separated from their day-to-day maintenance, which is undertaken by one of the three organizations mentioned under section 4.2.

The management and maintenance work has achieved good results which are summarized below :

1. Effects of a comprehensive treatment of the river water environment in Shenzhen have been stabilized and consolidated
2. River clean-up work is successful and the rivers and river banks have been greatly improved
3. The awareness of nearby residents in terms of caring for and protecting the rivers has significantly improved
4. The inspection and security of the rivers has been enforced to ensure that the rivers run in a normal, healthy and safe environment
5. The capability and competence in dealing with river emergencies have significantly improved.

# 9 Approach in the assessment and the quantification of the results

## 9.1 Conduction of a questionnaire survey

Questionnaire surveys are a common way of obtaining information about the society. The project team used this method to evaluate the degree of satisfaction of residents living close to the Longgang River before and after the standards were implemented.

The project team sent out 200 questionnaires and received 183 effective responses.

The questionnaire included 6 aspects:

1. How long have you lived in this area?
2. What changes did you find after the implementation of standards in Longgang River?
3. Are you satisfied with the water quality, river cleaning, ecology of the landscape, security of the Longgang River since the implementation of standards?
4. Is it necessary that the government continues to invest in river management?
5. Are you willing to support river management, and in what way?
6. If you are willing to financially support the river management, how much are you willing to pay?

## 9.2 Use of the Contingent Valuation Method (CVM)

The contingent valuation method is a survey-based economic technique for the valuation of non-market resources, such as environmental preservation or the impact of contamination. While these

resources provide public utility, certain aspects of them do not have a market price as they are not directly sold – for example, people receive benefits from a beautiful view of a mountain, but it would be difficult to value these benefits using price-based models. Typically a contingent valuation survey asks how much money people would be Willing To Pay (WTP) (or Willing To Accept (WTA)) to maintain the existence of (or be compensated for the loss of) an environmental feature, such as biodiversity.

Contingent valuation surveys are a technique used to measure these aspects. They are often referred to as a stated preference model to measure the utility people obtain from a certain condition or service.

**CVM questionnaire design**

The investigation was undertaken through face-to-face interviews with residents and subsequent completion of the questionnaire. The core question in the questionnaire to obtain a valuation of the utility by residents derived from the river management, was as follows:

"If you are willing to financially support the management of Longgang River, what is the maximum amount you would be willing to pay from your monthly income:

❑CNY 0 ❑CNY 10-20 ❑CNY 20-50 ❑CNY 50-100 ❑CNY 100-200

Please give reason(s) if you choose the option "CNY 0":

# 10 Calculation of the non-economic benefits of standards

## 10.1 Job creation

After the publication and a three-year implementation period of SZDB/Z 24-2009, *Technical specification for river maintenance and protection*, the number of rivers subject to river management has been extended from the four pilot rivers to their branches. 302 new jobs have been created, and the budget of the river management amounts to CNY 5 000 000 (around USD 0.79 million).

## 10.2 Water quality

The project team collected the data on water quality from the Shenzhen environmental bulletin before and after the implementation of standards. The water quality has improved steadily since 2009. The bulletin showed that in 2009, before the implementation of standards, water quality of the Longgang River was at level III as defined in GB 3838-2002, *Environmental quality standard for surface water*. In 2010 and 2011, two years after the implementation of standards, the water quality raised to level II. In 2012, the third year after the implementation of standards, the water quality raised to level I.

## 10.3 Public awareness

Awareness of the importance of river management among local residents has increased significantly, as reflected in the statistical results from the questionnaire survey. When residents were asked the question whether it was necessary that the government continued to invest in river management, the majority (178 residents) gave a positive answer and only five people gave a negative response. They

were all willing to contribute to the ecological improvement of the Longgang River in different ways:

- 21 were willing to donate money
- 9 were willing to pay environmental taxes
- 85 chose to contribute in the form of volunteering
- 44 were willing to assist the government in publicizing river protection, and
- 19 were willing to act in other ways

The distribution of the "willingness" is illustrated in **Figure 5.** The results of this survey showed that most people are conscious of the importance of good public environmental protection and would be willing to support the Longgang River management in certain ways.

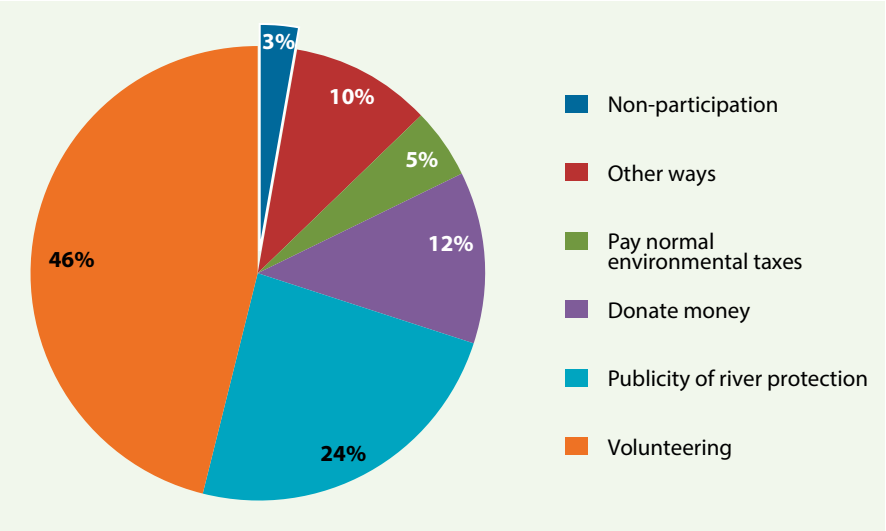


**Figure 5** – Contribution to river management – Preferences expressed by residents

## 10.4 Estimated total environmental benefits of standards

The estimated total of environmental benefits of standards is based on the CVM results. When the residents were asked the question about their Willingness To Pay (WTP) to support the Longgang River management, 174 people responded favourably, accounting for 95 % of the questionnaires. The responses concerning the willingness to pay (WTP) peaked in the range of CNY 10-20 per month, with a decrease of CNY 20- 50 per month and CNY 50-100 per month. The WTP-distribution is shown in **Table 4** and **Figure 6.**

| WTP (CNY) | 0 | 10-20 | 20-50 | 50-100 | 100-200 | Total |
|---|---|---|---|---|---|---|
| Number of people | 18 | 69 | 55 | 28 | 4 | 174 |

**Table 4** – The WTP-distribution among residents

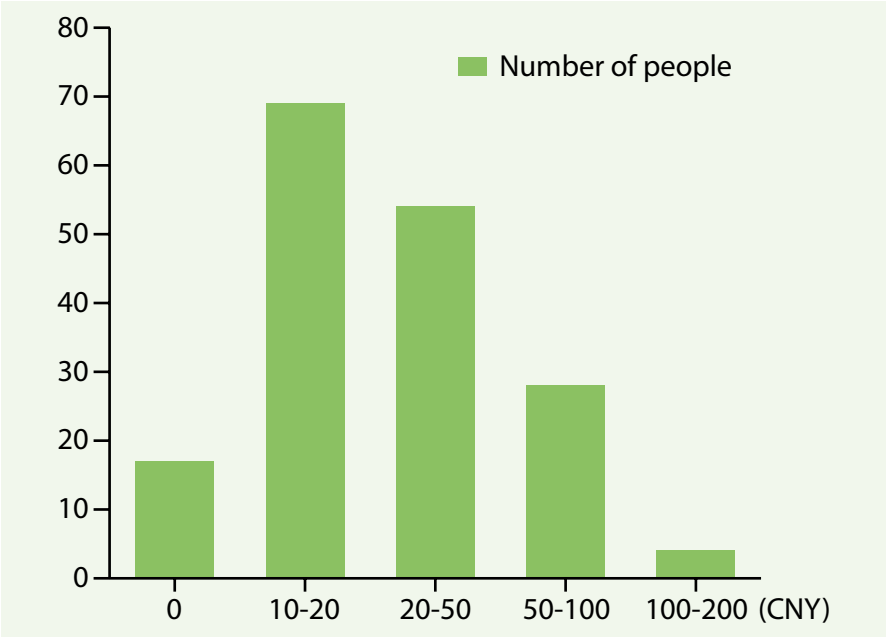


**Figure 6** – WTP distribution map of the residents

In this study we interpret the WTP as an expression of the value or the benefits residents assign to the river management measures. It can be considered as a consequence of the application of standards by the SZWRB and the subcontracted companies and in particular of SZDB/Z 24.

The average minimum payment is CNY 19.61 per month, and the maximum is CNY 42.24 per month. In addition, according to the population density statistics released by the Health, Population and Family Planning Commission of Shenzhen Municipality in 2011, the average population density of the Longgang River district was 2977 per square kilometer. It is therefore known that the resident population in the area shown in **Figure 7** is 9348 per square kilometer.

Applying the results of the WTP from the surveyed sample of residents to all residents in the relevant region, the corresponding environmental benefits of the designated area is between CNY 2 199 771 and 4 738 314 per year (between USD 348 518 and USD 750 708).

If we further extend the number of residents from the locality that was assessed to the whole region in Shenzhen through which the Longgang river flows, then we arrive at the following valuation of the river management and the resulting services: As the length of the Longgang River is 19.9 km, the total environmental benefits of Longgang River generated by the implementation of standards in river management is between CNY 20 897 872 and CNY 47 146 224 per year (between USD 3 310 930 and USD 7 469 550, using the conversion rate of 1 CNY = 0.15843 USD of 2013-01-01).


**Figure 7** – Geographical scope of the assessment

## 11 Conclusions

In the process of this case study, the project team found evidence that there are social, environmental and economic benefits generated by standards. Normally these different types of benefits are generated simultaneously and appear in many respects. However, standards that have a significant impact on the public sphere and which are applied by governmental departments tend to generate more social and environmental benefits than economic benefits. As shown in this case study, the reason seems to be that the public sphere is more related to the improvement of people's livelihood and sustainable development considerations rather than economic concerns alone.

# Annex 1

In addition to the persons mentioned on the cover page, the following have been participating in the project:

- **Standardization Administration of the People's Republic of China (SAC):**
  - Mr. Li Dongfang, Standardization Officer, Department of International Cooperation, SAC
- **Market Supervision Administration of Shenzhen Municipality (MSA):**
  - Mr. Tan Jianjun, Division Director, Standardization Division, MSA
  - Mr. Cheng Shengtao, Principal Staff Member, Standardization Division, MSA
- **Shenzhen Water Resources Bureau (SZWRB):**
  - Ms. Zong Rongfang, Section Chief, SZWRB
  - Mr. Xia Shuangxi, Engineer, Shenzhen Shenshui Water Resources Consulting Co., LTD
- **Shenzhen Institute of Standards and Technology (SIST):**
  - Mr. Lu Hongfeng, Director-in-Chief
  - Ms. Wen Lifeng, Deputy Director, Standardization Application Research Centre