

# Optimization of Coordinated Water Resource Management in Beijing-Tianjin-Hebei Region from the Perspective of Water Accounting

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Beijing-Tianjin-Hebei region is connected by geography and water veins with strong complementary advantages. The coordinated development of Beijing, Tianjin and Hebei is a major national strategy put forward by the Chinese government in the new historical period. However, Beijing, Tianjin and Hebei are faced with common problems such as water shortage, serious water pollution, over-exploitation of groundwater and fragile water ecology. The synergy governance of water resources is the basis and key issue behind the coordinated development of the tree areas. This paper analyzes the water problem in Beijing-Tianjin-Hebei region and the status of water resources accounting and discusses the basic ideas of inspecting water resources management and innovating water accounting system. In this paper, a fine, standardized, water accounting system is established, which is permitted for inter-sustainable use of water resources. On this basis, this paper proposes to keep in line with Australian water accounting standards and to establish General Purpose Water Accounting for disclosure of water accounting reports, based on accrual basis, so as to build a new mechanism of coordinated governance of Beijing-Tianjin-Hebei water resources. Finally, in order to demonstrate the optimization mechanism of Beijing-Tianjin-Hebei water resources coordinated management, this paper applies General Purpose Water Accounting to Beijing Waterworks Group Co., Ltd.

**Keywords:** water accounting, Australian water accounting standards, water resource management, general purpose water accounting

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## 1. Introduction

There are several water accounting methodologies developed by States and international organizations, with different purposes, disciplines and presentation formats. Many of these focus on the relationship between water use and economy in order to evaluate the costs associated with water services, the productivity of water, and the environmental cost. The System of Environmental-Economic Accounting for Water (SEEAW) introduces water resources into System of National Accounts, making

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the traditional national accounts more green-oriented by increasing the accounting of water supply, use, consumption, and discharge (United Nations, 2012). Other water accounting approaches refer only to physical magnitudes, in this case water volume. Some of these accounts show the state and quantity of water resources in order to better plan, manage and control water resources, and provide direct and accurate information on the allocation, management and use of water resources and resolve conflicts between co-riparian regions (Allan, 2012). The Australian example of General Purpose Water Accounting (GPWA) applies many of the measurement and disclosure techniques of financial accounting to resource accounting innovatively. Essentially, GPWA provides that annual reports should be provides for water entities (such as a particular region or catchment) which include the physical equivalents of a balance sheet, profit and loss account and cash flow statement as well as notes to the accounts (WASB & ABOM, 2009; 2012). As such, water information is characterized by comparability, reliability, understandability and transparency, improving the efficiency of water resources management and governance (Chalmers, *et al.*, 2012). Spain and South Africa pilot water GPWA in selected regions to explore indigenous experiences (Mombranch *et al.*, 2014; Hughes *et al.*, 2012).

The management of water resources in China is quite different from that in other countries. Water resources have been allocated through administrative instructions for a long time. The regional water authorities use statistical methods to calculate changes in water resources and report them to water resources management departments step by step. The strictest water resources management system has been implemented in China since 2012, allocating water use indicators to provincial, municipal and county levels and controlling and assessing the use of water resources more strictly than ever. At the same time, the water rights exchanges are established to encourage water rights trades.

Beijing-Tianjin-Hebei region is located in North China Plain. The three provinces, Beijing, Tianjin and Hebei, are connected geographically and by water veins. It is one of the most dynamic, open, innovative and most populous regions in China. In 2015, the outline of the Beijing-Tianjin-Hebei coordinating development plan was adopted and formally implemented. The coordinating development of Beijing, Tianjin and Hebei is a major national strategy of China. The aim is to build a global city group with international competitiveness and a new engine of high-quality development driven by national innovation. As urban population grows, industry scale expands, and urbanization progresses, more reliable water supplies are required. However, the amount of water resources per capita in this area is only 218 m<sup>3</sup>, which is far below the international water shortage warning line of 1000 m<sup>3</sup> per capita. In the land area of 217,000 square kilometers, the resident population is 110 million. The contradiction between the gradual reduction of water resources and the rapid development of population and economy has led to the common problems of unbalanced supply and demand of local water resources, serious water pollution and over-exploitation

of groundwater, which restrict the sustainable and healthy development of the three places and has become the bottleneck of Beijing-Tianjin-Hebei cooperative development. The Beijing-Tianjin-Hebei water problem is a typical example of China's water crisis. Taking the water resources management in Beijing-Tianjin-Hebei region as the research object, this paper explores the effect of implementing the strictest water resources management system and the water right trading system in China, and proposes to reform the water distribution and water accounting system to improve water resources management and water rights trade. For the first time, this paper takes Chinese enterprises as an example to study the advantages and limitations of applying GPWA under the background of China's water management system.

## **2. Water Problems and Water Accounting in the Beijing-Tianjin-Hebei Region**

Beijing, Tianjin, and Hebei are all located in Hai River Basin. Hai River is the largest drainage system in North China Plain and is one of the seven major river basins in China. Many rivers in this area act as upstream and downstream of each other, and water resource competition is fierce, with water ecosystem degradation and water environment deterioration. All of those are the main restrictive factors for the coordinated development in this area.

First of all, Hebei Province is located in the upstream area, although it is the largest source of water in the Beijing-Tianjin-Hebei region, the per capita water resource is only 259 m<sup>3</sup>, which is far lower than the internationally accepted standard of extreme water shortage per capita 500 m<sup>3</sup>. Due to the serious shortage of water resources and the long-term predatory exploitation of water resources, Beijing-Tianjin-Hebei region has become one of the regions with water resources and environment seriously overloaded. Under the background of regional coordinating development, the sustainable utilization of water resources not only needs the joint efforts of Beijing, Tianjin and Hebei, but also needs the innovation and intensification of water resource management and water accounting methods.

Second, water resources in the Beijing-Tianjin-Hebei region, the main receiving area, have been partly replenished since the middle route of the South-to-North Water Diversion Project which was officially opened at the end of 2014. In the past four years, the South-to-North Water Diversion has supplied 4.21 billion m<sup>3</sup> of water to Beijing, of which 2.808 billion m<sup>3</sup> has been used for drinking water supply, accounting for 73% of the water supply in the main urban area. The rational allocation and use of surface and ground water, external water and local, upstream and downstream water for the purpose of improving water security, protection of water sources and water balance of nature, requires intensified scientific allocation and fine management of water resources from the perspective of water accounting. Therefore, the innovation in water resources accounting method is very important.

Third, the Beijing-Tianjin-Hebei region is one of the most polluted water areas in the country. In 2014, the proportion of the Beijing-Tianjin-Hebei region in the category V water body exceeded 40 percent, approaching five times the national average (Li, 2016). The offshore area suffered the serious damage affected by terrigenous sediment pollution. At present, the Bohai Sea bend is one of the most polluted areas in the country's coastal waters. The development of Beijing-Tianjin-Hebei has provided a good cooperation mechanism for the joint management of water resources pollution in Beijing-Tianjin-Hebei province. It is necessary and feasible to study and promote water quality monitoring and information disclosure, and improve the way and content of water information disclosure, and promote enterprises and water resources management departments to fulfill their social responsibilities.

### **3. Review Water Resource Accounting and Management, and Innovate Water Accounting System**

#### *3.1. Review the Position of Water Accounting from the Level of National Strategy*

Policymakers should give high priority to improving the way water data are collected, processed and disclosed in order to enhance the regulation of water resources and their use (UNESCO, 2012). At present, China's water accounting is quite weak, and there is no standard system of measurement, accounting, reporting, supervision and management, which leads to water resource data distortion and weak effectiveness of decision support and influences policy making and implementation. With the development of the Beijing-Tianjin-Hebei integration, the infrastructure in this region has been continuously improved, and the process of industrialization has been accelerated, and population growth has been accelerated, and the demand for water resources has been intensified, and the impact on the aquatic environment has been increased. The government should attach great importance to the construction of water resource accounting system in Beijing-Tianjin-Hebei region, and take effective measures to establish a scientific and standardized water accounting system to safeguard the reform of various water management systems.

#### *3.2. Strengthen the Fine Accounting of Water Resources and Promote the Balance between Supply and Demand of Water Resources*

The outline of China's 13th Five-Year Plan clearly states that "production should be determined by water and so as cities". This is the strategic deployment of the government after considering the severe situation of China's water resources, and it shows that water resources have become a key factor in determining production and city size. In order to realize the principle of "fixing production by water, fixing city

by water”, it is necessary to master how much water resources there are in each area, to allocate water resources and to use water resources precisely. This requires the establishment of elaborate water resource management systems. Thus, a refined water accounting system is required because water information is an important support of water resources management, and an important basis for the public to participate in water resources management. Therefore, the Beijing-Tianjin-Hebei region should establish a refined water accounting system, which should make detailed accounting and reflection of all kinds of water resources, including local water, extraneous water, desalinated water and reclaimed water, and their changes in the whole process. It provides a solid foundation and effective tools for fine management of water resources, so as to balance the supply and demand of water resources in the region accurately and promote the sustainable development of economic and social ecology.

### *3.3. Reform the Way of Water Resource Management so that Water Resources Are Used and Accounted for in a Sustainable Manner over a Long Period*

Water resources management departments take and supply water in accordance with administrative instructions and use statistical methods to account for changes in water resources. In addition, the water authority of the government issues annual water consumption targets to water users such as enterprises and nonprofit organization. The units are required to take and use water in accordance with the targets. Higher water charges will be imposed on those who exceed the targets. If the actual water consumption is lower than the water consumption target, the water consumption will be automatically zero by the end of the year. The water management department will set the water consumption target for the following year according to the actual water consumption of the unit in the current year. If the unit has new buildings or green space, new employees, then the unit needs to apply to the water management department to increase water consumption indicators for the next year, and water management department will act in accordance with the relevant provisions of the calculation and issue next year indicators.

Such a way of water resources management does not mobilize the enthusiasm and initiative of all units to save water. We suggest that the Beijing-Tianjin-Hebei region should try to formulate a five-year water consumption plan, with a basically stable water consumption target each year, and the amount of water saved during the planning period can continue to be used until next year, and water rights trading can also be carried out. Thus, it is not only conducive to mobilizing the enthusiasm of all units to save water, but also is advantageous to the sustainable use of water resources. At the same time, in order to adapt to this way of water resources management, water resources accounting should draw on the principle of accrual basis, and carry out inter-term accounting of the status and changes of water resources and rights.

### *3.4. Adopt Accounting Theory and System to Establish General Purpose Water Accounting System*

High-quality, reliable, decision-making-related water information is an important foundation for supporting water resources planning and management. In China, the approach of water resources accounting is relatively backward, which can not mobilize the public to participate in water resources management. Moreover, water resources management involves water conservancy, land, environmental protection, ocean, urban construction, agriculture, forestry and other departments, and from the State Council ministries and commissions to the local grass-roots, they all implement a management system of segmentation. Lacking of information integration, sharing and centralized management results in poor water resources management and decision-making. In addition, the lack of Information asymmetry and transparency has greatly increased the difficulty of preventing and solving water problems, and the inadequacy of monitoring has further reduced policy effects and increased the difficulty of effectively preventing and containing water problems.

Therefore, in the process of Beijing-Tianjin-Hebei synergy development, those three governments should issue a unified water accounting guideline to regulate the collection and processing of water information by related units or departments in accordance with established procedures. The guideline should also prepare water accounting reports with a relatively strict and stable basic structure; in addition, it should be verified by auditors independent of the main body of water reports to assure whether they fairly reflect the true situation of water resources activities, which is called GPWA report. And the governments should disclose the water accounting report after verification. In this way, water accounting information can be trusted by investors, creditors, and government agencies, the public and other stakeholders. At the same time, the law must indicate the ownership of water resources. Water and water rights, which are owned or managed by the main body of water reporting and are expected to bring future benefits to the main body of water reporting or its stakeholders, are defined as “water assets”. Taking the water supply obligation of water accounting as “water liability” due to water supply plan or water right transaction contract, that is, inter-region claim on water of the entity not fulfilled at the end of the accounting period as “water liability” of water accounting body, the obligation to supply water to specific consumers will continue in the next period. Accounting double-entry bookkeeping system and accrual basis are used to compile three statements. Statement of Water Assets and Water Liabilities, Statement of Changes in Water Assets and Water Liabilities, and Statement of Water Flows, which have articulations with each other, so as to systematically and comprehensively reflect the processes and results of changes in water resources and water rights.

### *3.5. The information on the Quality of Water Reflected in GPWA*

The rapid economic development in Beijing-Tianjin-Hebei region, especially the

large increase in the proportion of industries, at the same time, it produces the huge amount of sewage discharge, which has obviously affected the water resources and environment due to the long-term economic and social development pattern. According to the 2017 Tianjin Water Resources Bulletin, the river length of Tianjin is 1657.5 km, of which 58.1% is the Inferior V type river, declined 12.4% compared with 2016. On October 28, 2015, the Ministry of Environmental Protection announced the results of the 2014 assessment of the water pollution prevention and control plan for key river basins. The assessment results of coastal cities along the Hai River such as Beijing, Tianjin, Henan, Hebei, and the Three Gorges Reservoir area as well as its upstream, Hubei Province, are poor. The monthly report on Surface Water Quality released by China National Environmental Monitoring Centre shows that surface water in the Beijing-Tianjin-Hebei region was moderately polluted in 2016.

The quality of water is the basic factor affecting the use of water resources. The better the quality of water is, the scarcer and the more valuable it is. According to the status of Beijing-Tianjin-Hebei Water Environment, in the GPWA report, besides the above-mentioned three reports of water quantity status and changes, water quality information should also be disclosed, including the type of water resources, the type and quantity of major pollutants, eutrophication and so on. This provides useful information for decision-making and on the other hand, it reveals the extent of water resource management responsibilities are being fulfilled by water resource managers.

#### **4. A Case Study**

In order to discuss the theory and application of general purpose water accounting and to analyze the impact of current water resources management system on the application of GPWA, a case study was conducted to collect data and prepare the GPWA statement through filed research and interview. In order to reflect the advantages of continuous operation and accounting more intuitively and to discuss the influences on establishing general purpose water accounting system in China, the paper also compares the structure and content of GPWA statement under the condition of whether the water accounting subject implements the accrual basis or not.

##### *4.1. Case Selection*

Beijing Waterworks Group was chosen as the case study because it not only meets the definition of the main body of water reporting, but also is one of the largest and most influential water supply enterprises in China. It is a wholly state owned company owned by the Beijing Municipal Government. It operates 23 water plants, which is responsible for the water supply in urban and suburban areas of Beijing. The city's water supply pipeline has a total length of more than 12000 kilometers, water service

area of more than 1000 square kilometers and the number of water users are up to 4.1 million. The management is relatively strict and standard, with typicality, water information data is easy to get.

#### *4.2. Project Design*

In this case, the Beijing Waterworks Group obtained water resources from Miyun Reservoir, Juma River in Zhangfang, groundwater, Hebei Reservoir and South-to-North Water Diversion Project. The purpose of preparing GPWA statement is to account and reflect the status of water resources and ownership of Beijing Waterworks Group. The Group is only responsible for buying water, producing and processing it into qualified drinking water and selling drinking water. It has no source of its own and its water assets are only the water in the reservoir and in the intake pipe. Therefore, the water in the reservoir and in the intake pipe as well as the continuous intake and supply of water are the objects of general purpose water accounting.

Beijing Waterworks Group operates according to administrative instructions and does not carry out continuous operation and accounting. There are no distributed but unfulfilled water supply plans at the end of the period. Therefore, there is no water liability and there is also no water asset with claims (such as unused water permits), which means water liabilities and claims are zero. Moreover, it is not necessary to compile sheets to record the changes in water asset and liability, but only need to prepare water asset and water liability sheet and water flow sheet based on cash basis.

#### *4.3. Measurement Method*

Beijing Waterworks Group Co., Ltd uses water meters to measure the water supply (consumption or factory water volume), and according to the actual measurement value to pay water charges. Each water plant also measures the water withdrawal (water inflow) from various channels and reports to the group that finally the group reports the data to Beijing Water Authority, but the data are only referenced by water management departments to formulate a plan for water use. The water volume of the reservoir is measured, but the water volume of the water distribution system is not measured.

Beijing Waterworks Group Co., Ltd does not provide relevant water volume information due to the confidentiality of the data. To show the pattern of GPWA report in water industry, and reflect the basic situation of water resource allocation and use. The research calculates and indirectly estimates relevant data, according to the interviews with Beijing Waterworks Group Co., Ltd about its production and management, water intake and water supply, and it also consults Beijing Water Resources Bulletin 2013 and Beijing Water Resources Bulletin 2014, as shown in

Table 1. In 2013 and 2014, Beijing Water Resources Bulletin announced four kinds of water supply: surface water, groundwater, South-to-North Water Diversion Project and Hebei Diversion Water. This research divides 80% of surface water into Miyun Reservoir and 20% of the water into Juma River in Zhangfang. In addition, multiplying the various water supply volumes in the bulletin and the conversion coefficient, the various inflow of water flow table in the GPWA report of Beijing Waterworks Group Co., Ltd can be obtained. The conversion coefficient is 45%, mainly because it takes into account the following factors: first, water supply volume in the bulletin refers to the gross water supply provided for consumers by various water source projects, including water loss (Beijing Water Authority, 2015; 2014), evaporation and leakage of surface water in the process of water supply from the water source project to the waterworks for instance. Second, Beijing's water is supplied not only to Beijing Waterworks Group Co., Ltd, but also to other users. Third, daily water supply capacity of Beijing Waterworks Group Co., Ltd is 3.7 million cubic meters.<sup>1</sup> There is almost no evaporation and leakage of groundwater exploiting. Some regions and units in Beijing urban areas obtain water from exploiting groundwater rather than the water supply group, and areas which are not covered by the water supply network, obtain water from groundwater extracted from villages and towns. Therefore, the amount of groundwater used by Beijing Waterworks Group Co., Ltd is also calculated as 45% of the amount of groundwater in Beijing Water Resources Bulletin. In the interview, the staff of Beijing Waterworks Group Co., Ltd said that the water inflow is 2% larger than the water leaving the factory. Therefore, water for consumption is 98% of the total water inflow.

Table 1. GPWA Statement Data of Beijing Waterworks Group Co., Ltd

| Data source                                                                      | Water accounting concept                                | Estimation strategy |
|----------------------------------------------------------------------------------|---------------------------------------------------------|---------------------|
| Water supply in Beijing water resources bulletin $\times$ conversion coefficient | Water inflows of Miyun Reservoir                        | A                   |
|                                                                                  | Surface water exploiting                                | A                   |
|                                                                                  | Water inflows of South-to-North Water Diversion Project | A                   |
|                                                                                  | Water of Hebei Diversion Water                          | A                   |
|                                                                                  | Water of Juma River, Zhangfang                          | A                   |
|                                                                                  | Water for consumption                                   | A                   |
| Total water inflows $\times$ 98%                                                 | Loss                                                    | A                   |
| Indirect Estimation                                                              | Water restored in reservoir                             | B                   |
|                                                                                  | Water restored in inlet pipe                            | B                   |

Notes: A, Periodically along the studied period, the value is accumulated; B, At the beginning and at the end of the studied period, the value is punctual.

<sup>1</sup> The data are obtained from the interview with Cheng Lizhu, director of the Dispatching Center of Beijing Waterworks Group Co., Ltd.

#### 4.4. Conclusion and Discussion

##### 4.4.1. GPWA Report Preparation Results of Beijing Waterworks Group Co., Ltd under Current Water Resource Management

In this research, the above research scheme and measurement method are implemented, and statements of water assets, water liabilities and water flows of Beijing Waterworks Group Co., Ltd under the current system are prepared, as shown in Table 2 and Table 3 respectively.

Table 2. Water Assets and Water Liabilities of Beijing Waterworks Group Co., Ltd under the Current System  
12.31.2014 (mm<sup>3</sup>)

| Projects                         | 2014 | 2013 |
|----------------------------------|------|------|
| Water assets                     |      |      |
| Surface water assets             |      |      |
| Reservoir                        | 85   | 78   |
| Water pipe                       | 62   | 55   |
| Total surface water assets       | 147  | 133  |
| Other surface water assets       |      |      |
| Unused water permits groundwater | 0    | 0    |
| Total other surface water assets | 0    | 0    |
| Total water assets               | 147  | 133  |
| Water liabilities                |      |      |
| Water allocation liabilities     | 0    | 0    |
| Total water liabilities          | 0    | 0    |
| Clean water assets               | 147  | 133  |
| Initial clean water assets       | 133  | 118  |
| Changes in clean water assets    | 14   | 15   |
| Ending clean water assets        | 147  | 133  |

Table 3. Water flow of Beijing Waterworks Group Co., Ltd under the Current System

| Projects                                                | 2014  | 2013  |
|---------------------------------------------------------|-------|-------|
| Water inflows                                           |       |       |
| Water inflows of Miyun Reservoir                        | 30600 | 17280 |
| Surface water exploiting                                | 88200 | 90450 |
| Water inflows of South-to-North Water Diversion Project | 3600  | 0     |
| Water of Hebei Diversion Water                          | 0     | 15750 |

| Projects                         | 2014   | 2013   |
|----------------------------------|--------|--------|
| Water of Juma River, Zhangfang   | 7650   | 4320   |
| Total water inflows              | 130050 | 127800 |
| Water outflows                   |        |        |
| Water for consumption            | 127449 | 125244 |
| Loss                             | 2591   | 2546   |
| Total water outflows             | 130040 | 127790 |
| Unstated differences             | 4      | 5      |
| Changes in storage capacity      | 14     | 15     |
| Initial storage capacity         | 133    | 118    |
| Add: Changes in storage capacity | 14     | 15     |
| Ending storage capacity          | 147    | 133    |

Table 2 shows the amount of water in reservoirs of all water plants and the amount of water in the water inlet pipes at 24:00 p.m. at the night of December 31, 2014 and 2013 of Beijing Waterworks Group Co., Ltd. Table 3 shows the amount of water taken and used by Beijing Waterworks Group Co., Ltd in 2014 and 2013. Combined with the two tables, it can be seen that the amount of water inflows and outflows is significantly greater than the number of water assets, revealing the water supply company's continuous water intake, water supply situation in one day. The water flow table shows that of the five water intake channels, groundwater takes the most proportion. In 2014, groundwater water intake accounted for 67.82% of the total water intake, and the water from Miyun reservoir accounted for 23.53%. The water from Juma river and the South-to-North Water Diversion Project were respectively 5.88% and 2.77%. In 2013, underground water use accounted for 70.77% of the total water withdrawal, as shown in Figure 1.

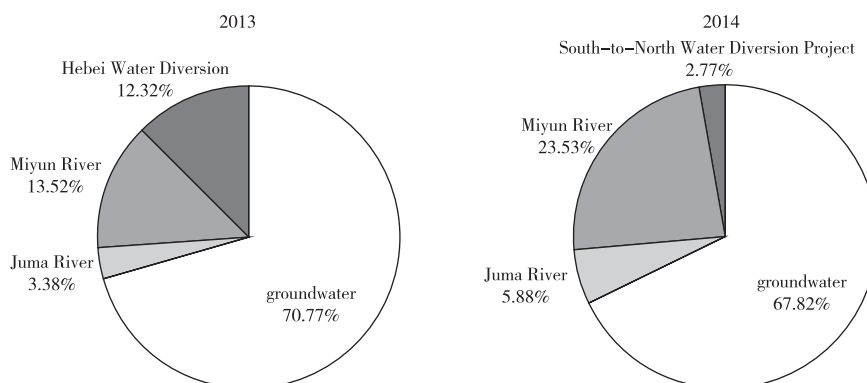


Figure 1. Water Withdrawal of Beijing Waterworks Group Co., Ltd in 2014 and 2013

The unstated difference in 2014 accounted for 2.72% (4/147) of water assets, which was less than the 2013 ratio of 3.76% (5/133), indicating that the water resource management of Beijing Waterworks Group Co., Ltd is good, with the error level controlled within 5%, and the ability to manage and control water resources in 2014 is improved compared with that in 2013.

#### 4.4.2. The GPWA Report's Prepared Result under the Assumption of Accrual Basis

To show the characteristics of the preparation of GPWA report in the case of the accrual accounting and more fully demonstrate the advantages of accrual basis in GPWA application, this research assumes that Beijing Waterworks Group Co., Ltd implements relevant policies, which involve continuous calculation and operation, by a given amount of water allocation plan and the regulation of water allocation plan which can continue to the next issue, in order to explain the method of the accrual basis of accounting.

Suppose that Beijing Waterworks Group Co., Ltd is allowed to exploit groundwater of 91 million m<sup>3</sup> per year, take 245 million m<sup>3</sup> per year from the Miyun Reservoir, and 64 million m<sup>3</sup> per year from the Juma River. If this issue has not used up the water, the rest will turned for next time use after the confiscation of 10%. But taking the water transferred into Hebei in 2013 and the water withdrawn from the South-to-North Water Diversion Project as temporary water, are not in the water allocation plan. Tables 4, 5, and 6 are schedules of the relevant accounts, with other data as shown in Tables 2 and 3. Based on These data, the GPWA reports of Beijing Waterworks Group Co., Ltd under the accrual basis are prepared, as shown in Table 7 and Table 8.

Table 4. Water License of Beijing Waterworks Group Co., Ltd—Groundwater Allocation Plan and Implementation

| Water licence—groundwater(mm <sup>3</sup> ) | 2014  | 2013  |
|---------------------------------------------|-------|-------|
| Initial balance                             | 495   | 0     |
| Add: Allocation plan                        | 91000 | 91000 |
| Minus:Allocation transfer                   | 88200 | 90450 |
| Total occurring amount of this period       | 2800  | 550   |
| Minus: Confiscated                          | (330) | (55)  |
| The ending balance                          | 2965  | 495   |

Table 5. Water License of Beijing Waterworks Group Co., Ltd—Groundwater Allocation Plan and Implementation of Miyun Reservoir

| Water licence—Miyun Reservoir(mm <sup>3</sup> ) | 2014   | 2013  |
|-------------------------------------------------|--------|-------|
| Initial balance                                 | 6498   | 0     |
| Add:Allocation plan                             | 24500  | 24500 |
| Minus:Allocation transfer                       | 30600  | 17280 |
| Total occurring amount of this period           | (6100) | 7220  |
| Minus:Confiscated                               | 40     | (722) |
| The ending balance                              | 358    | 6498  |

Table 6. Water License of Beijing Waterworks Group Co., Ltd—Groundwater Allocation Plan and Implementation of Juma River

| Water licence—Juma River(mm <sup>3</sup> ) | 2014   | 2013  |
|--------------------------------------------|--------|-------|
| Initial balance                            | 1872   | 0     |
| Add: Allocation plan                       | 6400   | 6400  |
| Minus:Allocation transfer                  | 7650   | 4320  |
| Total occurring amount of this period      | (1250) | 2080  |
| Minus: Confiscated                         | 62     | (168) |
| The ending balance                         | 560    | 1872  |

Table 7. Water Assets and Water Liabilities of Beijing Waterworks Group Co., Ltd under Accrual Basis

|                               | 12.31.2014 |      | mm <sup>3</sup> |
|-------------------------------|------------|------|-----------------|
| Projects                      | 2014       | 2013 |                 |
| Water assets                  |            |      |                 |
| Surface water assets          |            |      |                 |
| Reservoir                     | 85         | 78   |                 |
| Inlet pipe                    | 62         | 55   |                 |
| Total surface water assets    | 147        | 133  |                 |
| Other surface water assets    |            |      |                 |
| Water licence—groundwater     | 2965       | 495  |                 |
| Water licence—Miyun reservoir | 358        | 6498 |                 |
| Water licence—Juna river      | 560        | 1872 |                 |
| Total other water assets      | 3883       | 8865 |                 |
| Total water assets            | 4030       | 8998 |                 |
| Water liabilities             |            |      |                 |
| Water allocation liabilities  | 0          | 0    |                 |

| Projects                      | 2014   | 2013 |
|-------------------------------|--------|------|
| Total water liabilities       | 0      | 0    |
| Clean water assets            | 4030   | 8998 |
| Initial clean water assets    | 8998   | 78   |
| Changes in clean water assets | (4968) | 8920 |
| Ending clean water assets     | 4030   | 8998 |

Table 8. Changes in Water Assets and Water Liabilities of Beijing Waterworks Group Co., Ltd under Accrual Basis

|                                |        | 12.31.2014 | mm <sup>3</sup> |
|--------------------------------|--------|------------|-----------------|
| Projects                       | 2014   | 2013       |                 |
| Water asset growth             |        |            |                 |
| The temporary water withdrawal | 3600   | 15750      |                 |
| Water licence—groundwater      | 91000  | 91000      |                 |
| Water licence—Miyun reservoir  | 24500  | 24500      |                 |
| Water licence—Juma river       | 6400   | 6400       |                 |
| Total water asset growth       | 125500 | 137650     |                 |
| Water assets reduction         |        |            |                 |
| Water for consumption          | 127449 | 125244     |                 |
| Loss                           | 2591   | 2546       |                 |
| Confiscated—groundwater        | 330    | 55         |                 |
| Confiscated—Miyun reservoir    | 40     | 722        |                 |
| Confiscated—Juma river         | 62     | 168        |                 |
| Total water assets reduction   | 130472 | 128735     |                 |
| Unstated differences           | 4      | 5          |                 |
| Changes in clean water assets  | (4968) | 8920       |                 |

#### 4.4.3. Discussion

(1) The comparison of the two different GPWA reports reflects the advantages of using accrual basis.

The GPWA report, based on the accrual basis, distinguishes between “water assets” and “water liabilities” and better reflects the accrual relationship of water resource managers. In it, there are water asset change and water liability change tables compared with the current GPWA report, which can clearly reflect the specific situation

of water asset change and water liability change, and reveal the reasons for the change of net water resources in these two tables. Whether the accrual accounting system is implemented or not, the water flow table is prepared based on the cash basis, and the results (Table 3) are exactly the same. It reflects the situation of water intake and water supply in different years and reveals the allocation and use of water resources in Beijing. The change in the net storage in the water flow table (14) is equal to the change in the storage of physical properties in the water assets and liabilities tables (147–133). Moreover, the “Unaccounted-for difference 1” [(4030–8998)–(125500–130472)] in the tables of water assets and water liabilities and the “Unaccounted-for difference 2” [(147–133)–(130050–130040)] in the water flow table are both equal to 4. It proves that under the accrual accounting case, the “Unaccounted-for difference” can be used for trial balance.

(2) The sources and quantities of water withdrawal by Beijing Waterworks Group Co., LTD fluctuate greatly between years.

As shown in Table 3, although in 2013 and 2014, the difference of total water inflows is subtle, respectively 1.278 billion m<sup>3</sup>, 1.278 billion m<sup>3</sup>, the difference of the amount of water withdrawal from the various channels is large. Differences among fixed annual water channels: Miyun reservoir, Juma river and groundwater are respectively 77.08%, 77.08%, 2.49%, let alone emergency water from Hebei in 2013 diversion (157.5 million m<sup>3</sup>), and added water from South-to-North Water Diversion Project in Beijing in 2014 (36 million m<sup>3</sup>), which is not conducive to the sustainable utilization and fair distribution of water resources.

(3) The property right of water resources belongs to the state, and the protection and accounting of water assets by water-using enterprises are relatively rough.

Although Beijing Waterworks Group Co., Ltd is an enterprise, it is actually operated by the government and its main task is to supply water to the city. As the property right of water resources belongs to the state, enterprises do not have the right of operation and revenue. Therefore, enterprises do not have the concept of “water assets” and do not pay enough attention to the statistics of water assets. For example, there is a lack of statistics on the amount of water in the intake pipe. In addition, enterprises only pay attention to the statistics of water outflow and ignore the statistics of water inflow and storage, which reflects the phenomenon that China values the statistics of water supply and lacks the concept of water balance and the water accounting based on the law of water balance.

(4) The lack of transparency of water information in China hinders the supervision of water allocation and use by all sectors of society.

Beijing Waterworks Group Co., Ltd and Beijing Water Authority are both reluctant to provide data on water resources allocation and use, and even *Beijing Water Statistics Yearbook* compiled by the Beijing Water Authority is not open to the public. Water information in China lacks exchange and communication mechanisms hinders not only

the optimal allocation of resources and the supervision of water allocation schemes, but also the supervision of water accounting data. As a result, water accounting data quality is not high.

## 5. Concluding Remarks

In view of the severe and complex water problems in the Beijing-Tianjin-Hebei region, it is necessary to further examine the positioning of water resources accounting at the national strategic level, to innovate the water resources management mechanism, to improve the content of water resources management, to strengthen the integrated water resources management, and to encourage the participation of all social entities in water resources management. General purpose of water accounting is carried out on the premise of sustainable management and accounting of water resources. It can reflect the situation and change of water resources in a whole process, all-round, fine and standardized way, and enhance the transparency and comparability of water information. It is beneficial to mobilize the initiative and enthusiasm of all social entities to protect water resources and supervise water use, and is also an effective solution to help improve the level of water resource management in Beijing-Tianjin-Hebei region. Before the GPWA is implemented, the Beijing-Tianjin-Hebei region should break the existing practice of automatically clearing the unused allocated water every year and make a 5-or 10-year plan, which allows unused water use quotas every year of the plan period to be used up in the following year, and water rights to be trade. At the same time, the related policies about the water rights trade should be consummated. In this way, it is not only beneficial to the long-term sustainable utilization of water resources, but also can give play to the market mechanism to allocate resources and improve the efficiency of natural resources, economic resources and social resources allocation. On this basis, studying and formulating general purpose of water accounting standards will effectively solve the Beijing-Tianjin-Hebei integration process of water resources.

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