

Global Water Partnership (China) WACDEP  
Work Package One Outcome Report

# **Study on Management of Water Resources Regulation In the Yellow River Basin**

China Institute of Water Resources and Hydropower Research

December 2014

## Table of Content

I. General Introduction.....	1
1. Natural conditions.....	1
2. Social and economic conditions.....	2
3. Water resources .....	3
3.1 Characteristics of water resources.....	3
3.2 Impacts of climatic changes and human activities on quantity of water resources.....	4
II. Development and utilization of water resources in the Yellow River Basin .....	6
1. Water infrastructures .....	6
2. Development and utilization of water resources.....	6
3. Development trend of water supplies and demands .....	7
4. Problems .....	11
III. Water resources regulation and the problems in the Yellow River Basin.....	13
1. Water resources regulation management organization .....	13
2. Distribution of water resources in the Yellow River Basin .....	15
2.1 Development of water resources distribution plan .....	15
2.2 Features of water resources distribution plan .....	18
2.3 Implementation of water resources distribution plan.....	20
3. Water resources regulation in the Yellow River Basin .....	21
3.1 Evolution of water resources regulation .....	21
3.2 Features of water resources regulation rules .....	23
3.3 Water resources regulation process .....	25
3.4 Implementation and supervision of water resources regulation .....	28
4. Existing problems .....	30
4.1 New situation faced on water resources distribution.....	30
4.2 Inadequacy in water resources regulation.....	32
IV. GWP's role in water resources regulation in the Yellow River Basin .....	35
V. Recommendations for improvement of water resources distribution and regulation in the Yellow River Basin .....	40
1. Improvement of water resources regulation in the Yellow River Basin.....	40
1.1 System and mechanism .....	41
1.2 Administrative management.....	42
1.3 More support needed .....	44
2. Future focus of GWP work .....	45
VI. Conclusion.....	47
1. Status-quo of water resources distribution and regulation.....	47
2. GWP's role in water resources regulation.....	48
3. Recommendations for improvement.....	49

## I. General Introduction

### 1. Natural conditions

The Yellow River is the second largest river of China. It originates from Yueguzonglie Basin at the northern foot of Bayankala Mountain of the Qinghai-Tibet Plateau and winds its way across nine provinces and regions, including Qinghai, Sichuan, Ganshu, Ningxia, Inner Mongolia, Shaanxi, Shanxi, Henan and Shandong provinces, and flows into the Bohai Sea in Kenli County of Shandong Province. The trunk river course is 5,464km long with a fall of 4,480m. The whole drainage basin is located between 96° and 119° Eastern Longitude and between 32° and 42° Northern Latitude and about 1,900km long in the west-east orientation and about 1,100km in the north-south orientation. The drainage basin covers an area of 795,000sqkm. The upper reaches include the river section from the origin to Hekou Town (Tuoketuo) of Inner Mongolia; the middle reaches include the river section from Hekou Town to Taohuayu of Henan Province; and the lower reaches include the river section below Taohuayu.

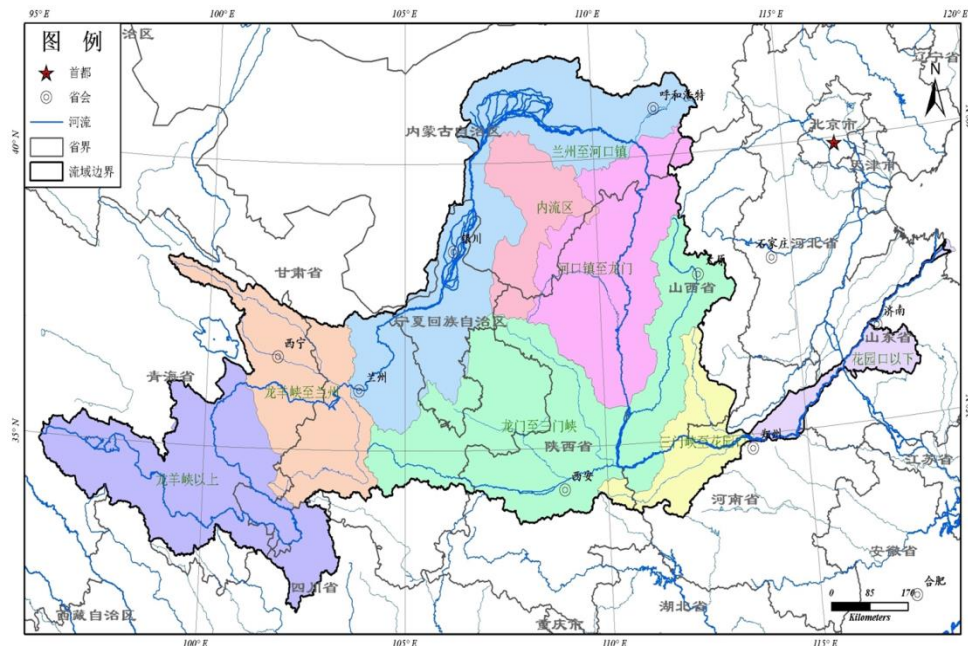


Figure 1-1 Map of Water System in Drainage Basin of the Yellow River

The drainage basin of the Yellow River is high in the west and low in the east and gradually descends from west to east. It comprises three giant geographic levels. The highest level is the Qinghai Plateau in the west with a mean altitude of over 4,000m. Bayankala Mountain in the south constitutes the watershed with the Yangtze River. The second level has Taihang Mountain as the eastern boundary with an altitude between 1,000m and 2,000m. It comprises Hetao Plain, Erdos Plateau, Loess Plateau and Weifen Basin. The third level starts at Taihang Mountain and ends at the seaside and comprises the alluvial plain at the lower reaches of the Yellow River and the mountain regions and hills in the middle of Shandong Province. The top of the

alluvial sector at the lower reaches is located near the mouth of Qin River with an altitude of 100m. The embankment of the Yellow River divides the plain into the southern part and the northern part. To the north of the embankment is the drainage basin of the Yellow River and to the south is the drainage basin of the Huai River. The mountainous regions and hills in the middle of Shandong Province comprises Taishan Mountain, Lushan Mountain and Mengshan Mountain with a general altitude between 200 and 500m. The hills take a round shape and the river valleys are wide and a small number of mountainous regions have an altitude of over 1,000m.

## **2. Social and economic conditions**

The drainage basin of the Yellow River covers 340 counties (cities and Qi) of 66 cities (states and Meng) of 9 provinces (regions). The population is unevenly distributed within the drainage basin, with 70% of the total population concentrated along the river section below Longmen which accounts for only 32% of the total area of the drainage basin. The river section above Longyang Gorge is extremely cold pasturing area with a limited population and accounts for only 0.6% of the total population but 16.5% of the total land area of the drainage basin. It has the lowest population density, or only 5 people/sqkm.

With the implementation of such strategies as the Grand Development of the West and the Rise of Central China, the drainage basin has registered rapid social and economic development in recent years, with a mean annual GDP growth of 11.0% and per capita GDP growing by more than 10 folds since 1980. Considering the geographic location of the drainage basin in China and the restrictions of historic and natural conditions, the drainage basin has comparatively backward social and economic development and accounts for only 8% of the total national GDP of China.

The Yellow River is also the largest source of water supplies for the northwestern and northern parts of China. With merely 2% of the runoffs generated by rivers nationwide, it feeds the 12% population and 15% arable lands of China within its drainage area and the downstream irrigated area and supplies water to the 50+ large and medium-size cities and Zhongyuan and Shengli Oilfields and other key enterprises along the Yellow River. Meanwhile, its water is further transferred to far-away regions outside the drainage basin. Sustainable use of the water resources in the Yellow River is essential to the sustainable socioeconomic development of the regions along the Yellow River. The utilization of advantageous conditions along the regions, including rich land, mineral and energy resources must have the water resources of the Yellow River as the support and guarantee.

The drainage basin of the Yellow River is the cradle of the Chinese people with

time-honored economic development and long-term cultural development. It used to be the political, economic and cultural center of China for long time. It spans the eastern, central and western parts of China with the Eurasian Continental Bridge running right across it. As such, it has not only the vigor and vitality of the eastern part of China and the high technologies thereof as the driving force, but also the solid agricultural base and energy and mineral resources of the central and western parts of China to offer enormous potentials. Amidst the strategic shift of China's economic development focus from east to west, it is both the destination and the transitional region. Therefore, the economic development along the Yellow River plays a vital and strategic role in the economic development of China.

### **3. Water resources**

#### **3.1 Characteristics of water resources**

The drainage basin of the Yellow River borders the Bohai Sea on the east and reaches to the hinterland in the west of China and therefore demonstrates significantly different climatic conditions. According to the general plan of the water resources of the drainage basin, the multi-year mean rainfall is 447mm within the drainage basin, with substantially different rainfalls across different years. The fewer rainfalls a region has, the more varied the rainfalls may be across different years. The drainage basin of the Yellow River<sup>1</sup> has a multi-year mean water resources of 71.94 billion cubic meters, including 60.72 billion cubic meters of natural river runoffs (accounting for 82.6% of all) and 11.22 billion cubic meters of surface water and groundwater.

The water resources of the Yellow River have the common characteristics of rivers in the north of China, i.e. substantial variations in different years, high concentration in the same year and uneven spatial distribution. Meanwhile, they are also uniquely characterized by considerable amount of sediment and different sources of water and sediment. Therefore, it is highly difficult to manage water resources in the drainage basin of the Yellow River considering such uneven distribution and substantial variation in different years.

The multi-year mean water resources of the drainage basin only accounts for 2.5% of the national total and its per capita water resources are only 30% those of the national per capita water resources. Water resources are highly precious resources for the socio-economic development and ecological environment protection in the drainage basin.

Different from the origins of water resources in the drainage basin, i.e. 54% from the upper reaches and 39% from the middle reaches, the upper reaches and the middle

---

<sup>1</sup> Data source: second national general plan of water resources.

reaches account for 3% and 93% of the multi-year mean sediment quantity of 1.6 billion tons of the Yellow River respectively. Therefore, the drainage basin of the Yellow River is characterized by much sediment in limited water and different sources of water and sediment.

The water resources are unevenly distributed across the drainage basin and the distribution of water resources does not match the distribution of production capacities within the drainage basin. Some regions have a severe lack of water resources which directly affects the sustainable development of the local economy. In general, water resources are more in the west than in the east and more in mountainous regions than in plains.

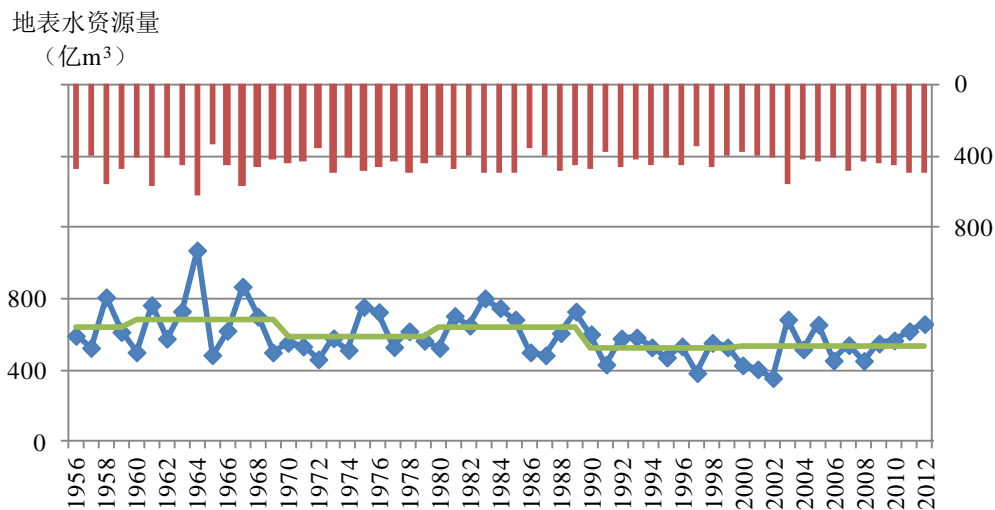
The drainage basin has a typical monsoon climate with highly different rainfalls in different seasons. The four continuous months with the highest rainfall mostly occur in the period from June to September which accounts for 70% to 80% of the annual total. The rainfalls mostly take the form of rainstorms. As the river runoffs are mostly generated by rainfalls within the drainage basin, the water resources are distributed in a substantially uneven manner in the year if the rainfalls change considerably across different seasons, with runoffs accounting for over 60% of the annual runoffs during the flood season and even as high as 85% in some tributaries. It makes somewhat difficult for the reasonable development, utilization and management of water resources in the drainage basin. In particular, frequent floods and droughts would occur during long flood season or drought season. Droughts would cause particularly severe threats to the sustainable utilization of water resources.

### **3.2 Impacts of climatic changes and human activities on quantity of water resources**

In the past 100 years, the mean temperature of the mainland area of China has increased distinctively, with the mean annual temperature increasing by about 0.6 to 0.8°C (Qin Dahe, etc, 2005) which is slightly higher than the warming trend of the world or the Northern Hemisphere. The warming effects are more evident in winter than in summer. In the drainage basin of the Yellow River, there has been a distinctive trend of fluctuation and increase in the mean annual and quarterly temperatures. In particular, the temperature rise trend is particularly evident in winter but less evident in summer. The annual rainfalls and quarterly rainfalls have registered a fluctuating trend of decline in the drainage basin except winter when slight increase of rainfalls is registered. According to the annual variations, the rainfalls have declined consistently after mid and late 1950s although rebounds were registered in the early years of the 21<sup>st</sup> century.

Considering impacts of continuous droughts and human activities on the underlying

surfaces, the water resources conditions have changed in the drainage basin of the Yellow River, particularly on the middle reaches of the Yellow River where the water resources have distinctively decreased. A comparison of the period from 1990 to 2013 and the period from 1956 to 1989, the rainfalls have decreased by 4.1% and the surface water resources have decreased by 17.4%. The scale of distributable water resources has decreased from 58 billion cubic meters to 53.5 billion cubic meters in the drainage basin and the water flows into the sea have decreased by 60.5%.



Surface water (100m m<sup>3</sup>)

Figure 1-2 Yearly Surface Water Resources

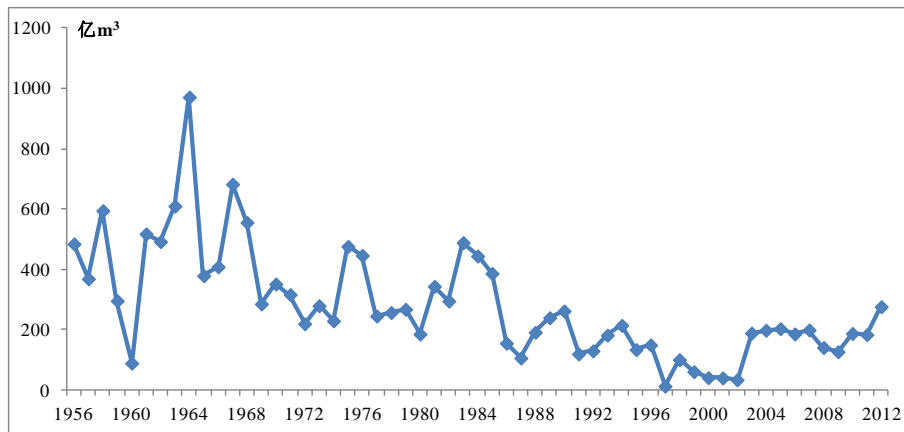


Figure 1-3 Yearly Water Flows into the Sea

The reasons that cause distinctive decline in water resources of the Yellow River include dwindling rainfall scale and changes in the relations of rainfall and runoff arising from changes in the conditions of the underlying surface. It is an irreversible trend for decline of water resources due to changes in the conditions of the underlying surface in the drainage basin. With the intensification of economic and social activities and the changes in the underlying surface due to human activities,

the level of utilization of rainfalls will be further increased so that the degree and extent of such changes will keep increasing in the future, hence further aggravating the already severe undersupply of water resources in the drainage basin of the Yellow River.

## **II. Development and Utilization of Water Resources in the Yellow River Basin**

### **1. Water infrastructures**

There is a long history of the development and utilization of water resources along the Yellow River. However, major developments took place only after 1949 when the scope of water supply gradually widened from the inside to the outside of the drainage basin. In the past 60+ years, many surface water and groundwater utilization works have been constructed to create sound conditions for the general harnessing of water resources of the Yellow River.

As of 2012<sup>2</sup>, totally 3,261 large, medium and small-size reservoirs were completed in the drainage basin of the Yellow River, creating a total reservoir capacity of 81.5 billion cubic meters. These reservoirs include 31 large-size reservoirs with a total capacity of 69.8 billion cubic meters, or 85.6% of the total reservoir capacity; 221 medium-size reservoirs with a total capacity of 7.6 billion cubic meters, or 9.4% of the total reservoir capacity; 3,009 small-size reservoirs with a total capacity of 4.1 billion cubic meters, or 5% of the total reservoir capacity. These reservoirs of various sizes play an important role in the water supply, electricity generation and flood prevention in the drainage basin of the Yellow River. Moreover, 2,571 flood gates of various sizes were completed in the drainage basin as of 2012.

The geographic distribution of various types of works is as follows: large-size reservoirs are mainly distributed on the upper and middle reaches; medium and small-size reservoirs, embankments, water well works and E&M shaft works are mainly distributed on the middle reaches. Water diversion works are mostly located on the upper and lower reaches of the Yellow River.

### **2. Development and utilization of water resources**

The limited water resources of the Yellow River not only support the social and economic development in the drainage basin of the Yellow River, but also play an active role in promoting the social and economic development in adjacent regions. In 2012<sup>3</sup>, various types of works in the drainage basin of the Yellow River offered a total water supply capacity of 52.36 billion cubic meters, including 41.11 billion cubic meters and 11.25 billion cubic meters inside and outside the drainage basin respectively. The water supply capacity within the drainage basin includes 28.05

---

<sup>2</sup> Data source: 2013 Statistical Annual of Water Resources in China

<sup>3</sup> Data source: 2012 Gazette of Water Resources in Drainage Basin of the Yellow River.



billion cubic meters of surface water and 13.06 billion cubic meters of groundwater, or 75.1% and 24.9% of all respectively.

In 2012, the total water use amounted to 52.36 billion cubic meters in the drainage basin of the Yellow River, including 5.04 billion cubic meters for domestic use, 1.49 billion cubic meters for industrial use, 37.66 billion cubic meters for agricultural use and 1.87 billion cubic meters for environmental use, or 9.6%, 14.9%, 71.9% and 3.6% of all respectively.

In 2012, the total water consumption amounted to 41.91 billion cubic meters, including 32.33 billion cubic meters of surface water and 9.58 billion cubic meters of groundwater, or 77.1% and 22.9% of all respectively.

According to statistics of the Gazette of Water Resources in Drainage Basin of the Yellow River, the total water supply has registered fluctuating increase in the drainage basin of the Yellow River since 2000. Living and industrial water usages have increased continuously while agricultural water usage has registered fluctuating increase due to variable climatic conditions. From the perspective of source structure, surface water supplies have increased gradually while groundwater supplies have decreased slowly. Changes in economic structure has also led to changes in water use structure, with gradual increase in the ratio of domestic and industrial water uses and distinctive decrease in the ratio of agricultural water use.

### **3. Development trend of water supplies and demands**

#### **(1) Analysis on current water resources shortage**

In the past 35 years since the implementation of reform and opening up policies, the economic conditions and water usage structure in the drainage basin of the Yellow River have changed substantially. The annual mean consumption of river runoffs have grown and exceeded the water supply capacity of the Yellow River since 1995. The water resources are consumed excessively for production purposes and environmental water supplies are not enough so that the health of rivers is severely endangered.

The competitions for water supplies among different sectors have resulted in lack of water, as primarily reflected by the lack of water supplies for irrigational purposes, the lack of environmental water supplies in river courses and unreasonable mining of groundwater. According to surveys, water supplies to an effective irrigated area of about 667,000hm<sup>2</sup> can't be guaranteed in the drainage area today; part of the irrigated area has an too low water supply standard; and specific cities and rural areas have highly limited water supplies. In the current conditions, the multi-year mean water supply is 41.97 billion cubic meters in the drainage basin. In a year with

normal water supplies, the multi-year mean water supply is 48.58 billion cubic meters in the drainage basin, registering a deficient water supply of 6.61 billion cubic meters and a water deficiency rate of 13.6% outside the river courses in the drainage basin. Primarily there is an undersupply of water for agricultural, forestry, pasturing and irrigational purposes. The water flows into the ocean amount to 20.67 billion cubic meters; the undersupply of environmental water is 1.33 billion cubic meters; the total deficient water supply for social, economic and environment purposes is 7.94 billion cubic meters in the base year, which severely restricts the sustainable social and economic development.

## (2) Analysis on future water resources shortage

With the rapid social and economic development in the drainage basin, particularly the changes of main water functional layout of China and the requirements on development of ecological civilization, the total water supply will increase to a certain extent in the drainage basin. According to the main water functional layout of China, the drainage basin of the Yellow River will include the key national development regions, i.e. Taiyuan City Cluster, Zhongyuan Economic Region, Guanzhong – Tianshui Region, Lanzhou – Xining Region, Ningxia Economic Region along the Yellow River and Region on the Northern Slope of Tianshan Mountain; the three main grain output regions, i.e. Huanghuaihai Plain Main Grain Output Region, Fenwei Plain Main Grain Output Region and Hetao Main Grain Output Region; the national key ecological functional region of Loess Plateau – Sichuan and Yunnan Ecological Barrier; the key water source replenishing ecological functional region of the Yellow River in South Gansu Province; the ecological functional region for water and soil conservation on hills and ravines in the Loess Plateau; the ecological functional region of grassland, meadow and wetland in Sanjiangyuan; and the ecological functional zone of grassland and meadow in Hulunbeier<sup>4</sup>.

The competitions for water resources for various purposes will become even fiercer in the future. It is predicted that the total water consumption in the drainage basin will reach 52.11 billion and 54.73 billion cubic meters in 2020 and 2030 respectively, up by more than 10 billion cubic meters compared with the current consumption. As a contrast, the water supply capacity will be 44.58 billion and 44.32 billion cubic meters then. In the absence of external inflows of water resources, there will be a water short supply of 7.35 billion and 10.41 billion cubic meters within the drainage basin then. The flows into the sea will be reduced from 20.67 billion cubic meters in the base year to only 18.88 billion and 18.58 billion cubic meters in 2020 and 2030 respectively which can hardly satisfy the demands for ecological and environmental

---

<sup>4</sup> Data source: National Plan of Main Water Functional Zones  
Zhang Xinhai, Utilization and Allocation of Water Resources in the Drainage Basin of the Yellow River, People's Yellow River, Vol(35),No.10,2013,80-82

supplies in the river course and result in a lack of ecological and environmental water resources of 1.33 billion cubic meters in the base year to 3.12 billion cubic meters in 2020 and 3.42 billion cubic meters in 2030. The total short supply of water resources for all purposes will increase from 7.94 billion cubic meters in the base year to 10.65 billion cubic meters in 2020 and 13.83 billion cubic meters in 2030.

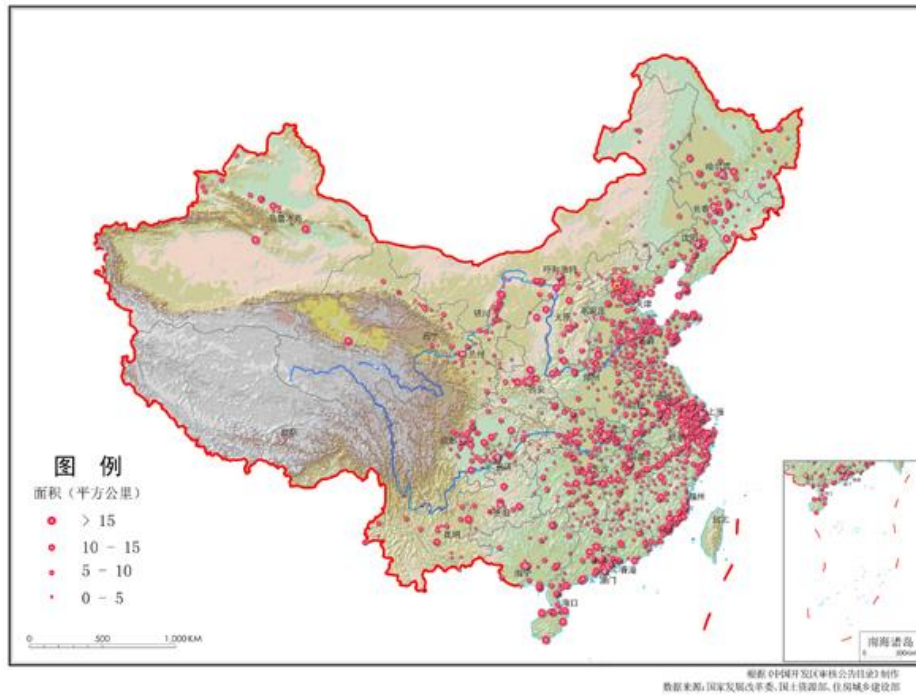


Figure 2-1 Strategic Layout Plan of Urbanization

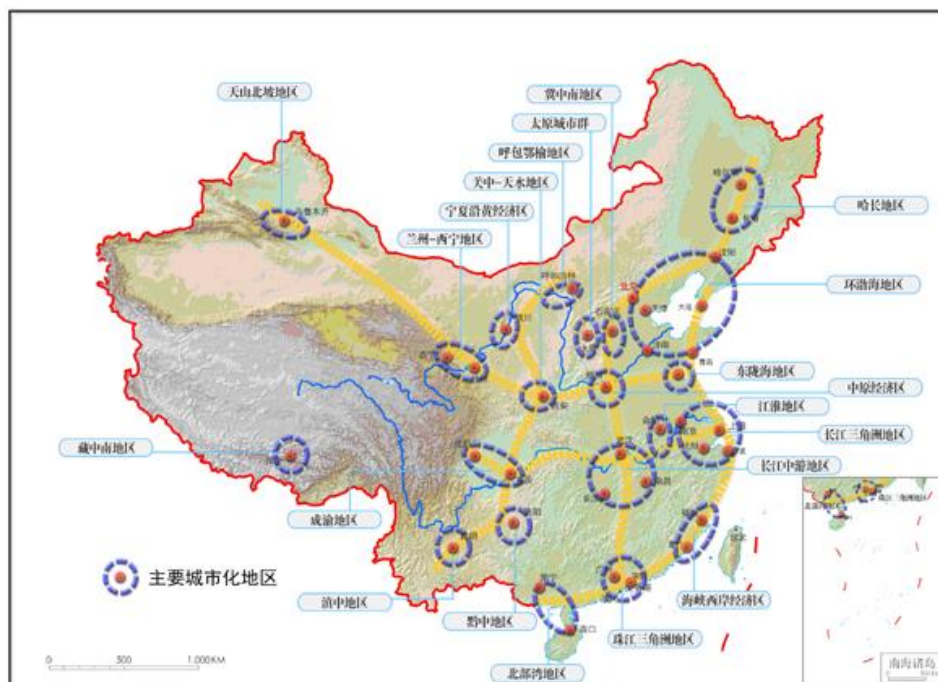


Figure 2-2 Strategic Layout Plan for Agricultural Development

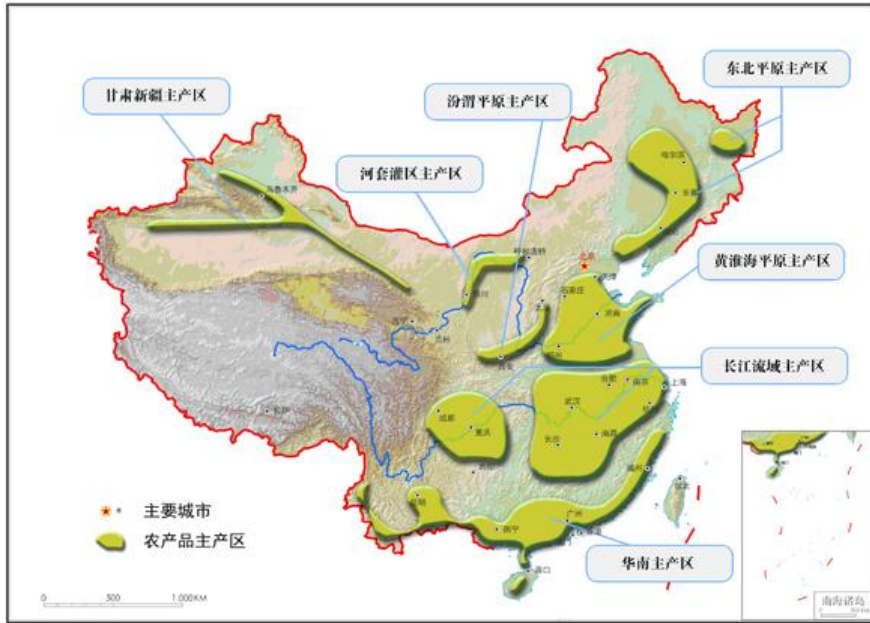


Figure 2-3 Strategic Layout Plan of Ecological Security



Figure 2-4 Layout Plan of Key National Ecological Functional Zones

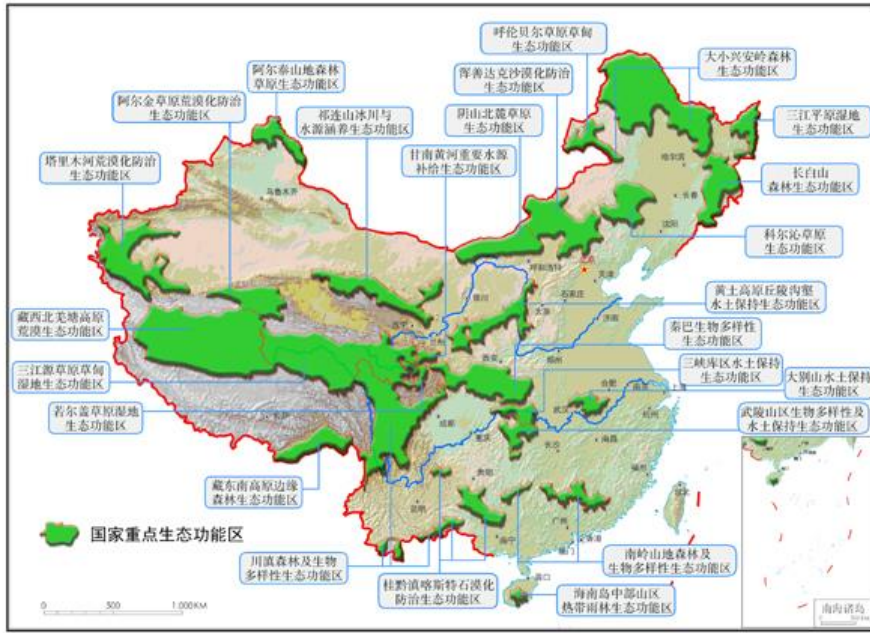


Figure 2-5 Strategic Layout Plan of Ecology

#### 4. Problems

(1) Worsening basic water resources can't support the sustainable social and economic development

The per capita water resources and the water resources per mu( 15 mu equals 1 hectare) in the drainage basin of the Yellow River both rank the last but one among all nine major drainage basins in China and are higher only than those in the drainage basin of the Hai River. However, three-fourths of the area of the drainage basin of the Yellow River is dry or half-dry and heavily depends on irrigation. Therefore, there is a poor basic situation for water resources here.

With social and economic development, there has been a continuous increase in water consumption in the drainage basin of the Yellow River and relevant other regions and therefore the restrictions of water resources are increasingly highlighted. As the Yellow River is characterized by limited water and much sand, it can hardly satisfy the continuously-expanding scope of and demand for water supplies. The actual consumption of runoffs already accounts for 73% of the natural river runoffs and that is beyond the limit already. One of the greatest challenges facing the social and economic development of the drainage area of the Yellow River is the severe lack of water resources.

With water and soil conservation, the construction of terraces and other human activities on the upper reaches since the 1970s, there has been a trend of further decline in the runoffs of natural rivers in the drainage basin and it further intensifies

the lack of water resources here.

(2) Ecological water supplies are massively taken for other purposes and the ecological environment is ever-worsening

Since the 1970s, the water flows into the sea have declined substantially due to economic development, increasing water consumptions and lower rainfalls in the drainage basin of the Yellow River. Ecological water supplies are massively used for other purposes so that the water flows have frequently stopped in the Yellow River. During the 28 years from 1972 to 1999, water flows stopped on the lower reaches for 22 years. Meanwhile, insufficient ecological water supplies in the river course also result in a series of problems, including sedimentation, worsening perched rivers and aggravating water environment. Although no stop of water flows has occurred on the lower reaches since the scheduling of water flows in the Yellow River in 1999, it is far away from satisfying the requirements on functional continuation of water flows because stringent controls of water consumptions on the upper and middle reaches have to be imposed.

Moreover, continuous massive extracting of groundwater has resulted in continuous decline of groundwater level and created a giant funnel structure underground in some areas on the one hand. And on the other hand, surface water sinks and that severely affects the runoffs of rivers,

(3) Low water utilization efficiency does not fit in with the severe lack of water resources

The water consumption and water utilization efficiency have substantially increased in the drainage basin of the Yellow River in the past 30 years although it is still low and there is still a severe waste of water compared with advanced standards at home and the standards of developed countries. The water efficiency management and water saving technologies are rather backward. The main water efficiency indexes are lagging far behind the national average and those of developed countries.

As some of the irrigated areas have aged and dilapidated channel systems, poor infrastructures, excessively large-size fields, long ditches, wide farmlands, uneven lands, backward irrigational technologies and rough water utilization management, there is a low utilization ratio of the channel systems and overflowing occurs in some irrigated areas to cause waste of water. Moreover, the water charging mechanism is not well established and the water price is generally too low, which also contributes to the waste of water resources. Water-efficient irrigation has been emphasized in most provinces (regions) in recent years. However, water efficiency increases slowly due to lack of investments.

(4) Water resources management can't satisfy current needs for river basin



management

Achievements have been made in the management of water resources in the drainage basin of the Yellow River in recent years. Comprehensive regulation of available water resources along the trunk of the Yellow River was started in 1999. In 2006, the State Council promulgated the Rules on Water Resources Regulation of the Yellow River to further establish the legal base for regulating water resources of the Yellow River. Meanwhile, achievements have been made in the licensing of water utilization, analysis of water resources available for construction projects, pilot project of water right conversion, etc.

Compared with the severe lack of water resources and the complexity of water resources regulation and management of the Yellow River, the current water resource management methods and measures can't satisfy the needs for drainage basin management. The technical system for water flow management that combines total amount control and quantitative management is not yet well established. The surface water quality management system that has water functional zone as the unit is not yet established; the groundwater functional zoning is not yet completed and the technical system is not well established; the development of water resources is either in disorder or excessive in some regions and not effectively inhibited; the code of conduct for water saving that is based on quantitative management is not fully implemented and lack of water and low water efficiency co-exist; drought monitoring and rainfall forecast can't satisfy the requirements on refined scheduling; water resource monitoring network is not well established, particularly the monitoring of water pickup and return; the system of scheduling and control parameters and indexes are not scientifically established for the control sections essential to maintenance of the health and life of the Yellow River. With the rapid social and economic development, the water resource management will become more complicated in the drainage basin and further improvements are required.

### **III. Water Resources Regulation and the Problems in the Yellow River Basin**

#### **1. Water resources regulation management organization**

Since the 1990s, frequent dry-up of flows on the lower reaches of the Yellow River have attracted extensive attention from the government and various circles of the society. In December 1998, approved by the State Council, State Development Planning Commission and the Ministry of Water Resources promulgated the Measures for Management of Water Resources Regulation of the Yellow River (Ji Di Qu [1998] No. 2520). It authorized the Yellow River Conservancy Commission to perform comprehensive regulation of water resources of the Yellow River, including regulation of water resources of the controlled river sections in various provinces (regions), formulation of water resources regulation plan of key reservoirs in trunks and tributaries and regulation of water resources in special conditions. The

Commission formally performed comprehensive regulation of water resources for the section between Liujiaxia Reservoir and Toudaoguai and between Sanmenxia Reservoir and Lijin Trunk after March 1999. Significant achievements were made after more than one year's practice. Today, the focus on the water resources regulation includes the river sections between Liujiaxia Reservoir and Toudaoguai and between Sanmenxia Reservoir and the downstream river mouth. The regulation period is eight months of the drought period (November until June next year).

In Feb. 1999, the Commission established the "Yellow River Water Resources Regulation Administration Bureau" to be liable for collective distribution and regulation of water resources. The Office of the Committee for Water Resources Regulation on the Upper and Middle Reaches of the Yellow River, the Department of Water Resources of relevant provinces, the Yellow River Affairs Bureau of Henan and Shandong provinces and key hydropower plants and reservoirs shall be liable for water resources regulation within their respective jurisdictions. See Figure 3-1 for the current water resources regulation administration system of the Yellow River.



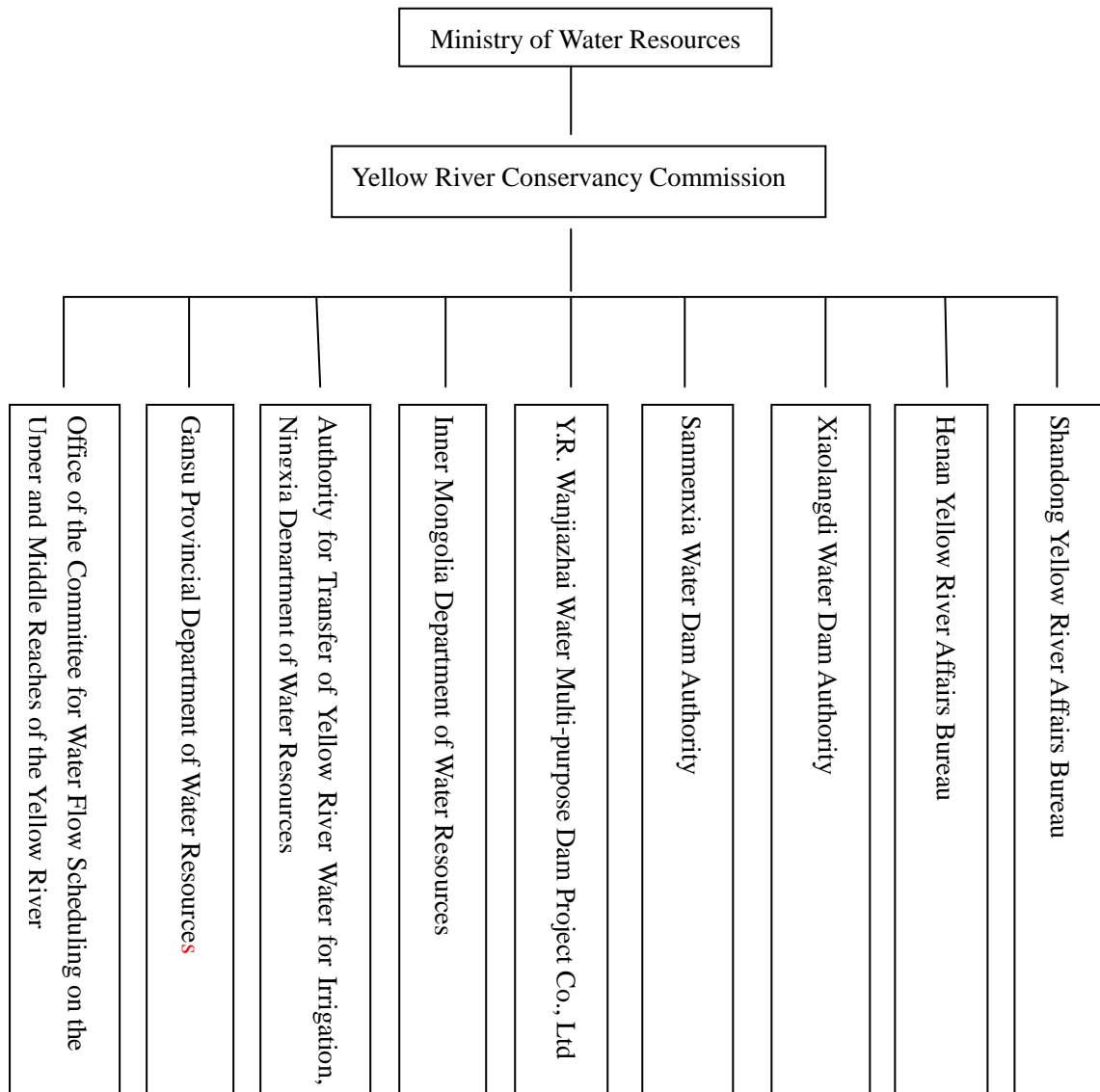


Figure 3-1 Current Water Flow Scheduling Administration System of the Yellow River

## 2. Distribution of water resources in the Yellow River Basin

### 2.1 Development of water resources distribution plan

#### 2.1.1 Development of water resources distribution plan and its content

In order to address the short supply of water on the upper and lower reaches of the Yellow River, the General Office of the State Council forwarded the “Notice on Report of Water Supply Distribution Plan of the Yellow River” promulgated by the State Planning Commission and the Ministry of Water Resources on September 11, 1987. This is the first water supply distribution plan of the Yellow River ever approved by the Central Government. It was issued by the General Office of the State Council as Guo Ban Fa (1987) No. 61 Circular to various provinces (autonomous regions and

municipalities) as the water supply distribution plan of the Yellow River before the South-to-North Water Diversion Project took effect.

Based on multiple years of survey and research, according to the actual needs of various provinces and regions and through repeated negotiations with relevant authorities of various province and regions along the Yellow River, it is predicted that the river runoffs distributed among various provinces and regions along the Yellow River will be 37 billion cubic meters before the South-to-North Water Diversion Project took effect (see Table 3-1). This distribution plan has been approved by the State Council and various provinces, autonomous regions and municipalities are expected to aggressively take measures to save water, formulate their water usage plans according to the water supply distribution plan and closely associate the plan with their local development plan of national economy with an aim to achieve higher general economic benefits.

Table 3-1 Yellow River Water Supply Distribution Plan

Region	Qinghai	Sichuan	Ganshu	Ningxia	Inner Mongolia	Shaanxi	Shanxi	Henna	Shandong	Hebei	Tianjin	Total
Annual water consumption (100m <sup>3</sup> )	14.1	0.4	30.4	40	58.6	38	43.1	55.4	70.0	20.0		370.0
Ratio	0.038	0.001	0.082	0.108	0.158	0.103	0.117	0.15	0.189	0.054		1.000

The State Planning Commission, the Ministry of Water Resources and relevant other state and local authorities have worked together to formulate the Plan for Annual Distribution of Water Supplies and Scheduling of Water Supplies in Trunks of the Yellow River. In December 1998, the State Planning Commission and the Ministry of Water Resources promulgated the Plan for Annual Distribution of Water Supplies and Scheduling of Water Supplies in Trunks of the Yellow River as Ji Di Qu [1998] No. 2510 Circular which specified the distributable water supplies among various provinces (autonomous regions and municipalities) in various months of a year with normal water flows. Such distributable water flows shall be taken as the index for control of water distribution in the year, as Figure 3-2 shows.

According to the Plan for Annual Distribution of Water Supplies and Scheduling of Water Supplies in Trunks of the Yellow River, the Yellow River Conservancy

Commission should formulate the annual distribution plan and preliminary scheduling plan of trunk water flows of the Yellow River in October each year. The annual water resources distribution shall be performed from July to June next year; the annual trunk water resources regulation shall be performed from November to June next year.

The Plan for Annual Distribution of Water Supplies and Scheduling of Water Supplies in Trunks of the Yellow River actually provides more details for the “87” water distribution plan in which the annual water consumption control is replaced by monthly water consumption control in order to further enhance the control over water utilization in various provinces (autonomous regions and municipalities) along the Yellow River. Objectively, it makes major contributions to alleviating the stop of flows of the Yellow River.

Table 3-2 Monthly Distributions of Water Supplies of the Yellow River in a Year with Normal Water Flows

Unit: 100m<sup>3</sup>

Item	Qinghai	Sichuan	Ganshu	Ningxia	Inner Mongolia	Shaanxi	Shanxi	Henna	Shandong	Hebei Tianjin	Total
July	1.76	0.03	4.04	6.59	8.62	3.95	4.46	5.58	2.56		37.61
August	1.73	0.03	3.22	3.44	2.49	4.41	5.67	6.77	3.64		31.41
September	0.85	0.03	1.84	0.97	7.39	1.78	2.94	4.49	6.11		26.40
October	1.29	0.03	2.33	1.03	11.40	2.39	0.76	3.66	5.47		28.34
November	2.24	0.03	3.34	3.89	0.52	3.45	3.06	1.55	2.17	5.00	25.25
December	0.17	0.03	0.37	0.09	0.54	2.91	2.24	1.05	5.32	5.17	17.88
January	0.17	0.03	0.37	0.09	0.54	2.47	2.04	1.16	1.31	5.17	13.35
February	0.17	0.03	0.33	0.09	0.48	1.88	1.20	4.10	4.34	4.67	17.29
March	0.79	0.03	2.47	0.09	0.54	4.34	6.21	6.59	12.39		33.45
April	1.14	0.03	2.64	3.28	0.83	4.11	5.75	5.87	13.31		36.97
May	1.97	0.03	4.84	11.44	14.38	2.41	4.81	6.76	9.29		55.93
June	1.82	0.03	4.60	9.00	10.88	3.91	3.97	7.81	4.10		46.13
July to October	5.64	0.14	11.43	12.03	29.90	12.53	13.82	20.50	17.78		123.77
November to June next year	8.46	0.27	18.97	27.97	28.70	25.47	29.28	34.90	52.22	20.00	246.24
Annual total	14.10	0.40	30.40	40.00	58.60	38.00	43.10	55.40	70.00	20.00	370.00

### 2.1.2 Further details of water resources distribution plan

The “87” water distribution plan of the State Council only specifies the total quantities of provinces and regions but does not indicate those for trunks and main tributaries. Therefore, more details are required for trunks and tributaries and various cities. The detailing of total water flow controls of the Yellow River is the base for refined management of water resources the Yellow River. The Commission and the departments of water resources of various provinces (regions) along the Yellow River always attach great importance to the detailing work of total water flow controls and actively establish the local “red line” system for the development, utilization and control of water resources of the Yellow River. Various provincial and regional governments have approved the detailing plans of total water flow controls of the Yellow River according to the “87” water distribution plan under coordination of various relevant entities along the drainage basin. As such, the local details (city, Zhou and Meng) of water consumption indexes of each province (region) are established and the control indexes of trunks and tributaries are also determined.

The detailing plan of total water use control of the Yellow River is formulated according to nine principles, i.e. total quantity control principle, sustainable utilization principle, no-reservation principle, legal water consumer priority principle, stringent control of water quotas of trunks, coordinated control of water quotas among upper, middle and lower reaches, matching of water resource configuration and relevant plan, consideration of provincial (regional) demand for water resources for economic construction, full consideration of provincial (regional) opinions and other principles.

The promulgation of the detailing plan of total water usage control will be good for the layered control of total water flows and hence effectively restrict the rapidly growing demands for water of the Yellow River, avoid imbalance of regional water resource distribution and settle the conflicts between various provinces (regions) for water supplies. It will also be good for transfer of water rights, the uniform management of the drainage basin and the region and the collective allocation, scheduling and management of water resources of the Yellow River. The implementation of the detailing plan of the local water usage control indexes will make it easier to identify the conflicts between the actual water usages and the plans of various cities, provinces and regions and hence help to adjust and improve the “87” water division plan.

## 2.2 Features of the water resources distribution plan

As the water supply distribution plan implemented before the south-to-north water diversion project takes effect, the water supply distribution plan of the Yellow River has the following features:

(1) The highest possible water supply capacity of the Yellow River has been considered in this plan but it still can't satisfy the water demands of various provinces (regions). The probability of construction of large and medium-scale dam projects and their water regulation effects have been considered in the formulation of the plan. Water balancing has been performed for different river sections and the proposed water supply of 37 billion cubic meters is already the highest possible water supply capacity of the Yellow River during a year with normal water supply.

(2) This water resources distribution plan already reserves an ecological water use of 21 billion cubic meters for sediment transport along the water course. It plays an important role in maintaining the flood relief and sand transmission capacity and the sound water ecology and water environment of the river course.

(3) The water flow quotas distributed to various provinces (regions) as specified in this water resources distribution plan refer to the maximum consumption of water from the Yellow River by various provinces (regions) during a year with normal water resources. This consumption index includes the total consumption of water from the trunk and tributaries of the Yellow River. Water consumptions indicated in this plan refer to the water flows acquired from the Yellow River minus the flows back into the trunk and tributaries of the Yellow River. To the Yellow River, it refers to the water flows that are actually lost and can't be returned to the river.

(4) Compared with the approved water resources distribution plan, there is one more detailed allocation plan which provides details about the water flows distributed to different trunks and main tributaries and to different water consumers of different provinces (regions and municipalities). This detailed plan is somewhat significant to the control and management of total water flows before the provincial (regional) detailed plans are released.

The "87" water resources distribution plan of the Yellow River makes the Yellow River the first river whose water resources are fully allocated in China and it well promotes the planned water use and water saving in various provinces and regions in the Yellow River Basin. This allocation plan also becomes one of the most fundamental criteria for the uniform control of water resources of the Yellow River and plays a highly significant role.

(1) It lays the foundation for establishment of the water right distribution system of the drainage basin and provides the base for settlement of conflicts between various provinces (regions) in water usage and the control of total water consumptions.

(2) It creates favorable conditions for the subsequent uniform management of water resources in the drainage basin and plays an important role in reasonably distributing the water source projects and promoting the water usage planning and water saving in various provinces (regions).

(3) The mode of organization, coordination and approval of water resources distribution of the Yellow River becomes a good reference for the water resources distribution of other rivers that cross different provinces (regions). The drainage basin administration is liable for the formulation of the water resources distribution plan of the Yellow River and the governmental organs of relevant provinces (regions) participate in the formulation process. Relevant authorities of the State Council solicit opinions from relevant parties and perform the organization and coordination job too. The State Council gives the final approval. This mode reflects one basic principle, i.e. water resources are state-owned. It also balances and protects the interests of different provinces (regions) and gives full rein to the role of the drainage basin administration in organization and coordination. The mode of organization, coordination and approval of water flow distribution of the Yellow River is the same as the one specified in the Water Law revised in 2002.

(4) It allows various provinces (regions) that use water resources from the Yellow River to clarify their respective rights and interests in the use of the Yellow River and hence becomes the base for them to formulate their respective national economic development plans.

### **2.3 Implementation of water resources distribution plan**

Regarding the implementation of the water resources distribution plan and according to the water consumption statistics of various provinces (regions and municipalities) in the past ten years, the actual water consumptions of Qinghai, Ganshu, Ningxia, Inner Mongolia and Shandong provinces all exceeded their respective annual quotas. In particular, the actual water consumptions of Inner Mongolia and Shandong provinces exceeded their quotas by over 1 billion cubic meters. Judging from the results of annual implementations, Ganshu and Ningxia provinces both exceeded the annual quotas in all the years while Qinghai, Inner Mongolia and Shandong provinces exceeded their annual quotas in most of the years.

Regarding the distribution of water resources along the trunk, the annual scheduling plan distributes the water resources along the trunk during non-flood period (November to June next year). Before 2001 – 2002, the river section of the trunk subject to scheduling included the section from Liujiaxia to Toudaoguai and from Sanmenxia to the river mouth and the involved provinces and regions included Ganshu, Ningxia, Inner Mongolia, Henan and Shandong provinces. From 2001 – 2002,

the river section from Toudaoguai to Sanmenxia on the middle reaches were also included in the uniform scheduling and the Shaanxi and Shanxi provinces were also included in the scope of scheduling. After promulgation of the Regulation on Scheduling of Water Flows of the Yellow River in 2006, the river sections subject to scheduling are further extended upstream to Longyangxia and Qinghai Province was further included.

Regarding the control of water consumptions in the trunk during non-flood seasons, statistics show that the actual water consumption exceeded the annual quotas in three of the thirteen years subject to uniform scheduling, i.e. 2001-2002, 2002-2003 and 2008 – 2009, registering a surplus of 1.86%, 5.19% and 2.33% respectively. In these three years, the Yellow River suffered a particular drought year in 2001-2002 and 2002-2003. Severe droughts occurred along the drainage basin in 2008-2009, resulting actual water consumptions being higher than the annual quotas. The water consumptions were below the annual quotas in other years though.

### **3. Water resources regulation in the Yellow River Basin**

#### **3.1 Evolution of water resources regulation**

(1) Hard beginning period (before end of June 2002)

The first regulation order was issued on March 1, 1999 to formally launch the uniform regulation of water resources of the Yellow River. The Yellow River is the first major rivers subject to comprehensive regulation of water resources in China. Through this phase of the regulation work, a monthly and quarterly water resources regulation system is established initially; real-time regulation is implemented; water resources regulation supervision is initially launched to basically guarantee the water supplies for urban and rural living and industrial and agricultural purposes, particularly during the critical period of farmland irrigation. As such, the water resources of the Yellow River remained uninterrupted for three years after 2000, marking an initial reversal of the unfavorable condition of dry-up in the lower reaches of Yellow River every year and creating sound social benefits.

Through the regulation work, a complete water resource management system comes into being and teamwork with provinces (regions) and reservoir administration is initially established, hence ensuring the healthy development of the water scheduling work.

In 2000, the Yellow River Conservancy Commission further proposed the working concept of “creating new situations in the regulation work of water resources of the Yellow River based on higher water resource utilization ratio and in economic and technical methods” on the basis of the previous guideline of water resources regulation, i.e. “meticulous forecast, meticulous scheduling, meticulous supervision

and meticulous coordination". It also established the water resources allocation research team and the Yellow River water resources regulation system development leadership panel to research on the optimized allocation of water resources and the development of the water flow scheduling system of the Yellow River. It strengthened the negotiation and communication with various provinces and regions, established a contact person system and strengthened industrial management. On the basis of considerable regulation practices, it strengthened water use management and supervision, improved the assurance measures, set up a water resources regulation joint discussion system and formulated and promulgated the Measures for Management of Water Supply on the Lower Reaches of the Yellow River and the Responsibility System for Water Resources Regulation Work on the Lower Reaches of the Yellow River in order to standardize the regulation management work.

At this phase, the Yellow River had a severe lack of water resources. Through a series of robust and effective measures, water supplies to relevant provinces and regions within the Drainage Basin were basically guaranteed and the sixth transmission of water from the Yellow River to Tianjin was also successfully completed.

#### (2) Innovation and development period (July 2002 to June 2006)

The period from July 2002 to June 2006 is the phase of innovative development for the water resources regulation of the Yellow River and it is a very important period of development that guides the water resources regulation work of the Yellow River towards modernization and also an interim period leading to advanced regulation. The goals of this phase include: ensuring non dry-up of the Yellow River; alleviating the conflicts between water supply and demand in the drainage basin of the Yellow River; promoting fair utilization of water in various regions and by various entities; gradually implementing the "87" water distribution plan of the State Council; and continuously improving the level of water resources regulation of the Yellow River.

The comprehensive water resources regulation of the Yellow River is characterized by many points along a long distance of regulation and has such problems as incomplete management information, poor real time and reliability and backward technologies of information transmission and management. Therefore, conventional scheduling methods can hardly satisfy the requirements on time efficiency and modernization of the scheduling work. In order to improve the scheduling methods and the level of scheduling management and guide the scheduling work towards high technology, informatization and modernization, advanced and mature information technologies were fully utilized to aggressively promote the development of the Yellow River water resources regulation management system according to the principle of "state-of-art, practical, reliable and efficient" within the general framework of "digital Yellow River". The development and use of the Yellow River water resources



regulation management system marks the beginning of scientific and refined regulation of water resources of the Yellow River.

(3) Standard management period (from June 2006 until today)

In 2006, the State Council promulgated and implemented the Rules on Water Resources Regulation of the Yellow River as the legal base for regulation of the water resources of the Yellow River. In 2007, the Ministry of Water Resources further promulgated and implemented the Detailed Implementation Rules (Trial) for this to increase its operability. In 2008, the Commission revised the 2003 Regulations on Response to Emergencies of Water Resources Regulation of the Yellow River. In the same year, the Yellow River Flood and Drought Prevention Command Office promulgated the Preliminary Plan for Drought Prevention in the Drainage Basin of the Yellow River to further improve the emergency water resources regulation mechanism of the Yellow River. By then, the legal base for water resources regulation of the Yellow River was basically established. The promulgation of such Rules on Regulation of Water Resources of the Yellow River and its detailed implementation rules marks a new phase when the water resources regulation of the Yellow River has the legal base. On the one hand, there are complete legal means for more stringent regulation of water resources of the Yellow River. On the other hand, there are higher mandatory legal requirements on the regulation of water resources of the Yellow River.

### **3.2 Features of water resources regulation rules**

The Rules on Water Resources Regulation of the Yellow River is the first law on the regulation of water resources of major rivers in China and it plays an important role in scientifically managing water resources regulation work of the Yellow River and becomes a model for the comprehensive Water resources regulation of other drainage basins.

The Rules on Water Resources Regulation of the Yellow River consists of 43 articles in 7 chapters. It specifies the responsibility system and coordination/negotiation system for water resources regulation of the Yellow River, the reporting and announcement system for implementing conditions water resources regulation of the Yellow River, the control system of total water use and section flow, the emergency water resources regulation system and the plan declaration and information reporting system. This document and the supporting documentation are useful primarily in the following aspects:

(1) Clarify the scope of regulation and management of water resources of the Yellow River

After promulgation of this document, the geographic scope of the regulation and

management of water resources of the Yellow River covers Qinghai, Sichuan, Gansu, Ningxia, Inner Mongolia, Shaanxi, Shanxi, Henan and Shandong provinces in the drainage basin as well as Hebei Province and Tianjin which were approved by the State Council to obtain and use water resources from the Yellow River. The year of regulation shall start from July 1 until June 30 the next year. It also clarifies that the period of regulation shall be the full year instead of just the non-flood period.

(2) Determine the principles for water resources regulation of the Yellow River

After promulgation of the document, the principles for water resources regulation of the Yellow River are as follows: prevention of dry-up; dual-control and layered management of and layered responsibility for total water consumption and section flow; order of priority for use of water, i.e. urban and rural living water demands are preferentially satisfied compared and agricultural, industrial and ecological water demands are reasonably arranged.

(3) Rationalize the water resources regulation management system and the organizational and assurance system

The document specifies that the water resources regulation management system shall comprise the central management organ and the local management organs and also the division of labors between them. It also specifies and duties and authorities of the State Development and Reform Commission, the Ministry of Water Resources, the Yellow River Conservancy Commission (hereinafter referred to as the Commission), relevant local governments and water administration in the formulation and issuance of water resources regulation plan, annual water resources regulation plan, monthly and quarterly water resources regulation plan and real-time orders. It also clarifies the authorities and duties of various provincial people's governments and the Commission and the Henan and Shandong Provincial Yellow River Affairs Bureaus regarding the regulation of key reservoirs along the trunk and tributaries of the Yellow River.

(4) Establish the legal status of the Yellow River water resource distribution plans

According to Article 7 of the document, the Yellow River water resources distribution plan approved by the State Council is the basis for water resources regulation of the Yellow River and must be implemented by relevant local governments, the Commission and its subordinated organizations. Meanwhile, Articles 7 and 9 specify the formulation and revision procedures of the Yellow River water resources distribution plan. To formulate or revise the plan, the Commission and the governments of eleven provinces (regions and municipalities) shall discuss and submit their proposals to the State Development and Reform Commission and the Ministry of Water Resources for their review and finally send to the State Council for approval.

(5) Clarify the regulation mode and address the problem of formulation procedure of regulation plan

According to Article 10, annual water resources regulation plan, monthly/quarterly water resources regulation plan and real-time regulation orders are combined together for regulation of water resources of the Yellow River.

(6) Establish an emergency water resources regulation system to prevent stop dry-up of the Yellow River

The document specifies the conditions for emergency water resources regulation and the preliminary plan and measures for water resources regulation in case of drought or other emergencies.

(7) Specify stringent supervision and inspection and the legal responsibilities associated therewith to ensure the realization or implementation of regulation orders.

In order to prevent violation of the principles of “fair, equal and open”, it establishes stringent supervision and inspection and the legal responsibilities associated therewith. Firstly, it specifies that the Commission should regularly report about the implementation of water resources regulation of the Yellow River to the 11 provincial water resources authorities and reservoir managers or operators and open them to the public in a timely manner. This is the way the implementations are supervised by the public and the stakeholders. Secondly, the mode and scope of patrol supervision and inspection of the main water entries and exits of reservoirs are improved. Thirdly, violators of the water resources regulation disciplines shall be punished administratively. Fourthly, those who violate the water resources regulation rules or undermine the order of water resources regulation shall be punished administratively and even called for criminal responsibility.

### **3.3. Water resources regulation process**

#### **3.3.1 Water resources regulation principles**

General principles of water resources regulation of the Yellow River: total quantity control, demand-based supply, management at different levels, responsibility for different levels, annual distribution of water resources and preliminary regulation of water resources of the trunk.

Principles of water resources distribution of the Yellow River: the annual water quotas of various provinces (regions and municipalities) shall be adjusted proportionately in line with the rainfall conditions, i.e. the quotas are distributed according to the available water supplies approved by the State Council in 1987 and the ratios of various provinces (regions and municipalities) and reduced

proportionately in a drought year.

Principles for water resources control of trunk of the Yellow River: the water consumptions of various provinces (regions and municipalities) shall be controlled based on two indexes, i.e. river section total water consumption and boundary section downward water resources.

### 3.3.2 Main section water resources index

The Detailed Implementation Rules on Water Resources Regulation of the Yellow River specifies the warning flow on the controlled section of the trunk and the minimum flows of tributaries along the sections at provincial boundaries and upon entry into the Yellow River. It also incorporates the warning flows along the sections at provincial boundaries and key controlled sections implemented in the water resources regulation of the Yellow River since 2003 and specifies the minimum flow on controlled sections of key tributaries of the Yellow River and the guarantee ratios thereof. See Table 3-3 and Table 3-4 for details.

Table 3-3 Schedule of Warning Flows along Sections at Provincial Boundaries and Key Controlled Sections of the Trunk of Yellow River

Unit: m<sup>3</sup>/s

Section	Xieheyan	Shizuishan	Toudaoguai	Longmen	Tongguan	Huayuankou	Gaocun	Sunkou	Luokou	Lijin
Prealarm flow	200	150	50	100	50	150	120	100	80	30

Table 3-4 Minimum Flows on Controlled Sections of Key Tributaries of the Yellow River and the Guarantee Ratios thereof

River	Section	Minimum flow (m <sup>3</sup> /s)	Guarantee ratio (%)	River	Section	Minimum flow (m <sup>3</sup> /s)	Guarantee ratio (%)
Yaohe	Hongqi	27	95	Weihe	Beidao	2	90
	Liancheng	9	95		Yuluoping	2	90
	Xiangtang	10	95		Yangjiaping	2	90
	Minhe	8	95		Huaxian	12	90
Fenhe	Hejin	1	80	Qinghe	Runcheng	1	95
Yiluohe	Heishiguan	4	95		Wulongkou	3	80
Dawenhe	Daicunba	1	80		Wuzhi	1	50

### 3.3.3 Water resources regulation process

Water resources regulation of the Yellow River mainly includes four parts: firstly, formulation of annual water resources distribution plan and preliminary plan of trunk

water resources; secondly, formulation and promulgation of monthly/quarterly water resources regulation plans; thirdly, real-time water resources regulation and monitoring; fourthly, operation summary. The period for water resources regulation of the Yellow River is from July to June next year.

(1) Main duties on regulation:

From July to October: water resources regulation and supervision in the trunk of the Yellow River during flood seasons; distribute water resources to various provinces (regions) according to the water discharged of Liujiaxia, Wanjiazai, Sanmenxia and Xiaolangdi Reservoirs so as to prevent cut of flows at various river sections. Cooperate with the Office of the Yellow River Flood Control Drought Relief Command Office to regulate water and sediment.

From November to March next year (February on the lower reaches): formulate and release the monthly regulation plan of water resources of the trunk of Yellow River and regulate the water resources of the trunk of the Yellow River.

From April to June next year (March to June next year on the lower reaches): formulate and release the monthly and quarterly regulation plan of water resources of the trunk of Yellow River and regulate and monitor the water resources of the trunk of the Yellow River.

(2) Main operation process

Phase of preliminary plan formulation: determine the annual available water supply of the Yellow River and distribute it among the 11 provinces (regions and municipalities) along the Yellow River and across all months in the year; receive the annual provincial (regional) water use plans, balance the reservoir operation plans and formulate the preliminary regulation plan of water resources of the trunk of the Yellow River.

Phase of monthly and quarterly (downstream order) plan formulation: receive the various local water use plans, monthly/quarterly reservoir operation plans and downstream water orders; compile monthly and quarterly water regulation plans.

Phase of real-time water resources regulation and monitoring: trace and monitor the water conditions, working conditions, rainfall, drought and water diversion conditions, predict the development trend and keep providing opinions to the leadership for decision-making; supervise reservoir discharges and flows across provincial boundaries; analyze and summarize the provincial (regional) water diversion and back water flows; receive downstream water guide orders; hold negotiations and coordination meetings for different river sections to settle the

conflicts of water supply and demand; supervise and inspect reservoirs and key water diversion mouths.

Phase of plan implementation and summary: check the accuracy of long-term and short-term runoff forecasts; compare and analyze water resources regulation plans; analyze completion of monthly water resources regulation targets; analyze benefits of annual water flow scheduling; make annual summaries of water resources regulation.

### **3.4 Implementation and supervision of water resources regulation**

#### **3.4.1 Implementation of water resources regulation**

Under the correct leadership of the Ministry of Water Resources and with close cooperation and strong supports from various provinces (autonomous regions and municipalities) and dam operators, the Commission has stuck to the scientific development concept, strictly implemented the Rules on Water Resources Regulation of the Yellow River and the Detailed Implementation Rules thereof and taken practical and effective measures to overcome various adverse factors and smoothly fulfilled the water resources regulation tasks of the Yellow River for the year to prevent the dry-up of some sections of the Yellow River for 14 years running, avoid warning flows on the trunk of the Yellow River for eight years running and basically guarantee the required discharge flow of reservoirs and along the section of provincial boundaries. In 2012, the flows of various controlled sections of key tributaries all satisfy the minimum guarantee ratio of flows for the first time, hence guaranteeing the sufficient supply of sediment transport and ecological water use and fulfilling the emergency water resources regulation duties, i.e. diversion of water from the Yellow River to Tianjin and Hebei Province. Downstream ecological water resources regulation is continued on the lower reaches of the Yellow River and flow passage is fully ensured at Diaokou for the fourth time.

Implementation of trunk water flow scheduling plan: judging from the annual averages since the comprehensive regulation in 2006, the annual regulation plans have been well implemented at the main sections of the trunk and the mean discharge flow deviates from the goal within 10% at various sections during non-flood periods. Except for the section at Lijin, the total discharge flow is controlled within an error of 5% at all the sections. In particular, it is controlled within 2% at Liujiaxia, Shizuishan and Toudaoguai. The accuracy control standards specified in the Detailed Implementation Rules (Trial) are well implemented at various controlled sections.

Implementation of water resources regulation plan for controlled sections at provincial boundaries: among the controlled sections at provincial boundaries, the

monthly average discharge falls below 95% of the goal at all the sections during peak periods of water consumption and the flood period except that the monthly average discharge is not below 95% of the goal at Xiahe section.

Implementation of water flow scheduling plan for controlled sections of reservoir: the preset goals of water flow scheduling at tributaries are basically satisfied. From July 2011 to June 2012, the flow rate at various controlled sections of key tributaries all satisfy the minimum flow rate guarantee ratio for the first time.

### 3.4.2 Water resources regulation effects

Since the comprehensive regulation of water resources of the Yellow River, significant achievements have been made through comprehensive regulation and scientific allocation, including absence of dry-up of the Yellow River for 14 years after Sept. 1999, harmony between the human beings and water, sustainable development of the economy in the drainage basin and relevant regions and safety of water supply for domestic, industrial and agricultural purposes in the drainage basin.

(1) After comprehensive regulation, the dry-up of some sections of the Yellow River since the 1990s came to an end and the sediment transport and water transmission on the lower reaches of the Yellow River was effectively increased. It effectively inhibits the shrinkage of courses of the Yellow River and plays an important role in maintaining the health of the Yellow River; (2) since the comprehensive regulation, the Commission has collectively managed and distributed the water resources to various regions and users according to the Water Law, the Rules on Water Resources Regulation of the Yellow River, the Detailed Implementation Rules (Trial) and other laws. As such, the Yellow River available water resources distribution plan approved by the State Council in 1987 was further implemented; the trend of excessive water use by various provinces (regions) was collectively inhibited and the water demands of other provinces (regions) were satisfied; (3) the ecological environment in the drainage basin, particularly in the delta region at the river mouth, was improved; the harmony between the human beings and nature were gradually recovered; the 200sqkm wetland at Hekou which had been damaged by the dry-ups was recovered; the growing conditions of phytoplankton and the living environment of fishes near the river mouth were improved; the offshore ecological system near the mouth of the Yellow River started to recover; (4) it promoted the development of a water-efficient society; restricted the water use of provinces (regions) that had excessive water consumptions through comprehensive regulation and water management according to laws; urge various provinces (regions) to take measures in water saving and industrial re-structuring so as to increase water utilization efficiency, restrict the development of big water consumers, adjust agricultural structure and reasonably adjust water supply price; classified water prices were also established to

promote the development of a water-efficient society; (5) comprehensive water resources regulation also facilitated the establishment of the water right market. Facing the restrictions of water quotas of the Yellow River, some provinces (regions) took water-saving measures during economic development and transferred the residual water quotas to industrial projects, hence adjusting the water rights of industrial water and agricultural water and promoting the exchange of water rights and the development of a water market; (6) the comprehensive regulation came up with significant economic, social and ecological benefits and also a series of experiences in the uniform administration and regulation of water resources in the drainage basin. It also became a reference for the water resources regulation work of other rivers that lack water resources and would effectively promote the optimized allocation and utilization of water resources in North China where water resources are short.

#### **4. Existing problems**

##### **4.1 New situations faced on water resources distribution**

###### **(1) Decreasing water resources of the Yellow River**

Due to climatic changes and human activities, the water resources of the Yellow River have undergone vehement changes in recent years, including changes in flow generation and convergence features and decline in the amount of surface water. In 2010, in its approval of the national plan on water resources, the State Council proposed the controlling of the total water resources within 670 billion cubic meters by 2020 and 700 billion cubic meters by 2030. In this plan, the total water resources of the Yellow River decreases from the 58 billion cubic meters approved in the “87” water distribution plan by the State Council to 53.5 billion cubic meters today, i.e. down by 4.5 billion cubic meters and registering a trend of decline while the total water consumption of various provinces and regions in the drainage basin tends to increase. The ecological water use and its development trend are not considered though

###### **(2) Continuous increase of water use along the Yellow River**

With the fast social and economic development, the rigid water demands have grown rapidly along the Yellow River. Compared with 2003, the total water supply increased by about 10 billion cubic meters in 2012, including an increase of water supply from outside the drainage basin by 2 billion cubic meters. More and more provinces (regions) are approaching, reaching or even exceeding the annual water quotas. With the continuous economic and social development in the drainage basin of the Yellow River and relevant regions, the conflicts between water demand and supply will become aggravated in the Yellow River Basin. Water resource management of the Yellow River will face new bottlenecks and such conflicts between water supply and demand will be unprecedented. This is the new



bottleneck and challenge common to the Commission and the provinces (autonomous regions). According to the national plan on water resources, the total shortage of water will be 10.65 billion cubic meters and 13.84 billion cubic meters for the national economy within the drainage basin in 2020 and 2030 respectively.

### (3) Emphasis on combined regulation of surface water and groundwater

The “87” water distribution plan only distributes surface water resources of the Yellow River and proposes the maintenance of current utilization of groundwater. However, it does not indicate rigid indexes on the extraction of groundwater so that there is no quota for the drainage basin. The mode of development and utilization of water resources has changed in various provinces and regions so that the water circulation process is affected in the drainage basin. In particular, the water extraction on the banks of the Yellow River has changed the exchange relations between the surface water and the groundwater. According to estimations, the mining of groundwater within the drainage basin has usurped about 3 to 4 billion cubic meters of groundwater and becomes one of the main reasons for declining surface water resources. According to the second national general plan of water resources, the groundwater resources amount to 37.6 billion cubic meters in the drainage basin and there are frequent exchanges with the surface water, leading to repeated amount of 26.4 billion cubic meters. Therefore, joint distribution of surface water and groundwater will be increasingly emphasized.

### (4) Changes in targets of water resource distribution

In the “87” water division plan, the water resource capacity of the Yellow River and the living and production water usage are primarily considered. Only the water in the outside the river course is coordinated for ecological purpose and the ecological and environmental water demand in the river course is not specified. With the major changes in the national strategic development structure, the development of water ecological civilization and the increasing vulnerability and massive aggravation of ecological environment of the Yellow River, maintaining the basic ecological water supply required for the health of the Yellow River is receiving greater emphasis. Therefore, it is necessary to satisfy necessary ecological water demands and perform ecological water regulation other than regulation of domestic and production water use in the drainage basin in the future.

### (5) Considerable changes in the structure of regulation work

Phase 1 project of the eastern line of the south-to-north water transmission project will be formally launched in the middle of November 2013 and the principal work of the middle line has been completed and accepted and was ready for launching in late September 2014. With the launching of the middle and eastern lines of the project in 2014, the shortage of water resources in various provinces and regions along the Hai

River and Huai River will be partially alleviated and the water demand and supply conditions will change within the regions subject to the Yellow River, including Hebei and Tianjin, hence changing the water resource distribution structure of the project that guides the Yellow River water to Tianjin and Hebei Province. As there are significant conflicts between water supply and demand in the drainage basin of the Yellow River and a certain amount of water shall be guaranteed particularly for the arid and desolate regions in the northwest of China, the water resources of the Yellow River shall firstly satisfy the living and production needs of the drainage basin and the treatment of the desolate deserts in the northwest of China. Considering the impacts of the south-to-north water diversion project on the subject regions, it is necessary to appropriately adjust, rationalize and improve the “87” water distribution plan of the Yellow River.

Moreover, the launching of such water diversion projects across different drainage basins, e.g. the project to guide Han River water to Gansu Province and Hongyan River to Shitou River will also affect the water resources distribution structure of relevant provinces and regions along the Yellow River.

#### (6) Changes in sediment-carrying water flows

The remaining 21 billion cubic meters of water is left for carriage of sediment and maintenance of river course stability in the “87” water distribution plan. However, the river sedimentation conditions have changed significantly and flood flows declined substantially since the Xiaolangdi Reservoir was put into operation in 2000. As a result, the downstream river courses have been subject to water erosions every year and the riverbed sinks without sedimentation. The depth of river course has increased by 2m and 1m on the average respectively in the section in Henan Province and the section in Shandong Province respectively so that the flood prevention conditions have changed historically. On the lower reaches of the Yellow River, Xiaolangdi Reservoir has regulated the sediment and sludge for multiple years and floods are utilized to discharge sediment. Through improvements of conditions on both banks, a highly-efficient sediment passage has been established. It can reduce the water needed for sediment transport and hence the saved water can be allocated for other purposes. As such, it will affect the readjustment of the water distribution plan of the Yellow River.

#### **4.2 Inadequacy in water resources regulation**

The comprehensive regulation of water resources of the Yellow River realizes continuous flow of water in the Yellow River for 14 years since September 1999, supports the sustainable economic development in the drainage basin and relevant regions, guarantees the safety of domestic, industrial and agricultural water supplies within the drainage basin, brings significant social, ecological and economic benefits

and accumulates experiences for the water resources management and regulation of rivers that lack water resources. It is also worthy to note that much still need to be improved on the comprehensive regulation system, administration and support in order to realize the long-term safety of the Yellow River.

(1) Measures on water resources regulation to be further improved

Administrative measures are still the main measures for comprehensive management and regulation of water resources of the Yellow River while the legal, economic and technological means are still rather backward. Although administrative measures have played an active and effective role at certain phases, they are no longer applicable for the current market-oriented economic conditions because they have a high degree of elasticity and are highly artificial. The legislation is rather backward and regulations are incomplete in the drainage basin. The water pricing mechanism that adapts to the rules of a market-oriented economy is not yet established and excessively low water prices affect the water resources regulation to a certain extent too.

(2) Water resources regulation for tributaries to be further regulated

Since the promulgation of the Implementation Rules (Trial), achievements have been made in the water resources regulation of some tributaries. However, the current problems are not fundamentally solved, including unregulated water use, insufficient supervision, incomplete mechanism, unclear duties, inappropriate management and weak basic researches on some tributaries, due to a severe lack of water metering facilities and short regulation period. It is hard to share and coordinate the water information. The supervision system is not yet established. Emergency response is slow. It is still difficult for regulation and management of tributaries and that severely restricts the further implementation of the tributary water resources regulation work. The water division indexes of various provinces (regions) specified in the "87" water distribution plan refers to the total index of trunk and tributaries but only the trunk is subject comprehensive regulation today. There is no index control for the water diversion of tributaries and therefore the total quantity control requirements can hardly be satisfied. As such, comprehensive regulation of water resources of the Yellow River is not implemented in a real sense and data are not enough for implementation of the water division plan approved by the State Council.

(3) Excessive water consumption to be avoided in the Yellow River Basin

The drainage basin of the Yellow River lacks water resources and the conflicts between water supply and demand are severe. With the implementation of a series of preferential agricultural policies by the Central Government, farmers have greater initiatives to plant crops. The areas of crop planting have been blindly expanded in some provinces (regions), particularly the planting areas of crops that consume

massive water, so that there have been continuously increasing demands for water. With the economic development in the Yellow River Basin, the demands for industrial water have gradually increased. In some dry provinces (regions), the Yellow River is also utilized to develop tourism, hence further widening the gap of water supply and aggravating the conflicts of water supply and demand.

Since the comprehensive regulation of water resources, the excessive consumption of water in some provinces (regions) has been inhibited although the goals specified in the water division plans of various provinces (regions) approved by the State Council in 1987 are still not yet satisfied and excessive water consumption still exists on the upper reaches, which affects the implementation of the State Council's water division plan. Therefore, it is necessary to strengthen uniform management of water resources. Meanwhile, it is proposed that relevant provinces (regions) should correctly understand the preferential agricultural policies and understand the current shortage of water in the drainage basin of the Yellow River. The water resource capacity shall be fully considered while planning the planting area and it is necessary to reasonably determine the scale of planting, improve the structure of planting, control the planting areas of crops that consume massive water, strictly forbid rashly construction of landscapes with an extensive water area, further strengthen the development of a water-saving society and ensure the effective implementation of the "87" water distribution plan according to the principle of total quantity control.

(4) Combined allocation and regulation of groundwater and surface be implemented as soon as possible

Groundwater management is rather weak in the drainage basin of the Yellow River. Excessive extracting of groundwater has caused severe environmental and geological disasters. Meanwhile, it also snatches away the river runoffs so that there is a loophole in the total quantity control and management. Therefore, controlling and managing surface water of the Yellow River alone can no longer satisfy the goal of monitoring the water resources development and utilization and sustainable utilization of water resources.

For the uniform allocation of groundwater, it is necessary to reasonably determine the controlled scale of groundwater mining. For that purpose, it is necessary to firstly allocate the groundwater within the drainage basin and consider the exchanges with the surface water. It is necessary to establish a perfect groundwater monitoring network, formulate the corresponding system and policies for total quantity control of groundwater development and utilization, master the dynamic conditions and ensure the balance of extracting and recharging of groundwater, reasonably allocate and regulate river runoffs according to the regulation and supervision of the water resources at the section of provincial boundaries on tributaries that cross different

provinces (regions) and hence realize the joint allocation and regulation of groundwater and surface water.

(5) Basic research and technical means can't satisfy the needs for water resources management and regulation of the Yellow River

Water resources management and regulation of the Yellow River involves a multitude of parties and complicated relations but the basic researches are comparatively weak, e.g. the researches on the rules of conversion between surface water and groundwater, the basic water quantity required to maintain the life of a river, the water resources and water environment capacity, the rules of water generation and consumption of typical tributaries in the drainage basin and the development trend. Moreover, there are still many difficulties and challenges to avoid functional stop of flows of the Yellow River.

In response to such problems as incomplete management information, low timeliness and reliability and backward information transmission and management technologies during water resources regulation, the Commission has facilitated the development of the Phase I project of "Digital Yellow River", i.e. the water resources regulation and management system of the Yellow River, in recent years. Preliminary achievements have been made although the information base is still poor and the decision-making support system is incomplete for the comprehensive regulation of the Yellow River. In particular, the flood-period runoff flow rate forecast system is not yet established and the existing water flow allocation and regulation model is characterized by oversize management granularity or excessively small range of application. The existing water resources regulation service system is designed for emergencies and therefore its scope of coverage can not satisfy the operation requirements. Therefore, it is necessary to speed up the development of the Phase II project of the Yellow River water resources regulation system and further enhance the ability and technical level of the supervision of the Yellow River's water resources regulation work.

#### **IV. GWP's Role in Water Resources Regulation in the Yellow River Basin**

In 1996, the Global Water Partnership (GWP) was established under the support of the UN organizations. It is an international network open to all organizations involved in water resources management, including the governmental organizations of developed and developing countries, UN organizations, bilateral and multilateral development banks, professional associations, research institutions, nongovernmental organizations and private sectors. In November 2000, the Technical Advisory Committee of China Region of GWP (GWP China) was established with supports from relevant water authorities in China. Since its establishment, GWP China has established four provincial water partnerships in Fujian, Hebei, Shaanxi and

Hunan provinces and one river basin water partnership, i.e. the Yellow River Water Partnership.

GWP China fully utilizes its advantages and features as a cross-industrial and trans-departmental international NGOs to set up a platform and organize many activities on IWRM and the GWP China Yellow River also organize activities on Yellow River water resources management including the water resources regulation of the Yellow River. The achievements and impacts mainly include:

### **1. Actively establish partnerships with various organizations**

GWP China has continuously developed its network. So far, it has established formal partnerships over 100 water-related authorities and entities, including governmental organizations, public institutions, large-size enterprises, social organizations, research institutions, universities. Various partners can share their information and experiences that effectively promote the IWRM concept at all levels.

It has also further consolidated and strengthened contacts with the Ministry of Water Resources and other governmental authorities, including the National People's Congress, the Chinese People's Political Consultative Commission, the State Development and Reform Commission, the Ministry of Environment Protection, the Ministry of Health, the Ministry of Housing and Urban-rural Development, the Ministry of Science and Technology, the Ministry of Land Resources, China Meteorological Administration, All-China Women's Federation and other relevant organizations. These contacts have played an active role in promoting the water resources management and Yellow River water resources management and regulation.

### **2. Establish a joint discussion mechanism, actively participate in the water resources regulation in the Yellow River Basin, coordinate with the annual preliminary water resources allocation plan and help promote the smooth implementation of the water resources regulation of the Yellow River.**

Actively participate in the process of water resources regulation of the Yellow River and fully utilize its advantages and features as a cross-industrial and trans-departmental international NGO to establish a regular joint discussion mechanism, set up a coordination and joint discussion platform during the preliminary plan formulation phase, monthly/quarterly plan formulation phase and peak hours of water consumption, organize the governmental authorities, reservoir and irrigation areas operators, social organizations, big water users and the public and promote them to reach an agreement on the annual water use plan.

### **3. Actively establish a dialogue platform for publicizing and discussing the relevant policies on water resource management and water resources regulation**

GWP China and GWP China Yellow River fully utilize its unique advantages as a neutral platform to offer a bridge of communication and cooperation among authorities of different sectors, scientific research institutes, local people and various other stakeholders. GWP China Yellow River holds various types of activities, including roundtable meeting, forum, workshop and on-site dialogue, translate and publish relevant technical reports and collections of theses and promote the IWRM. It also carries out a series of social activities based on the Yellow River issues, including flood prevention and disaster relief, river basin water resources management, formulation of water law and relevant regulations, etc. It has held a dialogue on the implementation of water law and relevant regulations in the Yellow River Basin, a dialogue on the implementation of the Rules on Water Resources Regulation of the Yellow River, a workshop on the explorations and practices of water resources of the Yellow River in the strictest administration conditions of water resources, a high-level forum on allocation and regulation of water resources of the Yellow River, a workshop on the conversion of water rights of the Yellow River, a high-level forum on the protection and maintenance of ecology at the river mouth, a workshop on the efficient utilization and ecological compensation of water resources on the Loess Plateau, a workshop on the treatment of wide river sections and sustainable development of the flood plain on the lower reaches of the Yellow River, etc. It also carries out researches on the hot topics and hard problems associated with the allocation and regulation of water resources in the Yellow River Basin.

GWP China Yellow River held the “workshop on the treatment of wide river sections and sustainable development of the flood plain on the lower reaches of the Yellow River” in April 2006 during which the participants expressed their opinions on basic conditions of the flood plain, downstream river course treatment strategies, flood plain compensation policies, grassroots governmental proposals, etc. The compensation policies proposed for the flood plain area on the lower reaches of the Yellow River have aroused high attention from relevant national authorities.

GWP China Yellow River held the “dialogue on the implementation of water law and relevant regulations in the Yellow River Basin” in December 2006 during which the participants conducted extensive and equal dialogues and discussions on the achievements and experiences of implementation of water laws and regulations in the Yellow River Basin, the necessity for special legislation on the Yellow River Basin, the basic framework of the special regulations of the Yellow River Basin, the achievements and experiences in the legislation on water administration in the Yellow River Basin and issues relating to the formulation of the Yellow River Law. The participants called for the river basin administration to take the leadership in

organizing relevant organizations of the provinces (regions) in the basin to jointly study and facilitate the formulation of the Yellow River Law, strengthen the legal administration of the Yellow River, realize the harmony between the human beings and the Yellow River and provide sufficient water resources to promote the sustainable social and economic development in the Yellow River Basin.

GWP China Yellow River held the “dialogue on the implementation of the Rules on Water Resources Regulation of the Yellow River” in May 2007. Mr. Bjorn, the Senior Network Officer of the GPW, attended the meeting. The meeting called for the water resource administrations to further establish relevant supporting policies and regulations, deepen the implementation of the Rules and hence make greater contributions to the health of the Yellow River and the sustainable social and economic development in the Yellow River Basin.

GWP China Yellow River held the “workshop on the conversion of water rights of the Yellow River” in August 2007 during which all participants unanimously believed that water right conversion provided an effective approach for optimized allocation and efficient utilization of water resources and the economic compensation mechanism is an important support to the realization of water right conversion; the achievements and experiences made in Ningxia Region in water right conversion are very good practices and experiences in the development of a water-saving society. The strong cooperation and support from grassroots users and enterprises are basic guarantees to water right conversion.

#### **4 . Actively participate in the basic work of water resources regulation**

GWP China Yellow River conducted a survey of the water use of some key water consumers, the construction and operation conditions of Xinxiang Baoquan Pumped Storage Power Station, the consumption of industrial water by Ningxia Ningdong Energy and Chemical Base, the consumption of agricultural water by Ningxia Yinchuan Tanglai Channel, the water consumption by farmers in Yaofu Town, Pingluo County, Shizuishan, Ningxia Region and the water-saving work of the irrigation areas on the middle reaches of Hei River and the treatment project of Hei River. It also had a detailed study of the water-saving irrigation mode in various main irrigation areas of China, particularly the irrigation mode in the wheat irrigated areas, the irrigation mode in different climatic conditions and the utilization conditions of various irrigating facilities.

GWP China Shaanxi and Shaanxi Provincial Water Resources Department jointly organized to formulate the water resources distribution plan of main rivers, including Weihe River, Jing River and Han River. On the one hand, it matches the water distribution plan of the drainage basin administration. On the other hand, it establishes the system of control indexes for the development and utilization of



water resources of the five main rivers in Shaanxi Province in order to provide base for implementation of the most stringent water resources management system.

GWP China Shaanxi and Shaanxi Provincial Groundwater Administration and Supervision Bureau jointly performed the basic work for groundwater management legislation. It conducted an in-depth survey in the key areas where groundwater is much developed and utilized, including Xi'an, Baoji, Xianyang, Weinan, Yulin and Yan'an, fully listened to the opinions and proposals of the grassroots water resources organizations regarding the groundwater legislative work of Shaanxi Province, made an in-depth analysis of the status-quo and urgent problems of the groundwater resources management of Shaanxi Province and compiled the initial draft of Regulations on Groundwater Resources Management in Shaanxi Province. It also invited relevant leading officials and experts of the Legislation Office of the Provincial Government, the Agricultural and Industrial Committee and the Legislation Work Committee of the Provincial People's Congress and relevant departments and offices of the Department of Water Resources to attend a workshop on legislation and have an extensive and in-depth discussion on the importance, urgency and feasibility of the groundwater management legislation and the main problems to be addressed through the legislation.

In order to protect and recover the ecological environment in the drainage basin of the Heihe River, promote the integrated management of water resources of the Hei River and maintain the health and life of the river, GWP China Yellow River organized a high-level roundtable meeting for the comprehensive regulation mode of water resources in the drainage basin of the Hei River and the water required for restoration of ecology during which the participants discussed the scientific regulation of water resources of Hei River, improving the water use efficiency and development potentials of water resources of Hei River and the water resources regulation problems and proposals of the Hei River. It was also proposed to facilitate the implementation of the Plan of Development, Utilization and Protection of Water Resources in the Drainage Basin of the Hei River in the meeting. In particular, relevant authorities attached great importance to the essential engineering and non-engineering measures required for regulation.

**5. Fully utilize the information network platform and news media to strengthen information exchanges on water resources regulation laws, regulations, policies, proposals, public participation and water resources regulation experiences.**

Since the set up website by the Yellow River Research Society and the GWP China Yellow River in 2007, it played an important role in publicizing the work results and experiences of the GWP China Yellow River and strengthening internal and external

information exchanges. Through further improving website management, optimizing webpage and column design, strengthening network information management and increasing the utilization ratio of network platform, information load was further increased on the basis of academic exchanges, dialogues and negotiations. Connections to over 10 domestic and international websites are also established based on the information reports. An academic forum was also established to extensively publicize new concepts of and technical achievements in the comprehensive utilization of water resources. Their role as a channel and platform of information publicity, dialog and exchange has been fully utilized.

In order to expand the scope of spreading of the IWRM concept, GWP China has always attached great importance to the publicity via various types of news media. For instance, representatives from the media were invited to attend all the high-level roundtable meetings. CCTV, Xinhua News Agency and other main media filed real-time reports about the events. The People's Daily and other major newspapers also publicized special reports on the roundtable meetings. Various Internet portals also had comprehensive reports about it.

## **6. Actively attend major water events at home and abroad and publicize the achievements and experiences in promoting allocation and regulation of water resources of the Yellow River**

GWP China actively attended the major water events such as World Water Forum, the World Water in Stockholm, the International Yellow River Forum, Yangtze River forum and others; publicized the status-quo of the water resources in the Yellow River Basin, the activities carried out to promote the IWRM and the achievements and work experiences gained. The activities organized by GWP China and Provincial/River Basin water partnerships have attracted the attention from the representatives of international organizations and added value to water resources management in the Yellow River Basin and in China.

## **V. Recommendations for Improvement of Water Resources Distribution and Regulation in the Yellow River Basin**

### **1. Improvement of water resources regulation in the Yellow River Basin**

The general principle for improvement of water resources allocation and regulation in the Yellow River Basin is as follows: focus on increasing the utilization efficiency of the water resources of the Yellow River, set the goal to realize the sustainable utilization of the water resources of the Yellow River and ensure the health and life of the Yellow River, strengthen democratic management, collectively conduct and improve administrative, legal, economic and technological means, improve the management system that combines river basin management and regional

management, strengthen research on optimized allocation of water resources of the Yellow River after launching of the eastern and middle lines of the South-to-North Water Diversion Project and observe the principle of “collective water resources allocation and section flow control by the central government and collective distribution of water quotas and regulation of key water diversion ports and pillar reservoirs” by provincial (regional) governments” to ensure uninterrupted flow of the Yellow River and sustainable development of the regions in the Yellow River Basin and other relevant regions.

### **1.1 System and mechanism**

#### **(1) Improve relevant laws and regulations**

Achievements have been made in many ways in the formulation of laws and regulations on the comprehensive water resources regulation of the Yellow River. However, administrative measures are still heavily relied upon coordination of relations among various parties. It is necessary to facilitate the formulation of applicable laws and implementation plans commensurate with the allocation and regulation of the water resources of the Yellow River to ensure the legislative basis of comprehensive water resources regulation of the Yellow River.

(2) Establish a collective regulation management system for both trunks and tributaries; strengthen the development of a system that combines drainage basin management and regional management; improve the network of monitoring stations of the hydrological conditions of tributaries; strengthen forecast of tributary runoffs; and establish a tributary flow evolution model to promote the implementation and establishment of the collective regulation and management of trunks and tributaries.

#### **(3) Implement scientific and reasonable water pricing policies**

The basis for the water price management system of current irrigation works is the Measures for Administration of Water Supply Prices of Irrigation Works jointly formulated by the State Development and Reform Commission and the Ministry of Water Resources. However, such water prices do not reflect the nature of water as a commodity because they do not have a flexible adjustment mechanism. Therefore, it is necessary to scientifically determine the makeup of water prices of the Yellow River and re-assess the prices of agricultural, industrial and living water supplies according to the Water Resource Industrial Policies and promote the development of a water pricing mechanism that reflects the scarcity of water resources and the costs of water supply.

#### **(4) Improve water use licensing system**

Water use licensing system is the system by which use rights of water resources are distributed. It is necessary to keep improving the water use licensing system of the

Yellow River according to the actual conditions and establish a water use control and adjustment mechanism that fits in with the water resources allocation and regulation system. In order to control total water use, effective measures must be taken to strengthen supervision and management of water use of the Yellow River. It is also necessary to formulate the Measures for Control and Management of Total Water Use of the Yellow River, harmonize the relations between the Yellow River Conservancy Commission and provincial (regional) governments in the licensing of water use, organically align the drainage basin's total water use control to the provincial (regional) water use control and standardize the declaration and approval procedures of water use licensing plan and annual water use plans.

#### (5) Improve water right conversion market

The water right theory and the water right system are being discussed and established. The establishment of the water right system requires the corresponding legal basis. On such basis, it is necessary to explore and improve on the means of water right conversion across sectors and regions and transfer existing Yellow River licensing system gradually to the water right administration system. Water resources are owned by the state. Therefore, the core issue of the water right system is the administration of water resource use right.

To define the type of water rights, it is necessary to clarify the rights of ecological water use, reservoir water and water supply works and specify the registration, certification, de-registration, transfer and chargeable use of water rights other than directly using water works or mechanical water facilities.

It is necessary to observe the "87" water distribution plan of the State Council, strictly implement the water use licensing system and the quotas management system, explore and improve the means to convert water rights across sectors and regions, establish a water right trading platform for the drainage basin and try to break the bottleneck in the water resource management of the Yellow River.

### **1.2 Administrative management**

#### (1) Improve administrative organizations

Increase the capacity of the administrative organizations. As the water resources regulation and management and hydrological authorities of the drainage basin directly implement the water distribution policy, it is necessary to strengthen the development of policies, regulations and procedures of these organizations and increase their level of administration according to laws.

#### (2) Establish an effective coordination mechanism

The negotiation and coordination mechanism is particularly important in the

allocation and regulation of water resources of the Yellow River. The Commission has established a coordination and negotiation mechanism for the allocation and regulation of water resources of the Yellow River. From the long-term perspective, it is necessary to establish a water resources coordination or administration committee equally participated by various provinces, regions and other stakeholders in the Yellow River Basin so that all can discuss and negotiate on major issues relating to water resources distribution, water right transfer, interest compensation and major water disputes of the Yellow River, reach an agreement on water use under certain rules and agree on the punishment measures against violations. The Commission shall be liable for the implementation thereof. On such basis, it is necessary to improve the water use coordination system, clarify the coordination principles and procedures and harmonize the conflicts between water and electricity regulation, between industrial and agricultural water demands, between production and ecological water demands, between different provinces and between different sectors.

### (3) Promote extensive participation by water users

The drainage basin negotiation or coordination system is a macroscopic mechanism of common understanding while the water user participation is the microscopic mechanism of common understanding. It is necessary to actively encourage grassroots users to establish various types of water user organizations and gradually establish the user committees at various levels in the drainage basin so that the users can participate in the water administration work of the drainage basin.

### (4) Strengthen supervision, inspection and rewarding/punishment mechanism

Strengthen the supervision and inspection rights of the regulation division of the drainage basin administration. The drainage basin administration shall implement the annual water resources distribution plan and supervise and check the local water division and distribution conditions. Relevant regulations shall clarify the legal status of the administration in water regulation supervision and inspection and the principle of uniform supervision and separate responsibilities of various provinces. The limits and standards of punishments shall be defined and the drainage basin administration shall have the corresponding punishment rights.

Strictly implement the reward and punishment rules in the measures of water resources regulation management measures. The water quotas of the provinces, regions or entities that use water higher than the quotas specified in the scheduling plan shall be reduced and the excessive water consumption shall be deducted from the quotas in the next one or several months so as to safeguard the authority of the distribution rules. Establish a layered responsibility system of water regulation and an administrative responsibility tracing system and preferentially punish the conducts of

excessive water diversion and concealment of water use. Establish strict punishment measures, including the certification standards and punishments of violating conducts. Award the Yellow River water resources regulation with the corresponding punishment rights. Establish the financial punishment standards for illegal water uses and collect punishment surcharges for excessive water uses.

For the annual implementation of the water distribution plan, the Commission shall strengthen the disclosure mechanism. Severe violations of the water distribution plan and refusals to implement regulation orders may be exposed on the media by the Commission.

(5) Explore for new ways of water resources management

Establish a system for water resources analysis and planning and a warning mechanism for monitoring of water resources development and utilization. Explore ways to “save water, reduce excessive consumption, transfer water rights and enhance effects” where water consumptions reach and exceed the quotas in order to promote optimized configuration, reasonable development, efficient utilization, all-around saving and scientific management of water resources.

### **1.3 More support needed**

(1) Strengthen relevant basic researches on water resources distribution plan in the new situations

Considering the dual effects of climatic changes and human activities in recent years, the water resources of the Yellow River have been declining. Moreover, there have been enormous changes in the demands for water in various provinces (regions) during the implementation of the water resources distribution plan. Meanwhile, the eastern and the middle lines of the South-to-North Water Diversion Project will be operated soon. The water resources distribution of the Yellow River is facing new situations and new problems and requires research on optimized allocation of water resources of the Yellow River after operation of the eastern and the middle lines of the South-to-North Water Diversion Project, establishing details about the water distribution plan of tributaries and improving the water distribution system of the Yellow River.

(2) Conduct relevant basic researches on ecological water regulation

Although no dry-ups has occurred on the lower reaches since the regulation of water resources in the Yellow River in 1999, it is far away from satisfying the requirements on functional continuation of water resources because stringent controls of water consumptions on the upper and middle reaches have to be imposed. It is a systematic project to prevent functional stop of flow of the Yellow River. It is necessary to actively research to determine the applicable flow rate and ensure joint

regulation of water resources according to actual conditions to provide necessary technical supports to prevent functional stop of flows.

(3) Facilitate the modernization of hydrological information forecast and reporting and water resources regulation

Comprehensive regulation of water resources involves a multitude of complicated technical problems and conventional regulation methods are far from satisfying the timeliness and modernization requirements of water regulation. The completed Phase I project that includes an automatic information collection system, a computer network system, a decision-making supportive system and a remote automatic control system of downstream sluices and gates and one fully-functional and technology-intensive modern water scheduling center have played an important role in the water scheduling of the Yellow River. It is necessary to further implement the information strategy for the water resources of the Yellow River, promote the preparatory work for the optic fiber communication project of the Yellow River, the basic information platform project and other key projects, facilitate the development of “digital Yellow River”, strengthen information and resources integration and sharing and conduct cloud computing and other technical application researches. Complete the development of water resources regulation system of the Yellow River and realize one-stop applications. Continue strengthening the emergency response and monitoring capacity in the drainage basin of the Yellow River and improve the warning and forecast system of water, rainfall and heat conditions.

(4) Conduct researches on joint regulation of surface water and groundwater

Surface water and groundwater exchange frequently. The joint regulation of surface water and groundwater can be realized to effectively address the conflicts between water supply and water consumption and reduce the conflicts between ecological water demands and production water demands through adjustment of surface water supply process and groundwater extracting process. Therefore, it is necessary to perform researches on joint regulation of surface water and groundwater, including groundwater level regulation process, underground reservoir backcharging technology, joint regulation of reservoir group and groundwater, etc.

## **2. Future focus of GWP Work**

(1) Carry out survey and study on water resources distribution and regulation

Capitalize on the advantages and features of the GWP as a civil organization to carry out extensive surveys and studies; have equal contacts and dialogues with various industries and sectors having an interest in the distribution and regulation of water resources of the Yellow River, including industrial water users, farmers, irrigated areas administrations and authorities along the banks of the Yellow River; focus on the practical needs for water distribution and regulation of the Yellow River and consider

the actual conditions and features of the drainage basin to have a deep understanding of the local requests and wishes for the distribution and regulation of water resources of the Yellow River, analyze, colligate and summarize relevant information in a timely manner and hence offer the first-hand data for improving the allocation and regulation of water resources of the Yellow River.

(2) Strengthen communication with various organizations and actively promote the regulation of water resources

GWP China fully utilizes its unique advantages as a neutral platform to offer a bridge of communication and cooperation among industrial authorities, scientific research institutions, local people and various other stakeholders. It actively holds various types of activities, including roundtable meeting, forum, workshop and on-site dialogue; invites various stakeholders, including the national and local organizations of water resources, environment protection, health, urban development, agriculture and transportation to establish neutral exchange and dialogue platforms at different levels to discuss on the hot and hard topics of water distribution and regulation, water resources management and policy making from the perspectives of policy, mechanism, system, capital, management and technology with an aim to promote the implementation of water resources regulation across different sectors.

(3) Fully utilize online platform and media to publicize updates of water distribution  
Fully utilize the information network platform to strengthen information exchanges. Extensively publicize the stringent water resources management policies and regulations and the new concepts, technical achievements and updates about water resources distribution and regulation via the official websites of the Commission and the GWP China Yellow River, hence giving full rein to their role as the channel and platform of information spreading, dialogues and exchanges.

Strengthen communication with the news media and diversify the publicity means and expand the scope of influences. Strengthen education and publicity of water distribution and regulation knowledge of the Yellow River through website.

(4) Actively promote the establishment and implementation of regulations

Promote to incorporate the concept of IWRM into the water-related national, regional and local laws and regulations and ministerial regulations and combine it with the stringent water resources management system in China in order to promote the cooperation between various water-related entities and the partnership with non-water-related entities.

Actively promote the monitoring capacity of the Commission and relevant provincial and regional authorities; participate in the formulation of water resources



distribution plans and the detailing thereof; participate in the formulation of various regulations on the distribution and regulation of water resources; actively publicize, promote and facilitate the implementation of various laws and regulations on the distribution and regulation of water resources; coordinate to settle conflicts of interests between water-related organs, between different regions, between countryside and city, between upstream and downstream, between left and right banks, between surface water and groundwater, between external water and local water and between various stages, including water source, waterworks, water supply, water saving, water drainage and pollution treatment so as to promote the smooth annual distribution and regulation of water resources.

(5) Strengthen experience sharing with foreign countries via international platforms. Actively capitalize on the role of GWP China on the international stage, further strengthen contacts with international partners, actively exchange experiences with local and foreign partners on water resources distribution and regulation and further improve the water regulation plan.

Strengthen trainings on IWRM, promote the spreading and practice of the concept IWRM in China, promote the application of the GWP toolbox and better learning from the successful experiences of other parts of the world in IWRM so as to further promote the IWRM practices in China.

## **VI. Conclusions**

### **1. Status-quo of water resources distribution and regulation**

The Yellow River is also the largest source of water supplies for the northwestern and northern parts of China. With merely 2% of the runoffs, it feeds the 12% of population and 15% of arable lands of China within its drainage area and the downstream irrigated area and supplies water to over 50 large and medium-size cities and Zhongyuan and Shengli Oilfields and other key enterprises in the Yellow River Basin. Meanwhile, its water is diverted to far-away regions outside the drainage basin. The water resources of the Yellow River play an important strategic role in the social and economic development of China and provide the basis and guarantee for the sustainable social and economic development in the Yellow River Basin and relevant regions and the implementation of the Grand Development of the West and the Rise of Central China programs.

Under the leadership of the Ministry of Water Resources and with close cooperation and strong supports from various provinces (autonomous regions and municipalities) and dam projects operators, the Yellow River Conservancy Commission has stuck to the scientific development concept, strictly implemented the Rules on Water Resources Regulations of the Yellow River and the Detailed Implementation Rules

thereof and taken practical and effective measures to overcome various adverse factors and smoothly fulfilled the water resources regulation tasks of the Yellow River for years to prevent the dry-ups of the Yellow River for 14 years running, avoid warning flows on the trunk of the Yellow River for eight years running and basically guarantee the required discharge flow of reservoirs and along the section of provincial boundaries. In 2012, the flows of various controlled sections of key tributaries all satisfy the minimum guarantee ratio for the first time, hence guaranteeing the sufficient water supply for sediment transport and ecological water use and fulfilling the emergency water resources regulation, i.e. diversion of water from the Yellow River to Tianjin and Hebei Province. Downstream ecological water resources regulation is continued on the lower reaches of the Yellow River and flow passage is fully ensured at Diaokou for the fourth time.

Since the comprehensive water resources regulation of the Yellow River, harmony between the human beings and water, sustainable development of the economy in the drainage basin and relevant regions and safety of water supply for domestic, industrial and agricultural purposes in the drainage basin have been realized through comprehensive regulation and scientific allocation: the dry-ups in some sections of the Yellow River are avoided and the sediment-carrying water is increased in the river course to better maintain the health and life of the Yellow River; the safety of water supply for the national economy is guaranteed through legal water supply and scientific allocation; ecological environment in the drainage basin particularly the delta region, is improved and the harmony between the human beings and nature is gradually recovered; the development of a water-saving society is promoted; distinctive economic results are achieved through comprehensive water regulation; comprehensive water regulation accumulates experiences for the management and regulation of water resources in rivers with water shortage.

However, there are still some weaknesses in the comprehensive regulation of water resources, e.g. measures for water resources regulation needs to be further improved; excessive water consumption needs to be avoided in the Yellow River Basin; tributary water regulation has a poor basis and therefore needs to be further strengthened; combined allocation and regulation of groundwater and surface water shall be implemented as soon as possible; basic research and technical means can't satisfy the needs for water resource management and regulation of the Yellow River.

## **2. GWP's role in water resources regulation**

GWP China and the provincial/river basin WPs fully utilizes their advantages and features as cross-industrial and trans-departmental international NGOs to organize many activities in the distribution, management and regulation of water resources of the Yellow River. The good results and impacts are mainly reflected in following

aspects:

(1) Actively establish partnerships: have established close partnership relations with many water-related authorities and entities and such partnerships have played an active role in promoting the comprehensive management and regulation of water resources of the Yellow River.

(2) Establish a joint discussion mechanism, actively participate in the regulation of water resources of the Yellow River, coordinate with the annual preliminary water resources distribution plan and promote the smooth implementation of the water resources regulation of the Yellow River

(3) Actively establish a dialogue platform; publicize and discuss about relevant policies on water resource management and water resources regulation; discuss the hot and hard issues of water resources distribution and regulation in the Yellow River Basin so as to provide proposals to governmental organizations.

(4) Actively participate in relevant work at different levels of water resources regulation, including surveys of water uses of key water consumers, formulation of water resources distribution plans and the basic work in legislation and planning to promote the smooth implementation of water resources regulation in the Yellow River Basin.

(5) Fully utilize the information network platform and news media to strengthen information exchanges on water regulation laws, regulations, policies, proposals, public participation and scheduling experiences.

(6) Actively attend major water events at home and abroad and publicize the achievements and experiences in promoting distribution and regulation of water resources of the Yellow River.

### **3. Recommendations for improvement**

The general principles for improvement of water resources distribution and regulation in the Yellow River Basin is as follows: focus on increasing the water use efficiency of the Yellow River, set the goal to realize the sustainable utilization of the water resources of the Yellow River and ensure the health and life of the Yellow River, strengthen democratic management, collectively apply and improve administrative, legislative, economic and technological means, improve the management system that combines drainage basin management and regional management, strengthen research on optimized allocation of water resources of the Yellow River after the operation of the eastern and middle lines of the South-to-North Water Diversion

Project and observe the principle of “collective water resources allocation and section flow control by the central government and collective distribution of water quotas and regulation of key water diversion ports and pillar reservoirs” by provincial (regional) governments” to ensure the non dry-ups of the Yellow River and sustainable development of the regions in the Yellow River Basin and other relevant regions.

There are three main categories of measures: on the system and regulation level, it is necessary to improve relevant laws and regulations, establish a comprehensive regulation management system for both trunks and tributaries, implement scientific and reasonable water pricing policies and improve the water user licensing system and the water right conversion market. At the administrative level, it is necessary to improve administrative organizations, establish an effective coordination mechanism, promote extensive participation by water users, strengthen supervision, inspection and rewarding/punishment mechanism and explore new ways of water resources management. At the supportive level, it is necessary to strengthen relevant basic researches on water resources distribution plan under the new situations, conduct relevant basic researches on ecological water regulation, facilitate the modernization of hydrological information forecast and reporting and water resources regulation and conduct researches on combined regulation of surface water and groundwater.

GWP China and the provincial/river basin WPs fully utilizes their unique advantages as neutral platform to offer a bridge for the improvement of water resources regulation in the Yellow River Basin: (1) carry out extensive surveys and researches; have equal contacts and dialogues with various industries and sectors having an interest in the distribution and regulation of water resources of the Yellow River so as to provide first-hand data for the improvement of water resources distribution and regulation of the Yellow River; (2) strengthen communication with various organizations, set a communication platform for industrial administrations, scientific research institutions, local people and various other stakeholders and actively promote the regulation of water resources among different sectors; (3) fully utilize online platform and media to publicize the updates of water resources distribution; (4) actively promote the development and implementation of laws/regulations; promote the incorporation of the concept of IWRM into the water-related national, regional and local laws and regulations and ministerial regulations and combine them with the stringent water resources management system in order to promote the cooperation between various water-related entities and the partnership with non-water-related entities; (5) promote the exchanges and cooperation in water resources management with foreign countries via international platforms and learn the successful experiences from other countries, including the experiences on legislation, policy, mechanism, system and science and technology. On the other

hand, share the experiences of China in water resources management by other countries of the world so as to promote the sustainable utilization of water resources in the world.