Bulletin on the Ecological and Environmental Monitoring Results of the Three Gorges Project

2015

Ministry of Environmental Protection of the People's Republic of China

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Content

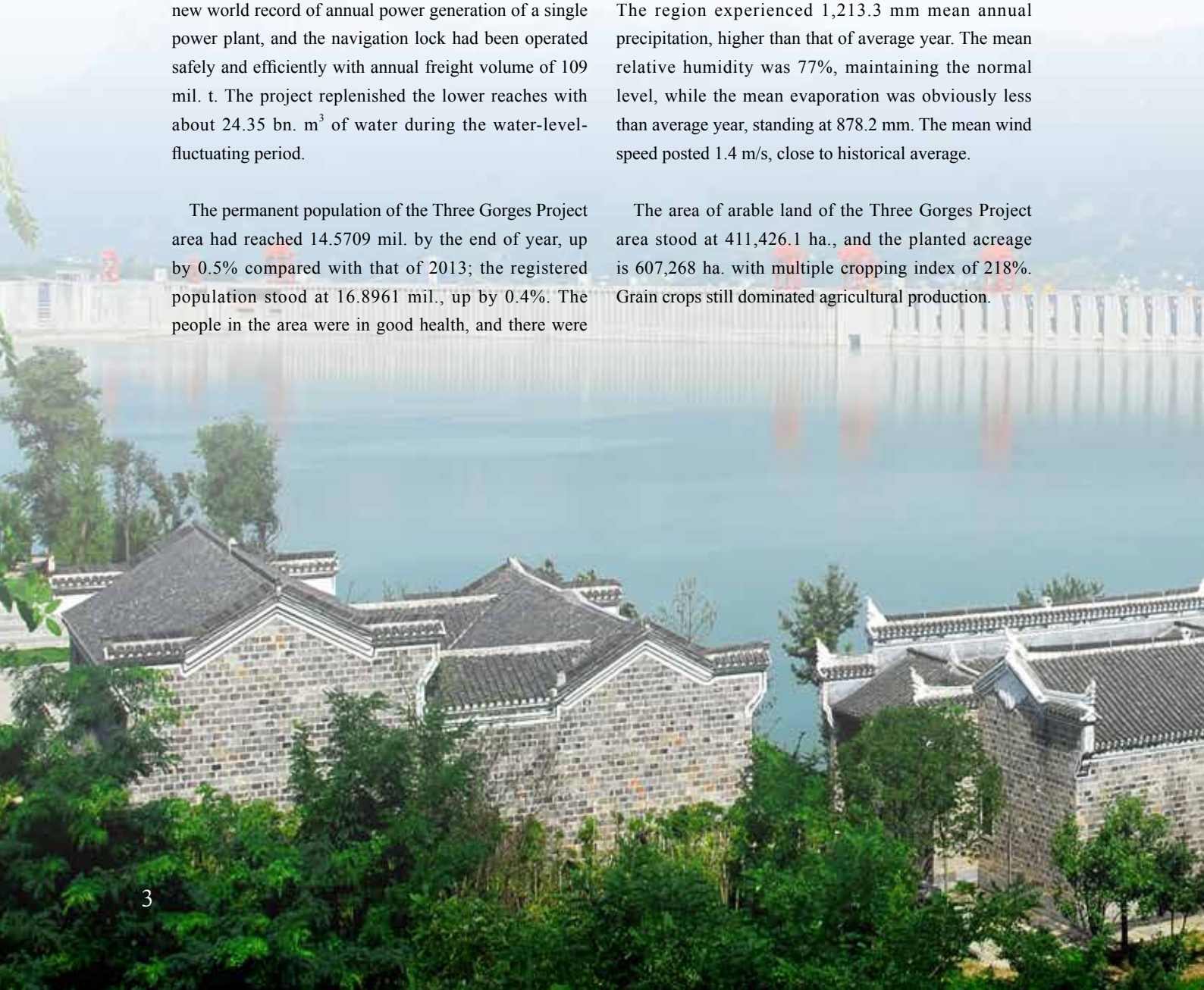
Summary

In 2014, the Three Gorges Water Project maintained stable and efficient operation for the eleventh consecutive year, giving full play to the comprehensive role of flood control, power generation, navigation, drought resistance and water replenishment. The 175 m trial impoundment was achieved in success for the fifth consecutive time. During the flood season, a total of 17.512 bn. m^3 floodwater was impounded. The Three Gorges power plant generated electricity of 98.8 bn. kWh accumulatively throughout the year, setting the new world record of annual power generation of a single power plant, and the navigation lock had been operated safely and efficiently with annual freight volume of 109 mil. t. The project replenished the lower reaches with about 24.35 bn. m^3 of water during the water-level-fluctuating period.

The permanent population of the Three Gorges Project area had reached 14.5709 mil. by the end of year, up by 0.5% compared with that of 2013; the registered population stood at 16.8961 mil., up by 0.4%. The people in the area were in good health, and there were no report on epidemic diseases. The GDP of the project area reached 632.059 bn. yuan, up 11.3% compared with that of 2013. The primary industry, secondary industry and tertiary industry achieved value added by 62.179 bn. yuan, 322.06 bn. yuan and 247.82 bn. yuan, marking an increase of 4.7%, 13.2% and 10.3% respectively than that of 2013.

The mean annual temperature of the project area posted 17.8℃, maintaining the level of average year. The region experienced 1,213.3 mm mean annual precipitation, higher than that of average year. The mean relative humidity was 77%, maintaining the normal level, while the mean evaporation was obviously less than average year, standing at 878.2 mm. The mean wind speed posted 1.4 m/s, close to historical average.

The area of arable land of the Three Gorges Project area stood at 411,426.1 ha., and the planted acreage is 607,268 ha. with multiple cropping index of 218%. Grain crops still dominated agricultural production.

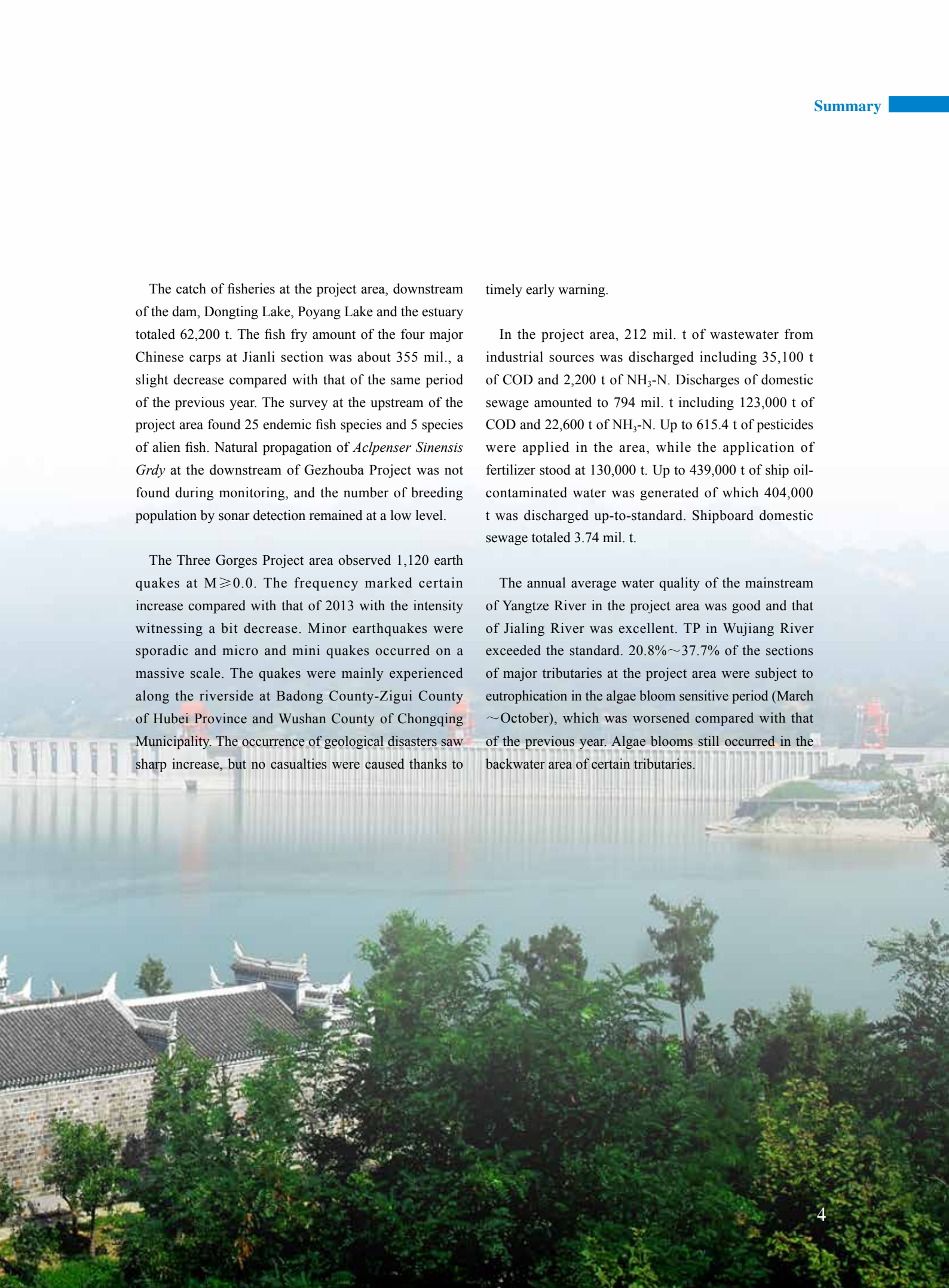


The catch of fisheries at the project area, downstream of the dam, Dongting Lake, Poyang Lake and the estuary totaled 62,200 t. The fish fry amount of the four major Chinese carps at Jianli section was about 355 mil., a slight decrease compared with that of the same period of the previous year. The survey at the upstream of the project area found 25 endemic fish species and 5 species of alien fish. Natural propagation of *Aclpenser Sinensis Grdy* at the downstream of Gezhouba Project was not found during monitoring, and the number of breeding population by sonar detection remained at a low level.

The Three Gorges Project area observed 1,120 earth quakes at M≥0.0. The frequency marked certain increase compared with that of 2013 with the intensity witnessing a bit decrease. Minor earthquakes were sporadic and micro and mini quakes occurred on a massive scale. The quakes were mainly experienced along the riverside at Badong County-Zigui County of Hubei Province and Wushan County of Chongqing Municipality. The occurrence of geological disasters saw sharp increase, but no casualties were caused thanks to timely early warning.

In the project area, 212 mil. t of wastewater from industrial sources was discharged including 35,100 t of COD and 2,200 t of NH_3-N. Discharges of domestic sewage amounted to 794 mil. t including 123,000 t of COD and 22,600 t of NH_3-N. Up to 615.4 t of pesticides were applied in the area, while the application of fertilizer stood at 130,000 t. Up to 439,000 t of ship oil-contaminated water was generated of which 404,000 t was discharged up-to-standard. Shipboard domestic sewage totaled 3.74 mil. t.

The annual average water quality of the mainstream of Yangtze River in the project area was good and that of Jialing River was excellent. TP in Wujiang River exceeded the standard. 20.8%～37.7% of the sections of major tributaries at the project area were subject to eutrophication in the algae bloom sensitive period (March ～October), which was worsened compared with that of the previous year. Algae blooms still occurred in the backwater area of certain tributaries.



Chapter 1
Operation of the Three Gorges Project

In 2014, the Three Gorges Water Project maintained stable and efficient operation for the eleventh consecutive year, giving full play to the comprehensive role of flood control, power generation, navigation, drought resistance and water replenishment. The 175 m trial impoundment was achieved in success for the fifth time.

● **Comprehensive regulation**

On November 26, 2013, the water level of the Three Gorges Reservoir began to fluctuate from 174.71 m and finally fell to the level of 146.06 m by June 10, 2014. The fluctuation took account of the needs of downstream navigation, water supply, power grid generation, emergency regulation during salt tide suppression at the Yangzi River estuary as well as ecological regulation for experiment use. The water replenishment lasted 180 days with the total volume mounting to 24.35 bn. m^3.

The reservoir had launched ecological regulation from June 4 to 6 of 2014, during which the water temperature had maintained in the range of 20.3～20.6℃ at the Yichang reach with the controlled outflow registering 15,600 m^3/s, 17,000 m^3/s and 18,700 m^3/s on the three days respectively, marking a gradual growth in daily average outflow. Monitoring results indicated that the ecological regulation had boosted the reproduction of the four major Chinese carps, and relatively large-scale spawning of the four Chinese carps occurred in the Yidu reach during the third day of the regulation.

During the flood season of 2014, the reservoir experienced seven floods with peak flow over 30,000 m^3/s. The maximum peak was 55,000 m^3/s appeared on September 20, and flood control was dispatched ten times with the maximum peak reduction of 22,900 m^3/s, bringing the peak reduction rate to 46.7%. Accumulative impoundment totaled 17.512 bn. m^3.

During the period of September to October of 2014, the Three Gorges Reservoir experienced three floods with relatively adequate water supply, and the beginning time of impoundment of the reservoir was delayed to September 15. By exercising regulation switching between impoundment and flood control and under the premise of ensuring flood control safety of the lower reaches, the 175 m trial impoundment was achieved in success for the fifth time during the impoundment at 10:00 on October 31.

● **Operation of the power station**

In 2014, water supply from the upstream of the Yangtze River was inadequate, 2.8% less than that of historical flow. By employing the measures of joint regulation of a group of water reservoirs, optimized regulation of small-and medium floods, timely cleaning of the floating garbage to enable adequate waterhead for power generation and heightening of power grid output coordination, the Three Gorges Power Station has further boosted its power generation benefits. The overall power generation capacity for the entire year of 2014 stood at 98.8 bn. kWh, setting the new world record of annual power generation volume by a single power station.

● **Navigation management**

In 2014, the navigation lock of the Three Gorges maintained safe and efficient operation for the eleventh consecutive year by enabling the delivery of 109 mil. t of cargo with the availability of major operation equipment reaching 100%, securing the smooth navigation on the Yangtze River. The lock-passing efficiency was further improved with the consequent growth of navigation benefits by the adoption of a sting of measures including renovation of floating mooring dolphin, high-volume navigation experiments and the adding of berthing facilities.

● **Project construction**

In 2014, the civil engineering of the Three Gorges shiplift was completed, and the relevant installation and trial operation were carried out gradually. The planning project for the Three Gorges Dam area progressed smoothly with the holding of multiple special seminars

and the adoption of relevant effective measures. Major projects like the breeding center for rare fish species and the museum of the Yangtze River progressed in an orderly manner.

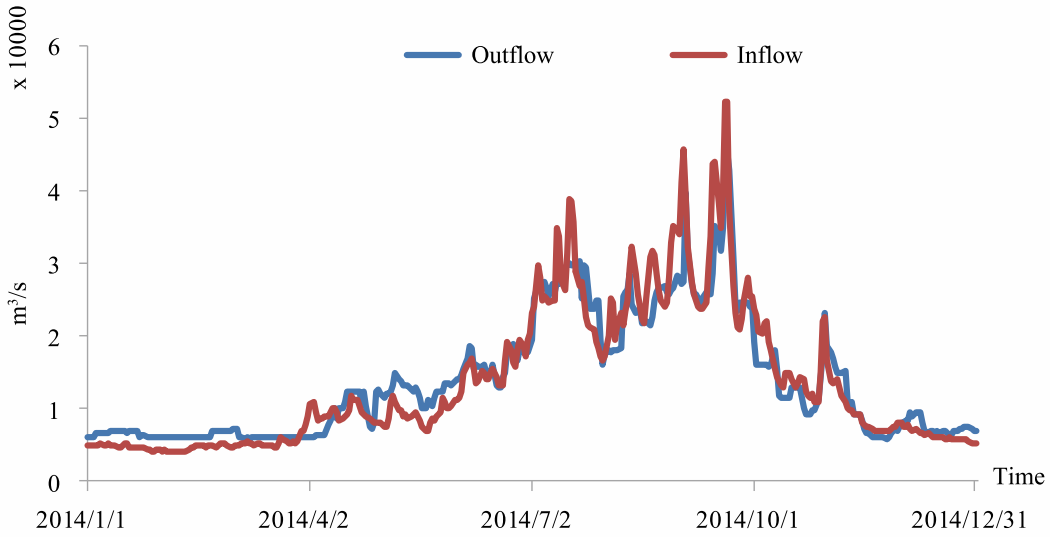


Figure 1–1 Statistics of the outflow and inflow of the Three Gorges Reservoir of 2014

Chapter 2
Economic and Social Development

In 2014, the permanent resident population of the Three Gorges Project area had numbered 14.5709 mil. by the end of the year, 77,200 more than that of 2013, marking 0.5% increase compared with the same time of the previous year. Among them, 13.0916 mil. were in the Chongqing project area, up 0.6%; 1.4793 mil. were in Hubei project area, up 0.4%. The permanent urban resident population of the Three Gorges Project area was 7.7444 mil. with the urbanization rate of 53.15%, up by 1.45 percentage points. There had been 16.8961 mil. registered population in the project area by the end of 2014, 63,400 more than that of 2013, marking 0.4% increase compared with the same time of the previous year. Among them, 15.3223 mil. were in the Chongqing project area, up 0.4%; 1.5738 mil. were in the Hubei project area, up 0.1%.

The GDP of the project area totaled 632.059 bn. yuan, an increase of 11.3% compared with that of 2013 and 3.9 percentage points higher than national average. In specific, the Chongqing project area and the Hubei project area achieved 561.09 bn. yuan and 70.969 bn. yuan respectively, up 11.4% and 10.7%. Judged from the perspective of the tertiary industry, the value-added of the primary industry, secondary industry and tertiary industry was 62.179 bn. yuan, 322.06 bn. yuan and 247.82 bn. yuan, up 4.7%, 13.2% and 10.3% respectively.

In 2014, 239,700 urban residents and 364,200 rural residents in the Three Gorges Project area received the minimum subsistence allowance, down 10.2% and 19.1% respectively than that of 2013. By the end of 2014, 2.73 mil. people had applied for the basic old-age insurance for urban enterprise employees, up 8.1%. Highway mileage in the project area stood at 89,149 km, up 2.7% than that of 2013, among which 63,727 km were classified highway, and 1,429 km were freeway, up 7.3% and 1.3% respectively than that of 2013. Healthcare and technical staff in the project area numbered 3,118, up 4.3% than that of the previous year. Number of beds in various healthcare organizations was 71,775, marking an increase of 9.3%. There were altogether 3,210 primary and middle schools in the project area, down 3.2% than that of 2013. The number of primary and middle school students stood at 1.7829 mil., down 0.8%, and the number of full-time teachers was 113,417, up 0.2%. There had been 3.4264 mil. collected books in public libraries by the end of 2014, up 6.5%.

As per the survey and statistics of 1,100 migration households in the project area, the per capita disposable income of the entire migration population of the Three Gorges Project area in 2014 was 15,205 yuan, up 11.8% than that of 2013, among which the per capita disposable income was 19,356 yuan for urban permanent residents and 9,216 yuan for rural migrated permanent residents, both up 11.8%.

Chapter 3
Natural Ecology and Environment

3.1 Climate

In 2014, the mean annual temperature in the Three Gorges Project area remained at the same level of average year while the mean annual precipitation was more than historical average. It was warm in early winter and cold in late winter with less precipitation. Temperature was at the normal level as previous years but changed dramatically in spring with precipitation mainly occurring in early spring and rainstorm taking place rather early. The temperature was lower than normal marking a typical cool summer with less precipitation in the early part of the season. It was rather warm and humid in autumn with more rain in the western part lasting for a rather long period of time. The average evaporation in the project area was less than average year with the mean relative humidity and mean wind speed remaining at the normal level. The meteorological hazards in the project area included frequent rainstorms and floods throughout the year, high temperature and drought in the summer, rainy weather in autumn and cryogenic freezing rain and snow disasters at the beginning of the year.

Table 3–1 Monitoring results of meteorological elements of each station in the Three Gorges Reservoir in 2014

Station	Mean temperature (℃)	Precipitation (mm)	Relative humidity (%)	Evaporation (mm)	Mean wind speed (m/s)	Sunshine hours (h)	Foggy days (d)
Chongqing	18.6	1437.0	79	908.2	1.3	-	69
Changshou	17.8	1366.2	80	658.4	1.4	1019.9	66
Fuling	17.5	1186.8	87	-	1.5	1012.7	182
Fengdu	18.4	1198.4	76	614.1	1.4	943.0	38
Zhongxian	17.9	1223.0	82	-	1.4	1010.3	182
Wanzhou	18.5	1285.6	79	935.8	1.0	924.0	43
Yunyang	18.2	1288.4	79	-	1.6	1135.2	85
Fengjie	18.3	1092.1	71	1018.7	1.8	1037.9	21
Wushan	18.5	1158.7	64	-	0.5	1240.1	3
Badong	17.2	1178.0	72	1263.3	1.8	1431.9	21
Zigui	16.7	1122.4	76	699.1	1.2	1323.1	1
Bahekou	17.1	-	78	-	1.4	-	0
Yichang	16.5	1023.1	75	928.0	1.8	-	68

Note: "-"means unavailable. According to meteorological observation regulation, if data is not measured for more than three days in a month, the data for this month will be recorded as unavailable. If data of over 10% of the months is missing, the data for this year will be recorded as unavailable. The evaporation data of Chongqing, Wanzhou, Fengjie, Badong and Yichang were those of small evaporation dish revised from those measured in big evaporation dishes.

3.1.1 Meterological elements

In 2014, the mean annual temperature of the project area recorded 17.8℃, remaining at approximately the same level as that of previous years (17.9℃) with the spatial distribution of higher temperature in the west and lower temperature in the east. The mean annual temperature was within the range of 17～18℃ in Wanzhou, Zhongxian, Fuling and Chongqing and within the range of 16～17℃ in Fengjie, Wushan, Badong and Yichang. Compared with previous years, the western part of the Three Gorges area was of rather lower temperature, among which Banan and Qijiang was 0.2～0.3℃ lower than normal level; and the central and eastern parts were of the similar level of or higher temperature than that of previous years, among which Fengjie and Enshi was 0.2℃ higher. In terms of seasonal distribution, the average temperature in the winter was 8.2℃, rather close to that of historical average (8.1℃), and that in the spring was 17.7℃, remaining at the same level of the same period of previous years. The temperature in the summer recorded 26.4℃, 0.6℃ lower than that of average year. The temperature in the autumn was 19.1℃, 0.5℃ higher than that of average year.

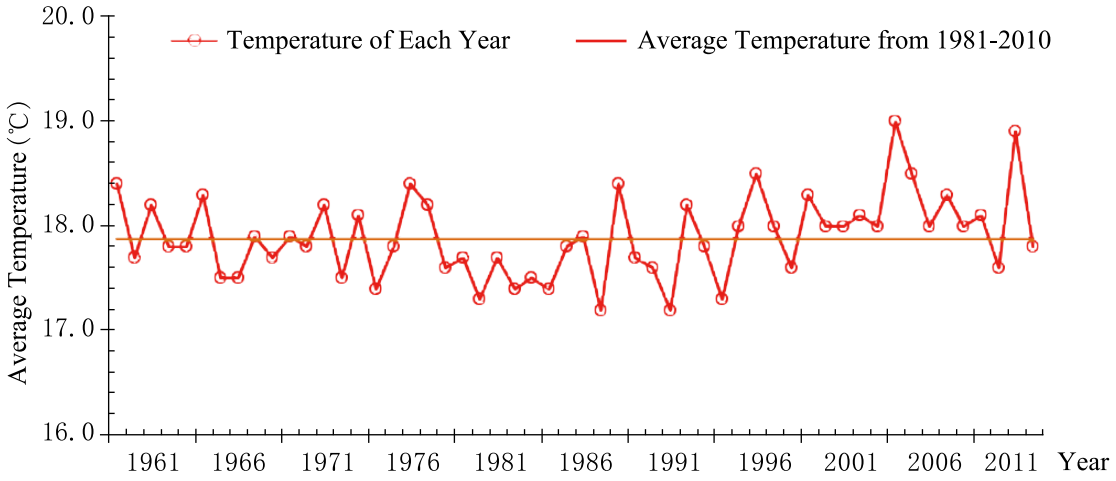


Figure 3–1 Mean annual temperature of the Three Gorges Project area of 1961–2014

The average precipitation in the project area in 2014 was 1,213.3 mm, 9% more than the historical average (1,114.9 mm) with the spatial distribution of more precipitation in the western part than that of the eastern part. The annual precipitation of Wushan as well as the central and western parts to its west was generally above 1,200 mm, among which Chongqing and Changshou were over 1,300 mm, and the precipitation of the eastern part was within the range of 1,000～1,200 mm. In terms of seasonal distribution, the average precipitation in the winter was 39.8 mm, down by 37% compared with the historical average (63.1 mm) and that in spring was 303.0 mm, close to that of average year (295.1 mm). The summer saw 513.0 mm rainfall, also close to historical average (496.9 mm), while the autumn had 362.2 mm rainfall, 39% more than the historical average (259.7 mm).

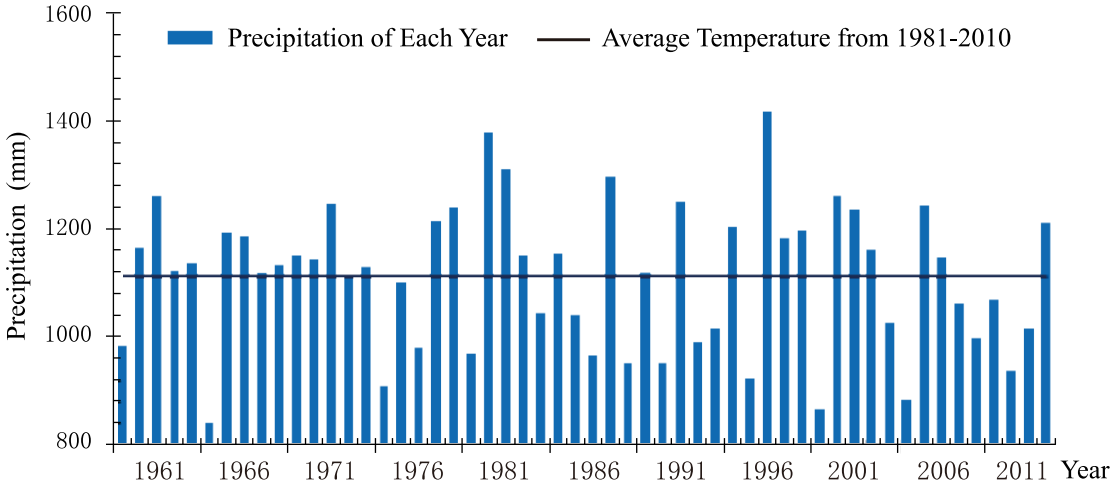


Figure 3–2 Mean annual precipitation of the Three Gorges Project area during 1961–2014

The mean relative humidity of the project area was 77%, close to that of historical average (76%). The relative humidity of all places ranged from 71% to 87% with the minimum at Wushan and the maximum at Fuling. Compared with average year, the relative humidity at Fuling was 7% higher, while that of Wushan was 5% lower, and the relative humidity at the rest places was close to normal level of previous years. Relative humidity (historical average) in the winter, spring, summer and autumn was 74% (77%), 76% (74%), 77% (76%) and 81% (79%) respectively, all close to that of the same period of previous years.

The mean annual evaporation in the project area recorded 878.2 mm, prominently lower than the historical average (1,299.7 mm). Spatial distribution indicated that Fengjie and Badong had a larger amount of evaporation, both higher than 1,000 mm while the amount of other places were all less than 1,000 mm. Specifically, Zigui, Fengdu and Changshou all observed evaporation less than 700 mm. Evaporation in the project area changed dramatically with season. The average evaporation in the winter, spring, summer and autumn was 111.4 mm, 203.5 mm, 351.0 mm and 217.0 mm respectively, all registering lower records than that of average year.

The mean wind speed in the project area was 1.4 m/s, close to that of historical average (1.3 m/s). The overall wind speed in the area was stable, and mean monthly wind speed hit the maximum in February, July and August, being 1.5 m/s, while the minimum occurred in January of 1.1 m/s. Apart from Wushan with wind speed averaged out at 0.6 m/s, other places all experienced wind speed above 1.0 m/s with Fengjie, Badong and Yichang having the maximum average wind speed of 1.8 m/s.

The annual number of foggy days was the most in Zhongxian and Fuling in the project area, both 182 days and the least in Zigui and Wushan, 1 day and 3 days respectively. For the rest places, the similar figure generally ranged within 20～80 days, among which Fengjie and Badong were 21 days, Fengdu was 38 days, Wanzhou was 43 days, and Chongqing, Changshou and Yunyang all exceeded 60 days. The average foggy days in the project area hit the maximum value in January and June of both over 9 days, and the minimum value appeared in March and July of both around 3 days.

3.1.2 Meterological hazards

In 2014, the project area and its neighboring areas were hit by frequent rainstorms in the spring, summer and autumn and consequent serious floods and secondary geological disasters such as landslide and mudflow. Lasting overcast and rainy weather plagued the area in the autumn, causing adverse impact on agricultural production. Large scale rain and snow disasters frequently happened in the beginning of the year with certain regions being hit by cryogenic freezing. The summer was notably cool, but the temperature in July was on the high end with short-term heat and drought.

● **Rainstorm and flood**

In 2014, the precipitation in the project area and neighboring area was more than adequate with frequent occurrence of rainstorms in the spring, summer and autumn mainly concentrating in the middle and western parts of the area. In specific, 128 time·station of rainstorms were monitored in Chongqing altogether with 23 time·station of heavy rainstorms (2 times that of average year). Twelve times of regional rainstorm weather occurred in the middle and western parts of the project area. With a rather early appearance this year, Chongqing, Changshou, Fuling and other places in the western part of the project area experienced the most serious disaster of rainstorm and flood ever since 1951 on March 19 and 20, and severe rainstorm and flood occurred in the project area from August 31 to September 2. The rainstorm-triggered floods caused damage to large range of crops and collapse of houses, and heavy rains brought about secondary geological disasters such as landslide and mudflow.

● **Continuous rain**

In the autumn of 2014, the project area had continuous days of rain with the general distribution of more rain in the west than in the east and the major occurrence from September 8 to 19, October 12 to 20, October 26 to November 4, November 12 to 18 and November 20 to 30. The precipitation of Chongqing Municipality reached 83.9 mm from September 9 to 18, 1.3 times more than that of the same period of the previous years, and the number of days featuring rainstorm weather in the same period hit the highest since 1951. The continuous rainy days in autumn exerted adverse impact on the maturing of middle-season rice and the coloring and maturing of citrus. In particular, the excessive humidity of soil caused by lasting rain led to severe development of plant diseases and insect pests in the fields.

● **Cryogenic freezing**

In February of 2014, Affected by cold air continuously added to the South, large scale rain and multiple snows occurred in the project area in the time period of February 4 to 7, 8 to 9, 12 to 13 and 17 to 18. Short-term low temperature, rain and snow as well as inadequate sunshine led to cryogenic freezing hazard in certain parts of the area, posing some adverse impact on the growth of farm produce including outdoor vegetables such as rape.

● **Short-term heat and drought**

In 2014, the project area experienced rather low temperature with typical cool summer, but the temperature in July was 0.6℃ higher than that of the same period of previous years with short-term heat and drought. The project area experienced twice heat weather from July 5 to 10 and July 19 to August 8. From late July to early August, most parts of Chongqing were plagued by meteorological drought affected by high temperature and little rain, among which certain locations in the middle part, south of the north-eastern part and western part saw medium-level meteorological drought. In Chongqing Municipality, 6,300 ha. of crops were hit by the drought, and regular domestic water supply was also affected in some villages and towns of Beibei and Kaixian.

● **Hail disaster**

In 2014, there were hails with strong convection from spring to summer in certain parts of the project area, causing certain casualty, collapse of houses and damage of farm produce. In specific, counties like Yichang, Changyang and Zigui were struck by hail, rainstorm and flood from the night of July 23 to 25, affecting over 40,000 people and 3,000 ha. of cropland and the consequent direct economic loss of 25 mil. yuan.

3.2 Forest resources

In 2014, the forest area of the project area occupied 2.7531 mil. ha. with the coverage rate of 47.74%. Among them, there were 2.6299 mil. ha. woodland, accounting for 95.52% of the total and 123,200 ha. special shrub land defined by the state, which took up 4.48% of the total. The volume of standing timber reserve totaled 144.3385 mil. m^3 which included 139.6954 mil. m^3 of forest reserve, or 96.78% of the total and 4.6431 mil. m^3 of scattered wood land, scattered trees and tress on the sides of villages, homesteads, roads and rivers, accounting for 3.22%.

In 2014, among the forested land of the project area, there were 1.8805 mil. ha. natural forests and 721,600 ha planted forests, marking the ratio of 7: 3; the reserve for natural forests stood at 103.0519 mil. m^3 and that for planted forests was 29.9227 mil. m^3 with the ratio of 8: 2. Natural forests dominated the forest resources in the project area.

In 2014, there were 1.6735 mil. ha. shelter forests and 90.3829 mil. m^3. shelter forest stock, accounting for 65.87% of the total forest area and 64.7% of the forest stock respectively. The area of special-purpose forests stood at 130,200 ha. and that of special-purpose forest

stock was 10.0555 mil. m^3., taking up 5.13% and 7.2% of their respective total. There were 610,100 ha. timber forests and 39.1685 mil. m^3 timber forest stock, taking up 24.00% and 28.04% of their respective total. The area of firewood forests stood at 6,000 ha. and the stock was 88,500 m^3, registering 0.24% and 0.06% of their respective total. Economic forests covered an area of 120,800 ha., taking up 4.76% of the total.

Sapling forests of the Three Gorges Project area covered 1.0985 mil. ha., and the stock was 40.2592 mil. m^3, accounting for 43.24% of the total arboreal forest and 28.82% of the total growing stock. There were 1.0382 mil. ha. half-mature forests with 64.3321 mil. m^3 reserve, taking up 40.86% and 46.04% respectively. The area and stock of near-mature forests were 291,600 ha. and 23.451 mil. m^3, constituting 11.48% and 16.79% respectively. Mature forests covered 98,800 ha. and the reserve stood at 9.9816 mil. m^3, accounting for 3.89% and 7.15% respectively. There were 13,600 ha. over-mature forests with 1.6715 mil. m^3 reserve, taking up 0.53% and 1.20% of the total respectively. Sapling and half-mature forests dominated the arboreal forests with the coverage and reserve accounting for 84.10% and 74.87% of the total respectively.

In 2014, planted forest covered 81,600 ha. in the project area, and 79,900 ha. were preserved with the survival rate of 97.90%. Among them, the planted forests amounted to 6,600 ha. in Hubei and 6,600 ha. were preserved with the survival rate of 100%. The planted forests reached 75,000 ha. in Chongqing and 73,300 ha. were preserved with the survival rate of 97.71%.

A total of 142,300 ha. forests suffered from forest hazards in 2014, accounting for 5.17% of the total forest area in the project area, including 142,200 ha., or 99.94%, damaged by forest diseases and insect pests, and 100 ha., or 0.06%, ruined by forest fires.

3.3 Terrestrial plants

Mixed evergreen and deciduous broad-leaved forest is the zonal vegetation in the northern subtropical zone of China and also one of the dominant types of vegetation in the Three Gorges Project area. From 2013 to 2014, a 10,000 m^2 large-scale sample zone was established to monitor the typical community of the mixed evergreen and deciduous broad-leaved forest in the project area.

● **Community habitat**

The community is located in the central part of Wanchaoshan Nature Reserve of Hubei Province. The mean annual temperature was 10.6℃, the mean annual precipitation was 1,296 mm, and the frost-free season lasts for 185 days. The soil is of yellow brown earth with the thickness of soil layer around 100 cm and pH value of 5.6. The content of organic matter, TN and TP stood at 41.0 g/kg, 1.6 g/kg and 4.0 g/kg.

● **Community composition**

The community is composed of a variety of species of altogether 210 species of vascular plants. In specific, there were 57 arbor species with the average DBH (diameter at breast height) of 17.7 cm, average tree height of 12.0 m, maximum DBH of 59.5 cm and maximum tree height of 25.0 m. There were 119 shrub species with the average brand diameter of 0.4 cm and average height of 1.5 m. There were 78 herbal species with the average height of 20.4 cm. The community is dominated by deciduous trees with their importance value of 2.5 times of that of evergreen trees, which indicated that deciduous trees were of overwhelming dominance in the community. Mixed evergreen and deciduous broad-leaved forest is rather commonly seen in the project area.

● **Community structure**

The density of the community plants was rather high with obvious distinction of arbor layer, shrub layer and herb layer. The canopy density for arbor layer was 0.8, the density was 1,201 plants/ha. with the major dominant plants of *Fagus engleriana, Rhododendron hypoglaucum*

Community structure of mixed evergreen and deciduous broad–leaved forests

Monitoring of litters

and *Carpinus hupeana*. The coverage of shrub layer was 66%, and the density was 14.5 plants/ha. with the major dominant plants of arrow bamboo and *Indocalamus tessellatus*. The coverage of herb layer was 15%, and the density was 4.5 plants/ha. with the major dominant plants of *Carex grandiligulata, Carex lanceolata* and *Polystichum neolobatum*. The Leaf Area Index (LAI) of the community was 3.4, 0.5 and 0.3 for the arbor layer, shrub layer and herb layer respectively with the overall LAI standing at 4.2. The community was displaying the typical features of mixed evergreen and deciduous broad-leaved forest with rather strong photosynthetic capacity.

● **Community dynamics**

There were altogether 48 types of arboreal sapling or seedling appearing in the community with the density of 1.6 plants/m^2. The regeneration seedling density of evergreen plants stood at 1.0 plant/m^2 with the ratio between seedling sprouts and seedling of 1:3.5. The regeneration seedling density of deciduous plants stood at 0.6 plant/m^2 with the ratio between seedling sprouts and seedling of 1:3.2, which indicated a sound regeneration of the community and a better performance of evergreen plants than that of deciduous plants. With the progress of the succession, the ratio of evergreen plants would increase to a certain degree.

● **Cycle of matter**

The average gross dry weight of the standing crop of litter in unit area was 1,047.1 g/m^2, among which flag took up the biggest portion of 67.7%, followed by deadwood of 220.5 g/m^2, fruit of 4.9 g/m^2, bark of 19.3 g/m^2, lichen of 5.4 g/m^2 and other matters of 88.6 g/m^2. The standing crop of litter represents the average return revert of the standing crop of organic matters, and the figure was 10.5 t/ha. for this community with the majority being the return of leaf litter.

3.4 Survey on the wintering water birds

The survey on wintering water birds was conducted in the submerged area below 175 m in the project area in January and February of 2015 which covered the Changshou Lake and Dahong Lake located in Changshou District, the river reach from the new town of Yunyang County to the entrance section of Modao Stream as well as the 9 tributaries-Wujiang River, Pengxi River, Tangxi River, Modao Stream, Meixi River, Daning River, Yandu River, Xiangxi River and Jiuwan Stream.

A total number of 5,082 water birds of 18 species belonging to 8 families of 7 orders were counted in the surveying area. In specific, there were 2,049 Anas platyrhynchos, 767 little grebe, 660 common cormorant and 542 Anas falcata in terms of the number of each species, and two State key protected species of Chinese merganser (Class Ⅰ) and mandarin duck (Class Ⅱ) were also identified in the survey. The mandarin duck had a rather wide range of distribution in the project area. Seven out of the 9 tributaries surveyed witnessed the appearance of mandarin duck with a rather large number in Wujiang River (35) and Daning River (32). Out of the lake-based wetlands surveyed, the number of water birds in Changshou Lake was the most of 1,254. In the 9 tributaries, the number of wintering water birds in Pengxi River was the most of 434 followed by Daning River of 276. The number of species of wintering water birds was the most in Daning River of 11 including Chinese merganser.

3.5 Rare and endemic aquatic animals

3.5.1 Endemic fish species

In 2014, up to 126 fish species were identified in the Yibin reach of the lower reaches of the Jinsha River, the Hejiang, Mudong, Wanzhou and Zigui reaches of the upper reaches and Yichang reach of the middle reaches of the Yangtze River. These included 25 species of endemic fish and 5 alien fish species in the upper reaches of the Yangtze River. Compared with the situation before impoundment, the number of endemic fish species did not change much in the upper reaches like Yibin and Hejiang. Distinct decline of endemic fish species was found in the waters of the project area.

A total of 92,661 sample fishes weighing 3,325.74

Habitat in the mainstream of the upper reaches of Yangtze River

kg were caught for the survey on fish catches. There were 7,612 endemic fishes which weighted 415.12 kg, accounting for 12.5% of the total weight and 8.2% of the total catches. Compared with that of 2013, the percentage of endemic fishes by weight dropped by 33.5% while the percentage of catches went down by 41.4%. The number of endemic fish resources in the upper reaches of the Yangtze River changed notably after impoundment. There were still certain endemic fish species at some scale at Yibin and Hejiang reaches and Mudongjiang reach at the tail of the reservoir, but the number of endemic fish at Wanzhou in the middle part of the project area, Zigui at the head of the Reservoir and Yichang reach in the downstream of the Three Gorges Dam went rare.

Experiment was carried out on the artificial propagation of *Sauyage et Dabry*. Induced ovulation rate of female *Sauyage et Dabry* reached 16.7% with the fertility rate of 50.2%. The experiment was successful with 40 Sauyage et Dabry fries being hatched.

Survey on the bycatch of rare fishes in Mudong Reach–mullet

3.5.2 Rare aquatic animals

In 2014, as estimated from the sonar detecting data, the average reproductive population of Chinese sturgeon (*Acipenser sinensis* Gray) at the Yichang reach in the lower reaches of Gezhouba Dam of the Yangtze River was 57, registering a 43.8% decline compared with that of 2013. Based on historical data, the population of Chinese sturgeon has remained at a rather low level since 2003 and showed the trend of steady decline. The survey made from November to December of 2014 on benthonic fishes preying on eggs indicated that no natural propagation activity was detected in known spawning ground in the lower reaches of Gezhouba Dam during the propagation season of Chinese sturgeon. As shown by the monitoring results of juvenile Chinese sturgeon in the lower reaches of Yangtze River and the waters of Chongming County in the estuary from May to September of 2014, no juvenile Chinese sturgeon of natural reproduction was found. While taking into consideration of the survey made on benthonic fishes preying on eggs at the Yichang reach in the lower reaches of Gezhouba Dam of the Yangtze River in 2013, the conclusion can be drawn that no propagation activity of Chinese Sturgeon was made in the Yangtze River in 2013.

In 2014, two cases of bycatch of adult Chinese sturgeon were found in the water area of the middle reaches of the Yangtze River, and no wild juvenile Chinese Sturgeon was found in the lower reaches and the water area of Chongming County in the estuary of Yangtze River. No record of bycatch of paddlefish was found, and one *Acipenser dabryanus* was found in the water area of Yichang in the lower reaches of Gezhouba Dam. Thirty-six cases of bycatch of mullet were found in the water area of Yibin, Mudong, Wanzhou, Zigui and Yichang reaches. The population of mullet in the upper and middle reaches of the Yangtze River was of small scale, and the population of paddlefish and *Acipenser dabryanus* was very small for now.

In 2014, as shown by visual sight and acoustic monitoring results of Poyang Lake and Dongting Lake, the population of Yangtze finless porpoise was around 460 in Poyang Lake, maintaining at a rather stable level. The population of Yangtze finless porpoise was within 120～130 in Dongting Lake. The distribution of the Yangtze finless porpoise changed along with the seasonal

fluctuation of the water level of the lake, and the water area from Bianshan to Nianyukou of Yueyang City remained the major habitat of the population. No *Lipotes vexillifer* was found in the survey of this year yet.

3.6 Agroecology

3.6.1 Ecological environment of farmland

The farmland in the project area totaled 411,426.1 ha. in 2014, down by 0.3% than that of the previous year. Analysis of the composition of farmland area indicated 108,150.0 ha. of paddy fields, 170,555.7 ha. of dry lands, 77,849.0 ha. of citrus orchards, 14,285.4 ha. of tea gardens, 4,778.0 ha. of traditional Chinese medicine gardens and 35,808.0 ha. for other crops.

Analysis of the tillage system showed 35.7% of the dry lands practiced triple-cropping system, 51.0% double-cropping system and 13.3% one-cropping system. The percentage of dry lands practicing double- and triple-cropping systems went up by 2.1 and 1.3 percentage points respectively while one-cropping land went down by 3.4 percentage points. As for paddy fields, the area practicing triple-cropping, double-cropping and one-cropping system accounted for 12.0%, 54.2% and 33.8% respectively. The area of paddy fields with triple-cropping and double-cropping system both went up by 0.1 percentage point than that of 2013, while that of one-cropping system dropped by 0.2 percentage point.

Analysis of slope gradient of the farmlands (excluding paddy fields) showed that the area of farmlands with slope gradient below 10º, of 10º～15º, of 15º～25º and above 25º accounted for 20.3%, 30.6%, 32.8% and 16.3% of the total respectively. Compared with that of 2013, the proportion of farmland with slope gradient below 10º increased by 0.6 percentage point, of 10º～15º grew by 0.5 percentage point, of 15º～25º dropped by 0.4 percentage point and of above 25º was down by 0.7 percentage point. Also in 2014, the area of gradient farmland renovated into terrace stood at 2,277.2 ha., and 10,594 ha. of farmlands were reclaimed for forests and grasslands.

Analysis of farmland altitude indicated that the area of farmlands with altitude below 500 m, within 500～800 m, within 800～1,200 m and above 1,200 m took up 53.8%, 31.6%, 11.7% and 2.9% of the total farmlands respectively. Compared with that of 2013, the percentage of farmlands with altitude below 500 m and above 1,200 m grew up by 5.8 and 0.3 percentage point(s) respectively, that between 500～800 m and 800～1,200 m were down by 3.6 and 2.5 percentage points respectively.

The sown area of crops totaled 607,268 ha., down by 0.2% than that of 2013, which included 396,909 ha. of grain crops and 210,359 ha. of cash crops, accounting for 65.4% and 34.6% respectively of the total. The multiple cropping index was 218%. Compared with that of 2013, the share of grain crops was down and that of cash crops was up.

3.6.2 Rural energy

In 2014, firewood consumption of the project area was 6.54 mil. t, 6.4 t for every household on the average. There was 2.4% reduction of firewood consumption and 1.5% reduction of firewood consumption per household compared with that of last year. There were 269,713 household biogas pools in countryside with annual output of 111.388 mil. m^3 biogas, 19.0 pools for every 100 households. There was 5.3% increase of biogas pool amount, 5.5% rise of annual biogas output and 10.4% rise of biogas pool amount per 100 households compared with that of last year. In addition, the energy mix of the Three Gorges Project area was composed of 2.594 mil. t straw, 282.91 mil. kW small hydropower and 690,000 t coals from small coal mines.

3.6.3 Crop diseases and insect pests

In 2014, 23 kinds of crop diseases and insect pests including rice planthopper were investigated. The findings indicated that crop diseases and insect pests occurred in 524,933 ha.·times, 512,667 ha.·times of them were under control. A total 239,303 t crops were saved, 64,484 t were lost with 126.57 mil. yuan economic losses. There was some increase in the area, actual loss and economic loss of crop diseases and insect pests compared with that of last year.

Among all crop categories, potato suffered most serious crop diseases and insect pests. The diseases and insect pests of vegetables also caused a great economic loss, while wheat suffered slight diseases and insect pests. In terms of the type of diseases and insect pests, Cnaphalocrocis medinalis, late blight of potato and vegetable aphids caused relatively great hazard. The crops in counties such as Shizhu, Yunyang, Wulong, Banan, Fengjie, Zhongxian, Wanzhou, and Wushan suffered relatively serious crop diseases and insect pests. Shizhu was struck the hardest, by 11 crop diseases and insect pests.

3.7 Fishery resources and environment

3.7.1 Fishery resources

In 2014, the total natural catches of the Three Gorges Project area, the downstream of Three Gorges Dam, Dongting Lake, Poyang Lake, and the estuary totaled 62,200 t, up by 8.9% compared with that of last year. The fry flow of four major Chinese carp species (*Mylopharyngodon piceus, Ctenopharyngodon idellus, Hypophthalmich-thyus molitrix, Aristichthys nobilis*) at Jianli section downstream the dam was 355 mil. with some reduction compared with that of last year. In the estuary waters, the total natural catches of *Coilia mystus* in the fishing period went down by 48.0%; parent crab went up 220.0% and elver increased by 217.0% compared with that of last year.

● **Project area**

The natural fish catches in the project area registered 7,089 t in 2014, up by 10.5% compared with that of last year. Among the catches, there were 1,795 t catfish, 1,481 t carp, 978 t silver carp, 574 t grass carp, 531 t bronze gudgeon (*Coreius heterokon*) and 319 t *Pelteobagrus fulvidraco*. Catfish, carp, bronze gudgeon, silver carp, grass carp and *Pelteobagrus fulvidraco* took up 80.1% of the sample catch by weight and are the main commercial fish species in the project area.

● **Downstream of the dam**

The natural fish catches amounted to 1,640 t in the downstream of the Dam in 2014. The calculation based on the catch composition indicated there were 418 t of carp, 310 t of four major Chinese carps, 192 t of *Parabramis pekinensis*, 91 t of *Pelteobagrus fulvidraco*, 90 t of catfish, and 42 t of crucian. The carp, four major Chinese carps, catfish, *Parabramis pekinensis, Pelteobagrus fulvidraco* and crucian took up 69.7% of the sample fishes by weight. They are the main commercial fish species in the downstream of the Dam.

● **Dongting Lake**

The natural fish catches was 26,000 t in the Dongting Lake in 2014, up by 12.1% compared with that of last year. Among them, 11,700 t came from eastern lake, 8,900 t from southern lake and 5,400 t from western lake, accounting for 45.0%, 34.2% and 20.8% respectively of the total. Settled fish species such as carp, crucian and catfish and the four major Chinese carp species took up 72.3% of the total catch by weight and are major commercial fish species of the Dongting Lake.

● **Poyang Lake**

The natural fish catches was 27,500 t in Poyang Lake in 2014, up by 7.0% compared with that of last year. Among the catch, settled fish species such as carp, crucian, catfish and *Pelteobagrus fulvidraco* and four major Chinese carp species accounted for 79.8% of the total catches and are major commercial fish species of the Poyang Lake. There were 35 spawning sites for fishes in the Poyang Lake with total area of 424 km^2, which were mainly distributed in eastern, central and southern parts of the lake.

● **Yangtze River estuary**

In 2014, the catch of *Coilia mystus* (tapertail anchovy) per ship, the output value per ship and the total catch of them during the fishing season of the Yangtze River estuary went down by 47.8%, 48.2% and 48.0% respectively compared with that of the same period of last year. The average length and weight went up by 8.9% and 6.5% respectively compared with that of last year.

In 2014, the catch of parent crabs per ship and total catch in the estuary during the fishing season increased by 23.0% and 220.0% respectively compared with that of the same period last year. The average shell height, average shell width and average weight went up by 33.3%, 29.3% and 25.6% respectively compared with that of the same period of last year.

In the fishing season of 2014, the elver (*Anguilla Japonica*) catch per ship, output value per ship and total catch of licensed ships in the estuary went up by 580.6%, 48.6% and 217.0% respectively compared with the same period last year.

Fish fry samples collected at Caiyanwo Section during ecological regulation

The amount of fishing permits for *Coilia mystus* issued by Shanghai authority in 2014 was similar to that of 2013. However, the granted amount of fishing permits went down by 7 for parent crabs and 461 for elver compared with that of last year.

● **Spawning sites of the four major Chinese carp species**

Jianli section in the downstream of the Dam recorded 355 mil. fries of the four major Chinese carp species between May and July 2014 with certain drop compared with that of last year. Silver carp and grass carp (*Ctenopharyngodon idellus*) were the dominant species among the four major Chinese carp species, taking up 63.5% and 18.4% respectively. The proportion of *Aristichthys nobilis* and *Mylopharyngodon piceus* was small at 18.1%.

A total of 6.835 bn. fish eggs of four major Chinese carps were monitored in Yidu section in the downstream of the Dam from May to July of 2014. The analysis based on historical data shows that the four major Chinese carp species still maintain relatively low spawning level at Yichang reach but with fluctuating rising trend over the past few years and a relatively big rise in 2014.

3.7.2 Environment of fishery waters

In 2014, 11 monitoring stations (Yibin, Banan, Wanzhou, Zhicheng, Jingzhou, Jianli, Yueyang, lake mouth, estuary, Dongting Lake, and Poyang Lake) were established in the downstream of Jinsha River, the mainstream of Yangtze River, Dongting Lake, Poyang Lake and Yangtze River estuary to monitor the water quality of important fishery waters in the Yangtze River Basin. The evaluation of water quality complies with the *Water Quality Standard for Fisheries (GB11607-89)*. The monitoring data indicated that in 2014 the water quality of important fishery waters in Yangtze River basin was good in general during the reproduction season, finishing season and overwinter season of fishes, and basically met the requirements for their growth and reproduction. However, part of the fishery waters was polluted to certain extent, and the main pollutants were TN and NH_3-N.

● **Upstream of the Yangtze River**

All of the monitoring indicators of fishery waters in Yibin and Wanzhou attained water quality standards. Up to 33.3% of fishery waters in Banan failed to meet water quality standard for petroleum oils during the finishing season, while all other water pollutants met the standard. There was no obvious change of water quality compared with that of last year.

● **Midstream of the Yangtze River**

NH_3-N concentration of 16.7% of the water samples taken from Zhicheng fishery waters exceeded the standard during the finishing season. In reproduction season, TP concentration of all of the samples failed to meet the standard, but all other pollutants met water quality standard. All of the monitoring indicators in Jingzhou fishery waters attained water quality standards. There was no evident variation of the concentrations of those monitoring indicators in waters of Zhicheng and Jingzhou compared with that of last year.

In fishery waters of Chenglingji, TN concentration of all of the samples failed to meet water quality standard in both overwinter season and reproduction season. The NH_3-N concentration of 66.7% of the water samples failed to meet the standard in overwinter season. There was some reduction in COD and TP concentrations and no evident change of other indicators compared with that of last year.

TN concentration of all of the samples taken from lake mouth fishery waters failed to meet water quality standard during overwinter, reproduction and finishing seasons. Other monitoring indicators met the standard. There was no obvious change of water quality compared with that of last year.

● **Spawning site of Chinese sturgeon**

All the monitoring indicators attained water quality standards in the spawning site of Chinese sturgeon in Yichang waters during the reproduction season, and the concentrations of those monitoring indicators had no obvious change compared with that of last year.

● **Spawning site of the four major Chinese carp species**

TP concentration of all of the samples taken from spawning site of the four major Chinese carp species in Zhicheng and Jianli failed to meet water quality standard during fish reproduction season, but all other indicators met the standard. There was no obvious change of water quality compared with that of last year.

● **Dongting Lake**

The COD of the Dongting Lake exceeded the standard by 33.3% during overwinter, reproduction and finishing

seasons. The nonattainment rate of TN was 100% in both overwinter season and reproduction season. The nonattainment rate of NH_3-N was 88.9% in overwinter season. Other pollution indicators met the standard. There was some reduction of NH_3-N concentration but no obvious change of other indicators compared with that of last year.

● **Poyang Lake**

All pollution indicators of waters of the Poyang Lake met water quality standard. There was some reduction of copper concentration but no obvious change of other indicators compared with that of last year.

● **Yangtze River estuary**

In the fishery waters of the Yangtze River estuary, the nonattainment rate of TN was 100% during the fishing seasons for elver, *Coilia mystus*, and parent crab. NH_3-N nonattainment rate was 16.7% for elver, 100% for *Coilia mystus* and 100% for parent crab fishing season. Other monitoring indicators did not go beyond water quality standard. There was some rise of NH_3-N concentration, some reduction of COD_{Mn} and no obvious change of other indicators as compared with that of last year.

3.8 Earthquake and geological disasters

3.8.1 Earthquake

There were 1,120 recorded earthquakes ($M \geqslant 0.0$) in the project area in 2014, up by 397 compared with that of last year. Among them, 850 earthquakes were rated at $0.0 \leqslant M < 1.0$, up by 277 compared with that of last year; 245 rated at $1.0 \leqslant M < 2.0$, up by 111; 18 rated at $2.0 \leqslant M < 3.0$, up by 5; 5 rated at $3.0 \leqslant M < 3.9$, up by 4; two rated at $4.0 \leqslant M < 4.9$, up by 1. The strongest earthquake was rated M4.5 and occurred in Zigui County of Hubei Province at 00:24 on March 30, 2014. There were more earthquakes but with some reduction of intensity compared with that of last year. There were several minor earthquakes and large amount of micro and mini seismic activities. The earthquakes were mainly distributed along the riverside from Badong to Zigui County in Hubei Province and Wushan area of Chongqing. There was relatively high frequency of earthquakes in the water-level-fluctuating period (January, March).

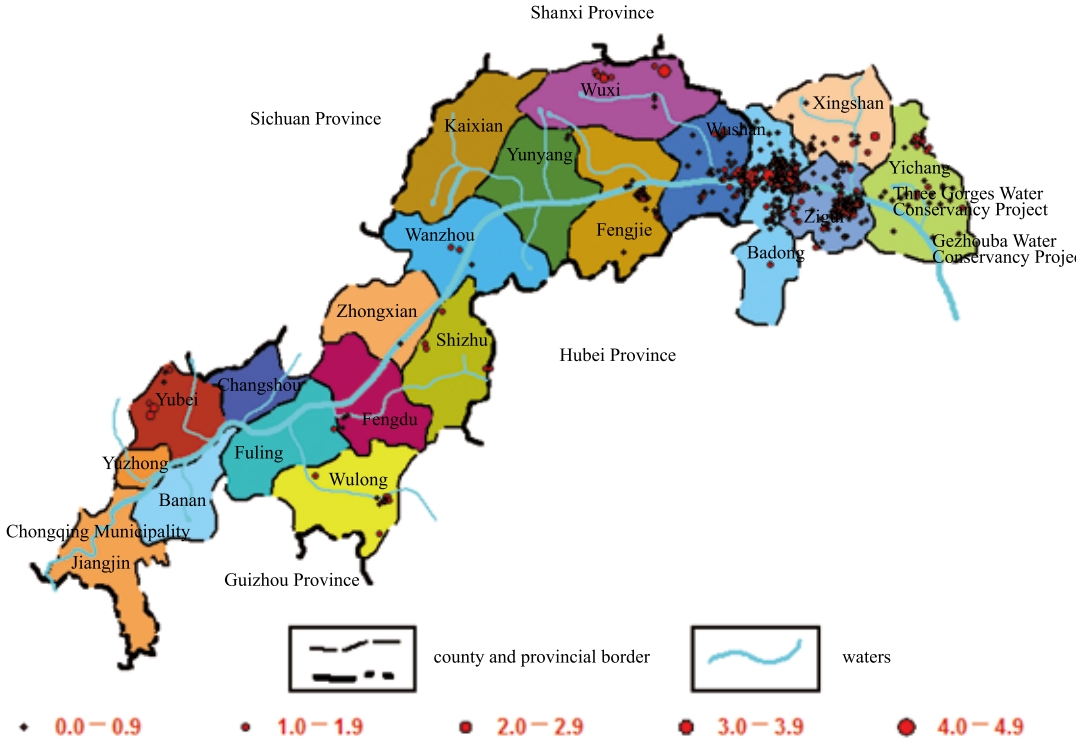


Figure 3–3 Map of epicenters of Three Gorges Project area in 2014

Table 3–2 Statistics on earthquake events of the Three Gorges Project area during 2013–2014

Year / Magnitude	2013		2014	
	Year (occurrence)	Monthly average	Year (occurrence)	Monthly average
0.0～0.9	573	47.75	850	70.83
1.0～1.9	134	11.17	245	20.42
2.0～2.9	13	1.08	18	1.50
3.0～3.9	1	0.08	5	0.42
4.0～4.9	1	0.08	2	0.17
5.0～5.9	1	0.08	0	0
Total (occurrence)	723		1120	
Max. M	5.1		4.5	

3.8.2 Geological disasters

In 2014, a total of 5,081 potential geological hazard sites (collapse, landslide and unstable reservoir banks) in the Three Gorges Project area were monitored. All the sites were monitored through mass monitoring and prevention, including 243 professional monitoring sites. A total of 1.337 mil. times of mass prevention and monitoring and 346,000 times of professional monitoring have been conducted with collection of 1.719 mil. pieces of data.

A total of 810 deformed landform sites prone to geological disasters were identified throughout the year, up by 34.3% compared with that of last year. Among them, 128 sites were subject to fierce deformation, 2.8 times of that of last year. Up to 340 sites reached hazard (disaster) level, 325 more than that of last year.

In 2014, there were frequent sudden geological disasters in the project area, a significant growth from last year. The main reason for great increase of geological disasters was heavy rainfall. A total of 11,400 people were evacuated safe and sound or resettled thanks to timely early warnings on geological disasters and effective emergency response measures. There was no casualty due to geological disasters.

Chapter 4
Discharge of Pollution Sources

4.1 Discharge of Industrial Effluent

In 2014, the total discharge of wastewater from industrial pollution sources of the Three Gorges Project area was 212 mil. t, up by 11.6% compared with that of last year. Among them, 170 mil. t were discharged by Chongqing-based project area, and 42 mil. t by Hubei-based project area; accounting for 80.2% and 19.8% respectively of the total. Among the discharged industrial effluent, 35,100 t were COD and 2,200 t were NH_3-N, up by 5.4% and 4.8% respectively compared with that of last year.

Table 4–1 Discharge of industrial effluent in the Three Gorges Project area in 2014

Region		Wastewater (100 million t)	COD (10,000 t)	NH_3-N (10,000 t)
Reservoir area in Hubei		0.42	0.61	0.03
Reservoir area in Chongqing		1.70	2.90	0.19
Total		2.12	3.51	0.22
Among them	Chongqing city proper	0.56	0.43	0.03
	Changshou Dist.	0.27	0.30	0.02
	Fuling Dist.	0.15	0.53	0.02
	Wanzhou Dist.	0.14	0.45	0.07

4.2 Discharge of Urban Pollutants

4.2.1 Urban sewage

In 2014, the total discharge of urban sewage of the Three Gorges Project area was 794 mil. t, up by 0.9% compared with that of last year. Among them, 754 mil. t were from the Three Gorges Project area in Chongqing and 40 mil. t were from the Three Gorges Project area in Hubei, accounting for 95.0% and 5.0% respectively of the total urban sewage of the project area. In the discharged urban sewage, there were 123,000 t COD and 22,600 t NH_3-N, down by 6.5% and 5.0% respectively compared with that of last year.

In 2014, there were a total of 124 urban sewage treatment plants in Three Gorges Project area, 4 more than that of last year. Among them, 24 were in the Three Gorges Project area in Hubei and 100 in Chongqing. The designed daily sewage treatment capacity for the Three Gorges Project area was 2.5247 mil. t.

4.2.2 Domestic garbage

In 2014, the total generated amount of domestic garbage from the 24 urban districts (counties) in the Three Gorges Project area reached 3.9043 mil. t, 3.4484 mil. t of which were disposed, taking up 88.3%; 455,900 t were discharged directly, taking up 11.7%.

Table 4–2 Discharge of urban sewage of the Three Gorges Project area in 2014

Region		Sewage (100 mil. t)	COD (10,000 t)	NH_3-N (10,000 t)
Project area in Hubei		0.40	0.72	0.13
Project area in Chongqing		7.54	11.58	2.14
Total		7.94	12.30	2.26
Among them	Chongqing city proper	4.39	3.36	0.99
	Changshou Dist.	0.29	0.58	0.09
	Fuling Dist.	0.43	0.91	0.14
	Wanzhou Dist.	0.59	1.43	0.20

Table 4–3 Urban domestic garbage of some areas of the Three Gorges Project area in 2014

Region	Urban permanent population (10,000)	Generated amount (10,000 t)	Disposal amount (10,000 t)	Directly discharged (10,000 t)
Jiangjin	41.60	16.00	13.76	2.24
Chongqing city proper	630.24	242.40	220.58	21.82
Changshou	31.60	12.15	10.45	1.70
Fuling	61.86	23.79	20.46	3.33
Wulong	8.10	3.12	2.59	0.52
Fengdu	20.17	7.76	6.43	1.32
Zhongxian	19.77	7.60	6.32	1.29
Shizhu	2.93	1.13	0.94	0.19
Wanzhou	91.24	35.09	29.13	5.96
Yunyang	25.87	9.95	8.26	1.69
Kaixian	25.34	9.75	8.10	1.65
Fengjie	22.77	8.76	7.27	1.49
Wushan	10.43	4.01	3.32	0.69
Badong	6.30	2.42	1.94	0.48
Xingshan	5.33	2.05	1.67	0.38
Zigui	11.56	4.45	3.61	0.83
Total	1015.11	390.43	344.84	45.59

4.3 Agricultural Non-point Pollution

4.3.1 Application and loss of pesticides

In 2014, 19 districts (counties) in the Three Gorges Project area applied 615.4 t pesticides (pesticide equivalent), a 4.7% reduction compared with that of last year. Among them, 302.0 t were organophosphorus pesticides, 108.0 t were herbicides, 61.9 t were carbamates, 59.2 t were pyrethroid pesticides, 84.3 t were others. The application of pesticides was 1.50 kg per hectare in the project area.

It is estimated from cropland plot monitoring data that the total loss of pesticide in the project area in 2014 was 38.4 t, 2.9 t less than that of last year. Among them, 23.8 t were organophosphorus pesticides, 5.7 t were herbicides, 2.8 t were carbamates, 2.7 t were pyrethroid pesticides and 3.4 t were others.

4.3.2 Application and loss of fertilizer

In 2014, 130,000 t fertilizers (fertilizer equivalent) were applied in the Three Gorges Project area, down by 4.4% compared with that of 2013; 85,000 t of them were nitrogen fertilizers, 36,000 t were phosphorus fertilizers, and 9,000 t were potassium fertilizers. The application amount per unit area is 0.32 t/ha..

It is estimated from cropland plot monitoring data that the total loss of fertilizers in the project area was 10,500 t in 2014, down by 600 t compared with that of last year. Among them, there were 8,300 t nitrogen fertilizers, 1,700 t phosphorus fertilizers and 500 t potassium fertilizers.

4.4 Discharge of Ship Pollutants

In 2014, there were 7,487 registered ships in the Three Gorges Project area. There was a reduction of 450 in registered amount and 652,100 t reduction in total tonnage compared with that of last year. There was no ship pollution accident in the area of the Three Gorges Project in 2014.

4.4.1 Oil-contaminated wastewater

In 2014, the attainment rate of oil-contaminated wastewater discharged by ship engine rooms of the project area was 90.1%. Among all types of ships, the attainment rate of oil-contaminated wastewater from engine rooms was 100% for towboats, 96.7% for passenger ships, 95.5% for non-transport ships and 88.3% for cargo ships. The attainment rate went down by 2.5% for cargo ships and 4.5% for non-transport ships compared with that of last year; while the attainment rate went up by 12.5% for towboats and 6.7% for passenger ships.

In 2014, the total amount of oil-contaminated wastewater generated in the project area was 439,000 t, 431,000 t of them were treated, taking up 98.2%. A total of 404,000 t discharged wastewater met discharge standard after treatment, taking up 91.9% of the total. The total generated amount of oil-contaminated wastewater went down by 61,000 t compared with that of last year. The post-treatment attainment rate increased by 0.8 percentage point. Among the discharged oil-contaminated wastewater, 46.1 t were petroleum oils, down by 9.1 t compared with that of last year.

4.4.2 Ship sewage

In 2014, 50 ships in the project area were surveyed on sewage discharge. Among them, the sewage of 35 ships was discharged after treatment with 54.3% attainment rate for suspended solids, 45.7% for BOD_5, 48.6% for COD, 20.0% for TN and 40.0% for E-coli. TP discharge of all ships failed to meet pollution discharge standard. The attainment rate of ship sewage had some reduction compared with that of last year, with TP and TN as major pollutants.

The estimate results based on factors such as the amount of various types of ships, annual generation of ship sewage, passenger amount, crew number, ship annual operation time, and the percentage of different tonnage ships show that the generated amount of sewage from all ships of the Three Gorges Project area in 2014 was about 3.74 mil. t, down by 198,000 t compared with that of last year. In ship sewage, there were 556.3 t of suspended solids, 548.6 t of COD, 244.4 t of BOD_5, 202.5 t of TN and 38.6 t of TP.

4.4.3 Ship garbage

In 2014, sample survey was conducted on generated amount and collection of the garbage from 61 ships. Based on the sample survey, it is estimated that the

Table 4–4 Discharge of oil–contaminated wastewater from ships in the Three Gorges Project area in 2014

Ship		Oil-containing wastewater						Petroleum oils	
Type	Amount	Generated amount (10000 t)	Pct. (%)	Treated amount (10000 t)	Treatment rate (%)	Attainment amount (10,000 t)	Attainment rate (%)	Discharge (t)	Pct. (%)
Passenger ship	2293	15.5	30.9	15.1	97.5	13.9	90.0	15.0	27.1
Cargo ship	3856	25.8	51.7	25.3	97.5	23.6	90.8	28.3	51.3
Towboat	163	1.7	3.5	1.5	87.5	1.5	87.5	0.1	0.2
Non-transport ship	1625	7.0	13.9	7.0	100.0	7.0	100.0	11.8	21.4
Total	7937	50.0	100.0	48.7	97.4	45.5	91.1	55.2	100.0

total generated amount of ship garbage of the Three Gorges Project area was about 45,000 t in the year. The port garbage collection center and garbage collection ships within the jurisdiction collected and disposed ship garbage. Among them, the garbage collection ships within the jurisdiction of the Maritime Administration collected 6,095 t ship garbage.

Chapter 5
Status of Water Environment Quality

In 2014, monitoring of the quality of water environment of the Three Gorges Project area included the monitoring on streamflow and water quality of both the mainstream and tributaries of the Yangtze River as well as comprehensive trophic state and algal bloom of main tributaries. The assessment of overall water quality and comprehensive trophic state complied with *Environmental Quality Standard for Surface Water* (on trial) (Huanban No.[2011]22) released by Ministry of Environmental Protection.

5.1 Streamflow

In 2014, five streamflow monitoring sections were established in the mainstream of the Yangtze River in the Three Gorges Project area. They were Zhutuo section in Yongchuan District, Cuntan section in Chongqing city proper, Qingxichang section in Fuling District, Tuokou section in Wanzhou District, and Guandukou section in Badong County. The discharge of the mainstream of the Yangtze River in the Three Gorges Project area ranged between 2,950 m^3/s and 37,000 m^3/s, and the mean flow rate varied from 0.09 m/s to 2.43 m/s. The flow rate of the reach from Tuokou section to the Dam became much smaller compared with that of upstream reaches due to the impoundment of the reservoir. The mean flow rate of each section from big to small was 1.47 m/s at Zhutuo, 1.32 m/s at Cuntan, 0.66 m/s at Qingxichang, 0.35 m/s at Tuokou, and 0.26 m/s at Guandukou. The maximum flow rate of each section in the order from big to small was 2.37 m/s at Zhutuo, 2.43 m/s at Cuntan, 1.55 m/s at Qingxichang, 0.84 m/s at Tuokou and 0.65 m/s at Guandukou.

5.2 Water quality

In 2014, 6 water quality monitoring sections were established in the mainstream of the Yangtze River in the Three Gorges Project area. They were Zhutuo section in Yongchuan District, Jiangjin Bridge section, Cuntan section in Chongqing city proper, Qingxichang section in Fuling District, Shaiwangba section in Wanzhou District, and Guandukou section in Badong County. Two water quality monitoring sections were established in Jinzi and Beiwenquan of the Jialing River and 2 water quality monitoring sections were established in Wanmu and Luoying of the Wujiang River.

Monitoring results show that the overall water quality of the mainstream of the Yangtze River in the Three Gorges Project area of 2014 was good. The overall water quality of the Jialing River was excellent. The TP concentration of the water of the Wujiang River failed to meet national surface water quality standard.

The overall water quality of 6 monitoring sections in the mainstream of Yangtze River in the Three Gorges Project area met Grade Ⅲ standard in 2014. The concentration of faecal coliform bacteria at Cuntan section failed to meet Grade Ⅴ surface water quality standard, but that of other sections met or was superior to Grade Ⅲ. In all months of the year, the water quality of Zhutuo section during January-July, Jiangjin Bridge section during March-July, Cuntan section in February and Qingxichang section in April met Grade Ⅳ standard, with TP as the nonattainment indicator. The water quality of the 6 sections in the rest months met or was superior to Grade Ⅲ standard. The concentration of faecal coliform bacteria at Cuntan section went beyond water quality standard in all months except in February and December at Grade Ⅲ. The concentration of faecal coliform bacteria at other 5 sections met was superior to Grade Ⅲ in all months.

The overall water quality of Jinzi section and Beiwenquan section of the Jialing River met Grade Ⅱ standard in the whole year. The overall water quality of Wanmu section of Wujiang River met Grade Ⅴ standard in 2014, while the water quality of Luoying section met Grade Ⅲ standard with TP as the main pollutant. The water quality of both Jinzi section and Beiwenquan section met Grade Ⅲ standard in all months. The water quality of Wanmu section met Grade Ⅴ standard during January-February, failed to meet Grade Ⅴ standard during March-May, met Grade Ⅳ standard during June-November and met Grade Ⅲ standard only in December. The water quality of Yingluo section met Grade Ⅳ standard in January, February and April; Grade Ⅴ standard in March and Grade Ⅲ standard in other months.

Table 5–1 Water quality of the monitoring sections of mainstream of the Yangtze River in the Three Gorges Project area in 2014

Section	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Zhutuo	Ⅳ	Ⅳ	Ⅳ	Ⅳ	Ⅳ	Ⅳ	Ⅳ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ
Jiangjin Bridge	Ⅲ	Ⅲ	Ⅳ	Ⅳ	Ⅳ	Ⅳ	Ⅳ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ
Cuntan	Ⅲ	Ⅳ	Ⅳ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ
Qingxichang	Ⅲ	Ⅲ	Ⅲ	Ⅳ	Ⅳ	Ⅳ	Ⅲ	Ⅲ	Ⅱ	Ⅱ	Ⅲ	Ⅲ	Ⅲ
Shaiwangba	Ⅲ	Ⅲ	Ⅳ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅱ	Ⅱ	Ⅲ	Ⅱ	Ⅲ
Guandukou	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅱ	Ⅱ	Ⅱ	Ⅱ	Ⅱ	Ⅲ

Table 5–2 Water quality of monitoring sections in the Jialing River and Wujiang River of the Three Gorges Project area in 2014

Section	River	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Jinzi	Jialing River	Ⅱ	Ⅱ	Ⅱ	Ⅱ	Ⅱ	Ⅱ	Ⅱ	Ⅱ	Ⅱ	Ⅱ	Ⅱ	Ⅱ	Ⅱ
Beiwen-quan	Jialing River	Ⅲ	Ⅱ	Ⅱ	Ⅱ	Ⅱ	Ⅱ	Ⅲ	Ⅱ	Ⅱ	Ⅲ	Ⅲ	Ⅲ	Ⅱ
Wanmu	Wujiang River	Ⅴ	Ⅴ	＞Ⅴ	＞Ⅴ	＞Ⅴ	Ⅳ	Ⅳ	Ⅳ	Ⅳ	Ⅳ	Ⅳ	Ⅲ	Ⅴ
Luoying	Wujiang River	Ⅳ	Ⅳ	Ⅴ	Ⅳ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅱ	Ⅲ	Ⅱ	Ⅲ	Ⅲ

5.3 Trophic state and algal blooms of main tributaries

5.3.1 Trophic state

A total of 77 trophic state monitoring sections were established in 38 main tributaries which are subject to the backwater effect of the mainstream of the Yangtze River, and in the bay waters in the upstream of the Dam which had similar hydrological conditions. Five indicators such as Chlorophyll-a, TP, TN, COD_{Mn} and SD were employed to calculate the trophic level index (TLI) and assess comprehensive trophic state of the water bodies. The findings showed that the eutrophication of the waters of 38 major tributaries of the Three Gorges Project area had some increase during sensitive period (March～October) of algal blooms in 2014 compared with that of last year.

In 77 monitoring sections, 20.8%～37.7% were in eutropher, 57.1%～75.3% were under mesotrophic state and 0～6.5% were under oligotrophic state in 2014. Among them, 20.0%～45.0% sections in backwater areas were in eutropher, while 16.2%～29.7% sections in non-backwater areas in eutropher. The eutrophication extent of backwater areas was higher than that of non-backwater bodies. The proportion of eutrophication sections in major tributaries in the project area went up 2.6, 11.7, 5.2, 9.1 and 5.2 percentage points respectively in March, April, June, September and October compared with that of same period of last year. The eutrophication sections went down by 6.5 percentage points in July and 5.2 percentage points in August, without notable change in May.

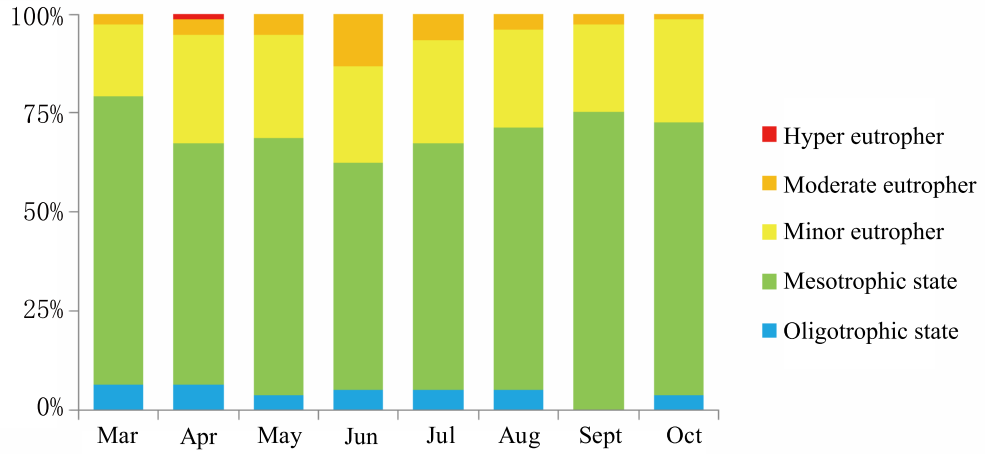


Figure 5–1 Trophic state of main tributaries of the Yangtze River in the Three Gorges Project area during March~October of 2014

5.3.2 Algal blooms

In 2014, there were algal blooms in backwater area of main tributaries of the Yangtze River such as Qinggan River, Shennong Stream, Daning River, Modao Stream, Meixi River, Qingxi River, Zhuxi River, Ruxi River, Dongxi River, Chixi River, Longhe River, and Xiangxi River in the Three Gorges Project area. The algal bloom mainly occurred in the spring and autumn. The dominant algae species of algal bloom in the spring were mainly Cyclotella, Synedra and Melosira of Bacillariophyta; Cryptomonas of Cryptophyta; Ceratium and Peridinium of Pyrrhophyta; Chlamydomonas of Chlorophyta; and Microcystis of Cyanophyta. In the autumn, the dominant algae species mainly were Anabaena of Cyanophyta; Eudorina of Chlorophyta; Cyclotella of Bacillariophyta and Cryptomonas of Cryptophyta.

Chapter 6
Status of Public Health

6.1 Basic Situation

In 2014, the monitoring range of public health of the Three Gorges Project area included 19 townships, towns and sub-districts of five monitoring sites including Chongqing city proper; Fengdu County, Wanzhou District and Fengjie County in Chongqing Municipality and Yichang City in Hubei Province. The total population under monitoring this year was 758,347, up by 5,232 compared with that of last year. Among them, 387,801 were male and 370,546 were female with the gender ratio at 1.05:1. A total of 422,194 people lived in cities and towns; while 336,153 people lived in countryside. There were 329 health institutions at all levels within the monitoring sites, 11 more than that of last year. There were 6,163 hospital beds in all health institutions of all monitoring sites, up by 310 compared with that of last year. The total amount of various public health workers at different levels was 7,031, an increase by 155 compared with that of last year.

6.2 Life Statistics

In 2014, a total of 5,992 babies were born in monitoring sites of Chongqing, Fengdu, Wanzhou, Fengjie and Yichang; 3,134 of them were male and 2,858 were female with the gender ratio at 1.10:1. The birthrate was 7.90‰, down by 5.73% compared with that of 2013. There were 4,863 infant deaths. The mortality was 6.41‰, up by 3.2% compared with that of last year. The mortality was 7.31‰ for male and 5.48‰ for female.

The birth rate was 9.00‰ for Chongqing, 10.03‰ for Fengdu, 5.08‰ for Wanzhou, 10.51‰ for Fengjie and 6.04‰ for Yichang. The mortality was 7.10‰ for Chongqing, 6.97‰ for Fengdu, 6.50‰ for Wanzhou, 4.78‰ for Fengjie and 6.76‰ for Yichang. There was 2.8% rise in Fengdu, 14.0%, 12.1%, 4.0% and 3.8% reduction of birthrate in Yichang, Chongqing, Fengjie and Wanzhou respectively compared with that of last year. The mortality of Wanzhou and Chongqing went up by 24.5% and 5.0% respectively; while the mortality of Fengjie, Yichang and Fengdu went down by 16.6%, 6.9% and 1.4% respectively.

All monitoring sites reported 20 cases of infant death, 12 of which were male and 8 female. The infant mortality was 3.34‰, down by 24.8% compared with that of last year (4.44‰).

According to the ICD-10 disease classification standard, the top five diseases with the highest mortality of the people in monitoring sites in 2014 were circulatory system disease, malignant tumor, respiratory system disease, damages & poisoning and digestive system disease with mortality at 235.51/100,000, 171.95/100,000, 112.48/100,000, 46.68/100,000 and 14.90/100,000; causing 36.7%, 26.8%, 17.5%, 7.3% and 2.3% respectively (combined, 90.7%) of the total deaths. The ranking of the top five diseases kept the same, with little change in the contribution of each disease to total deaths compared with that of last year.

6.3 Monitoring of Diseases

6.3.1 Monitoring of infectious diseases

All monitoring sites reported a total of 4,387 cases of notifiable infectious diseases in 2014. The reported morbidity was 578.50/100,000, up by 18.6% compared with that of last year. There was one death with mortality at 0.13/100,000. There was no reported case of Category A infectious disease. The morbidity from high to low was 752.59/100,000 in Chongqing, 709.91/100,000 in Yichang, 693.82/100,000 in Fengdu, 474.33/100,000 in Wanzhou and 368.86/100,000 in Fengjie. There was 69.5%, 20.8%, 19.9% and 7.2% rise of morbidity in Fengdu, Yichang, Chongqing and Fengjie monitoring sites respectively but 4.3% drop of morbidity in Wanzhou compared with that of last year. The reported cases of Category B infectious diseases were the most in June and the least in December, ranging from 140 to 220 in the rest months. There were two peaks (April～June and October～December) of Category C infectious diseases due to relatively more reported cases of hand-foot-mouth disease, parotitis and other infectious diarrhea.

All monitoring sites reported 2,167 cases of 10 types of Category B infectious diseases (excluding HIV victims) with morbidity at 285.75/100,000, up by 7.0% compared with that of last year. In all monitoring sites, Yichang had the highest morbidity of Category B infectious diseases at 437.74/100,000, followed by Chongqing, Fengdu, Fengjie; and Wanzhou has the lowest at 175.18/100,000. Compared with that of last year, the morbidity of Fengdu, Chongqing and Fengjie went up by 15.7%, 13.0% and 4.4% respectively; while the morbidity of Yichang monitoring site went down by 1.4% with no change in Wanzhou. The top five Category B diseases measured by morbidity were viral hepatitis (124.35/100,000), TB (97.05/100,000), syphilis (29.41/100,000), dysentery (18.20/100,000) and gonorrhea (9.63/100,000). The 5 kinds of diseases took up 97.5% of the total cases of Category B diseases. Among Category B infectious diseases, the morbidity of hepatitis B, hepatitis C, gonorrhea, measles and TB had some rise compared with that of last year; while the morbidity of the rest diseases had some decline. The amount of HIV infected cases went up by 13.6% compared with that of last year. The water-borne diseases in relation to impoundment such as hepatitis A (1.32/100,000) and dysentery (18.20/100,000) were still at a low level. There was one case of encephalitis B (natural focus diseases) due to change of media insects; but there was no reported case of leptospirosis, dengue fever, malaria and hemorrhagic fever.

All monitoring sites reported 2,220 cases of 6 kinds of Category C infectious diseases with morbidity at 292.74/100,000, up by 32.7% compared with that of last year. The morbidity of Category C infectious diseases from big to small was 383.26/100,000 in Fengdu, 374.22/100,000 in Chongqing, 299.15/100,000 in Wanzhou, 272.17/100,000 in Yichang and 124.35/100,000 in Fengjie. The morbidity went up by 172.0% in Fengdu, 89.6% in Yichang, 27.7% in Chongqing and 13.3% in Fengjie monitoring sites; but dropped by 6.7% in Wanzhou monitoring site.

The positive rate of serum antibody of hemorrhagic fever, leptospirosis and epidemic encephalitis B of healthy population of all monitoring sites was 6.6%, 9.2% and 82.5% respectively. Compared with the past monitoring results, the serum antibody level of hemorrhagic fever fluctuated under 10.0%. The serum antibody content of leptospirosis had great decline, especially among the populations of Fengdu and Fengjie monitoring sites. The serum antibody content of epidemic encephalitis B had big increase. There are populations susceptible to the above three kinds of infectious diseases at different degrees in the Three Gorges Project area. Therefore, further efforts should be made to strengthen the prevention and control of infectious diseases of the target populations and avoid any outbreak of epidemics.

6.3.2 Monitoring of endemic diseases

In 2014, the monitoring sites of Chongqing, Wanzhou, Fengdu, Fengjie and Yichang conducted monitoring on iodine deficiency disorders. Palpation method was employed to investigate thyroid enlargement. A total of 452 children aged 8~12 were investigated, 19 of them had Degree-I thyromegaly, taking up 4.2% and with some increase compared with that of last year; it was slight epidemic of this disease. A total of 1,573 households were investigated on their edible salt, 1,570 of them consumed iodine added salt, taking up 99.8%. The iodine added salt of 1,481 households was qualified, accounting for 94.3%. The consumption rate of qualified iodine added salt was 94.2%. The iodine added salt coverage, the qualification rate of such salt, and the consumption rate of qualified iodine added salt had some rise compared with that of last year. There was high coverage of iodine added salt but relatively low qualification rate and consumption rate of such salt in all monitoring sites; this might have something to do with factors such as the application of new iodine concentration for edible salt, rise of market share of multi-element nutrient salt as well as inappropriate storage and use of edible salt. The iodine added salt failed to cover 100% of Fengdu and Wanzhou monitoring sites and a small proportion of local residents still consumed non-iodized salt, this had something to do with poor supervision on non-iodized salt used for processing of preserved Szechuan vegetables in the region, which entered the market as a result.

In 2014, dental fluorosis was monitored in Fengjie County with a total sample of 349 children aged 8～12; 63 of them had dental fluorosis with positive rate at 18.1%. The data showed that the local dental fluorosis due to coal burning pollution still maintained relatively high morbidity.

6.3.3 Sudden public health event

There was no report of sudden public health event in all monitoring sites.

6.4 Monitoring of Biological Media

6.4.1 Monitoring of rats

In 2014, the average indoor rat density was 2.25% and the outdoor rat density was 2.86% for all monitoring sites of the project area. The average outdoor rat density was higher but indoor rat density was slightly lower compared with that of last year, and both were lower than the 5-year (1999～2003) average (3.94% and 4.22%) before stage II impoundment. The indoor and outdoor rat density of autumn was slightly higher than that of spring, similar to that of last year. In the spring, the indoor rat density (2.25%) was lower than outdoor rat density (2.70%). In the autumn, the indoor rat density (2.26%) was lower than outdoor rat density (2.98%), contrary to that of last year. The indoor rat density of all monitoring sites from high to low was 5.05% in Fengdu, 4.48% in Wanzhou, 1.68% in Fengjie, 0.91% in Chongqing and 0.67% in Yichang. The outdoor rat density from high to low was 6.59% in Chongqing, 4.13% in Fengdu, 3.87% in Wanzhou, 0.86% in Yichang and 0.72% in Fengjie. The monitoring data of 18 years showed an overall declining trend of both indoor rat density and outdoor rat density.

In indoor environment, sewer rat (*Rattus norvegicus*) was the dominant rat species, taking up 37.7%, followed by house mouse (*Mus musculus*) at 27.5% and *Rattus flavipectus* at 24.6%; in the same order as that of last year. In outdoor environment, the small insectivore [mostly Sichuan short-tailed shrew (*Anourosorex squamipes*)] still was the dominant species, taking up 51.1%. Sewer rat ranked No.2 at 16.1%; striped field mouse (*Apodemus agrarius*) took up 11.2%, rose to No.3 from No.4 last year. The proportion of indoor sewer rat and *Rattus flavipectus* went up, with significant reduction of house mouse proportion compared with that of last year. There were some catches of *Apodemus agrarius* and small insectivore with evident decline of other rat species. The outdoor catch of small insectivore still had the biggest amount with significant rise of its proportion compared with that of last year; whereas the percent of sewer rat, house mouse (*Mus musculus*), *Rattus flavipectus, Apodemus agrarius* and other rat species had some decrease. As the host of pathogens of hemorrhagic fever and leptospirosis, *Apodemus agrarius* has maintained as No.2～3 outdoor dominant species over the past years. Although the percent of *Apodemus agrarius* had great reduction during 2011～2012, it had gone up in both 2013 and 2014, therefore, attention should be paid to it.

Catching rats in the grass of the water–level–fluctuating area

6.4.2 Monitoring of mosquitoes

In 2014, the overall adult mosquito density of livestock pens and human dwellings was 135.63/ pen•labor hour and 26.82/room•labor hour respectively, both higher than that of last year but lower than the 5-year average (198.57/pen• labor hour and 63.97/room• labor hour) before stage II impoundment. Among all monitoring sites, the adult mosquito density of human dwellings from high to low was 90.8/room• labor hour in Wanzhou, 45.64/room• labor hour in Chongqing, 10.77/ room• labor hour in Fengjie, 10.44/room• labor hour in Fengdu and 6.64/room• labor hour in Yichang. The overall adult mosquito density of livestock pens from high to low was 186.55/pen• labor hour in Chongqing, 148.16/pen• labor hour in Wanzhou, 131.4/pen• labor hour in Fengdu, 121.56/pen• labor hour in Fengjie and 113.52/pen• labor hour in Yichang. The adult mosquito density of human dwellings had some rise in Fengdu, Wanzhou, Fengjie and Yichang but slight drop in Chongqing compared with that of last year, whereas the adult mosquito density of livestock pens had some rise in Chongqing, Fengjie and Yichang but some drop in Wanzhou and Fengdu. The monitoring data of the past 18 years showed overall declining trend of adult mosquito density for human dwellings with some rise in the past two years; and overall declining trend of adult mosquito density for livestock pens in the first 10 years and relatively stable trend in the latest 8 years ranging between 110～150/ pen• labor hour.

The 10-day change trend of adult mosquito density in both human dwellings and livestock pens was basically the same during May~September. The adult mosquito density of human dwellings of all monitoring sites peaked in late May in Yichang, early June in Chongqing,

Monitoring of biological media

late June in Wanzhou, early July in Fengdu and early August in Fengjie. Whereas the adult mosquito density of livestock pens peaked in late May in Yichang, early June in Fengdu, early July in Wanzhou, early August in Chongqing and early August in Fengjie. The *Armigeres subalbatus* was the dominant species in both human dwellings and livestock pens, taking up 78.5% and 84.4% respectively of the total. In human rooms, *Culex pipiens fatigans* ranked No.2 at 15.4%, followed by *Anopheles sinensis*, *Culex tritaeniorhynchus* and *Culex pipiens pallens* in descending order. In livestock pens, *Culex pipiens fatigans* ranked No.2; *Culex tritaeniorhynchus, Anopheles sinensis* and *Culex pipiens pallens* ranked No.3～5 respectively. There was some rise in the proportion of *Armigeres subalbatus* and *Culex pipiens fatigans* but certain drop of the percent of *Culex pipiens pallens* and *Anopheles sinensis* in both human rooms and livestock pens compared with that of last year. The percentage of *Culex tritaeniorhynchus* was the same in human rooms but had some rise in livestock pens compared with that of last year.

In general, the densities of major disease-spreading species of mosquitoes in human dwellings were quite low with relatively small risk of disease spread. There was slight rise of the density of *Culex pipiens fatigans* in livestock pens. However, there were more empty pens, and less pens were home to large livestock, which could reduce the risk of spread of epidemic encephalitis B.

Chapter 7
Environmental Quality of the Dam Area

7.1 Hydrology and Meteorology

7.1.1 Streamflow

In 2014, the statistical analysis of the monitoring data of Huanglingmiao Streamflow Measuring Station in the downstream of the Three Gorges Dam showed that the mean annual discharge was 14,100 m^3/s with the maximum discharge 47,000 m^3/s on September 20 and minimum discharge of 4,990 m^3/s on February 11. The mean annual sediment discharge was 0.334 t/s with average sediment concentration at 0.024 kg/m^3. The maximum mean sediment concentration of the monitoring section was 0.250 kg/m^3 on September 5 and minimum mean sediment concentration of 0.002 kg/m^3 on January 1. The mean annual discharge and mean annual water level of the Three Gorges Dam area went up; while the mean annual sediment discharge rate and mean sediment concentration went down compared with that of last year.

Table 7–1 Monthly discharge at Huanglingmiao Streamflow Measuring Station in 2014

Unit: m^3/s

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Average	6560	6360	6350	9660	12600	16200	25800	23200	30100	14100	9810	7470	14100
Max.	7650	7710	7270	14200	16800	20700	31000	30300	47000	22500	19900	9290	47000
Min.	5760	4990	5000	5350	8190	9960	12700	13200	21100	8290	5310	6000	4990

Table 7–2 Monthly sediment concentration at Huanglingmiao Streamflow Measuring Station in 2014

Unit: kg/m^3

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Average	0.002	0.002	0.003	0.003	0.005	0.009	0.042	0.023	0.064	0.009	0.005	0.003	0.024
Max.	0.002	0.003	0.004	0.004	0.006	0.017	0.104	0.057	0.250	0.036	0.006	0.004	0.250
Min.	0.002	0.002	0.003	0.003	0.004	0.006	0.012	0.009	0.014	0.003	0.004	0.003	0.002

7.1.2 Climate

In 2014, the mean annual temperature of the Three Gorges Dam area was close to the historical average with slightly more precipitation.

● **Air temperature**

The mean annual air temperature of the Three Gorges Dam area was 16.9℃, 0.2℃ lower than the historical average. The annual extreme high temperature was 39.9℃ on July 22; and the annual extreme low temperature was -2.6℃ on February 14.

● **Precipitation**

The annual precipitation of the area was 1,031.7 mm, 1.7% rise compared with the historical average. The distribution of precipitation was not even among the months, mainly concentrated on April～October with the maximum daily precipitation of 127.4 mm on August 7. The longest continuous non-precipitation period in the year was 22 days between December 16, 2013 and January 6, 2014. The longest continuous precipitation period in the year was 6 day, occurring during October 28～November 2.

● **Wind speed**

The mean annual wind speed of the area was 0.9 m/s with the maximum at 16.8 m/s on July 19. The wind direction of the area was ever-changing in the whole year with north wind in dominance, taking up 10%.

Table 7–3 Meteorological indicators of the Three Gorges Project area in 2014

Month		Jan.	Feb.	Mar	Apr.	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Year
T	Temperture (℃)	7.6	6.0	13.3	17.2	20.3	24.5	27.1	25.2	23.0	18.8	12.6	7.5	16.9
	Departure (℃)	2.4	-1.5	1.1	0.4	-1.4	-0.9	-0.3	-1.3	0.2	0.8	-0.3	0.0	-0.2
P	Precipitation (mm)	12.3	24.6	17.5	111.5	61.9	70.8	204.6	243.9	124.1	99.8	58.2	2.5	1031.7
	Departure (%)	-24.5	-33.2	-64.2	34.5	-51.3	-40.2	22.8	39.6	7.5	46.5	31.4	-83.4	1.7
Wind speed	Mean (m/s)	0.8	1.2	1.0	0.7	0.6	0.5	1.1	0.7	0.9	1.0	1.0	1.1	0.9
	Max. (m/s)	5.5	4.4	6.5	4.5	5.0	4.9	8.9	7.4	4.6	3.8	3.9	6.0	8.9
	Extreme (m/s)	8.9	9.7	10.0	9.1	7.8	8.2	16.8	11.8	8.1	6.7	8.0	11.2	16.8

7.2 Air quality

The assessment of ambient air quality of the Dam area (office and residential areas and construction sites) complied with the Ambient Air *Quality Standard* (GB3095-1996).

In 2014, the mean annual SO_2 concentration of the area was 0.009 mg/m^3, meeting Grade Ⅰ national air quality standard, up by 0.001 mg/m^3 compared with that of last year. The mean daily SO_2 concentrations all met Grade Ⅰ standard. The mean annual NO_2 concentration was 0.016 mg/m^3, meeting Grade Ⅰ air quality standard, down by 0.001 mg/m^3 compared with that of last year. The mean daily NO_2 concentrations met Grade I standard.

The mean annual TSP concentration of the area was 0.133 mg/m^3, meeting Grade Ⅱ air quality standard, down by 0.021 mg/m^3 compared with that of last year. Among them, 46.5%, 51.4% and 2.1% mean daily TSP concentrations of office and residential areas met Grade Ⅰ, Ⅱ or Ⅲ air quality standard respectively; while 45.1%, 53.5% and 1.4% of mean daily TSP concentrations of construction sites met Grade Ⅰ, Ⅱ or III air quality standard respectively.

7.3 Water quality

A total of 13 indicators including pH value, dissolved oxygen, NH_3-N, COD, COD_{Mn}, BOD_5, volatile phenol, cyanide, arsenic, Cr^{6+}, copper, lead and cadmium were chosen to assess the water quality of the mainstream of Yangtze River in the Dam area in accordance with the *Environmental Quality Standard for Surface Water* (GB3838-2002). Anion surfactant indicator was added to assess the water quality of near-bank waters.

In 2014, the water quality of all sections of the mainstream of Yangtze River and near-bank waters in the Dam area was excellent, meeting Grade Ⅰ standard in the year, basically same as that of last year.

Table 7–4 Water quality of the mainstream sections of the Yangtze River in the Three Gorges Dam area in 2014

Section	Q1	Q2	Q3	Q4	Year
Taipingxi	I	I	II	I	I
Letianxi	I	I	II	I	I

Table 7–5 Water quality of the near–bank waters of the Yangtze River in the Three Gorges Dam area in 2014

Sampling site		Q1	Q2	Q3	Q4	Year
Left bank (30m to the bank)	Upstream approach	I	I	II	II	I
	Downstream approach	I	I	I	I	I
Right bank (30m to the bank)	Auxiliary dam	I	I	II	I	I

7.4 Noise

In 2014, the average daytime and nighttime ambient noise of office and residential areas of the Three Gorges Dam area was 56.2 dB and 46.3 dB respectively, both meeting Grade II standard of the *Environmental Quality Standards for Noise* (GB3096-2008). There was 0.1 dB drop of average daytime ambient noise and 2.9 dB rise of average nighttime noise in the office and residential areas compared with that of last year. In the construction sites, it was 52.4 dB for the average daytime ambient noise and 47.3 dB for the average nighttime noise, both within the noise limits for workshops and operation sites specified in *Specifications for the Design of Noise Control System in Industrial Enterprises* (GBJ87-1985). There was 2.7 dB rise for average daytime ambient noise and 0.1 dB rise of nighttime noise in the construction sites compared with that of last year. The noise of boundary sites complied with the *Noise Limits for Construction Site* (GB12523-2011). The mean annual average traffic noise of the Three Gorges Dam area was 65.5 dB, down by 2.1 dB compared with that of last year.

Chapter 8
Monitoring and Studies on Ecological Environment

8.1 Wanzhou Model Zone

Centering on the issues such as appropriate use and protection of slope land, and control of water and soil erosion as well as non-point pollution, Wanzhou Model Zone has conducted studies on highly efficient ecological agriculture model for slope farmland focusing on the compound ridge tillage of grain crops, cash crops and fruit trees on slope farmland (hereinafter referred to as Model I) and slope land with hedgerow model.

8.1.1 Experiment on the compound ridge tillage of grain crops, cash crops and fruit trees on slope farmland

The monitoring results of 2014 showed that the compound ridge tillage of grain crops, cash crops and fruit trees on slope farmland (Model Ⅰ) could significantly improve physical and chemical properties as well as water retention capacity of soil and reduce non-point pollution load.

In improvement of soil physical and chemical properties, Model I raised the content of organic matter by 23.8%, TN by 17.9%, TP by 18.5%, TK by 8.9%, Kjeldahl nitrogen by 19.0%, available phosphorus by 38.1% and available potassium by 26.9% respectively compared with that of the traditional flat tillage of grain and cash crops up and down the slope (hereinafter referred to as Model Ⅱ).

Survey on soil fertility

In retention of water and soil, Model I has raised soil moisture by 14.2%, 11.5% and 12.4% respectively in 2, 4 and 8 days after rainfall compared with that of Model Ⅱ. Furthermore, there was 69.5% reduction of surface runoff modulus and 87.4% reduction of soil erosion modulus.

In the control of non-point pollution, the loss of TN and TP was 363.39 g/ha•y and 94.98 g/ha•y respectively for Model I, down by 82.2% and 83.7% compared with that of Model II. Among them, the loss of 164.26 g/ha•y of TN and 71.38 g/ha•y of TP was caused by sediment loss; and the loss of 199.13 g/ha•y of TN and 23.60 g/ha•y of TP was due to surface runoff loss.

In Model I, there was 6.5%, 4.9%, 16.3% and 8.3% rise of TN, TP, available phosphorus and available potassium content respectively in soil but with some drop of organic matter (8.8%), TK (12.0%) and Kjeldahl nitrogen (14.9%) compared with that of last year; whereas there was 16.1% rise of surface runoff and 32.8% reduction of soil erosion. In addition, there was 25.1% reduction of TN loss and 8.3% reduction of TP loss.

8.1.2 Experiment on steep slope hedgerow model

The monitoring data of 2014 showed that the hedgerow model reduced soil bulk density, raised soil porosity and soil silt and clay content, improved soil fertility, raised soil moisture, decreased surface runoff and erosion and lowered pollution load of non-point sources.

Regarding the improvement of soil physical and chemical properties, the hedgerow model has raised the content of soil organic matter, TN, TK, Kjeldahl nitrogen, available phosphorus and available potassium by 10.3%, 18.5%, 5.0%, 31.0%, 21.3% and 23.2% respectively compared with that of the bare steep slope (control model).

In water and soil conservation, the hedgerow model has increased the soil moisture by 5.5%, 6.7% and 6.9% respectively in 2, 4 and 8 days after rainfall. The surface runoff modulus was 101.00 m^3/ha•y and soil erosion modulus was 77.60 kg/ha•y, down by 68.0% and 31.8% respectively compared with that of the control model.

In the control of non-point pollution, the hedgerow model had 417.10 g/ha•y loss of TN and 105.41 g/ha•y loss of TP, down by 51.5% and 52.8% respectively compared with that of control model. Among them, there was 221.16 g/ha•y loss of TN and 79.15 g/ha•y loss of TP due to sediment loss; while there was 195.94 g/ha•y loss of TN and 26.26 g/ha·y loss of TP due to surface runoff loss.

There was slight rise of soil bulk density and some drop of porosity in the hedgerow model compared with that of last year. There was 3.5%, 27.3%, 4.1%, 2.8% and 6.9% rise of soil organic matter, TN, TK, Kjeldahl nitrogen and available potassium respectively compared with that of last year; however, there was 20.7% reduction of TP and 2.4% drop of available phosphorus. There was 52.6% rise of surface runoff modulus and 94.0% increase of soil erosion modulus. In addition, there was 76.8% rise of TN loss and 101.1% increase of TP loss.

8.2 Zigui Model Zone

8.2.1 Monitoring soil erosion and water and nutrient loss of slope farmland

The slope farmland and navel orange orchard with protection measures could remarkably reduce soil and water erosion and nitrogen and phosphorus loss. The three types of ecological plantation models, that is, ryegrass-soybean plot, wheat-peanut plot with toon interplanted as hedgerow and wheat-peanut plot with alfalfa interplanted as hedgerow reduced slope runoff by 26.1%, 55.8% and 38.2% respectively compared with that of the conventional wheat-peanut plot. They also reduced slope soil erosion by 60.4%, 81.9% and 76.8% respectively. The total loss of nitrogen went down by 28.9%, 35.5% and 18.2% respectively; and TP loss declined by 53.4%, 53.9% and 61.8% respectively.

Four kinds of treatment measures such as interplanting perennial White Clover as hedgerow, straw coverage, intercropping day lily as hedgerow, and embedment of contour impervious film helped reduce 52.6%, 55.5%, 47.8% and 36.0% respectively of slope sediment and decrease 14.2%, 36.7%, 24.3% and 32.0% respectively of sediment nitrogen loss compared with that of conventional navel orange orchards. Different from the way of nitrogen loss, a relatively high proportion of phosphorus was lost in the form of particles. The analysis results of sediment phosphorus loss showed that the above four measures reduced sediment phosphorus loss by 0.87%, 31.8%, 21.9% and 27.5% respectively compared with conventional navel orange orchards.

8.2.2 Studies and demonstration on eco-agricultural models on the slope farmland

Land use and management approaches have significant impact on the fertility of mountain soils. The findings of 2014 investigation showed the soils of the monitoring sites contained 48.8%～62.8% of sand (diameter of 2.0～0.05 mm), 14.6%～37.4% of silty sand (diameter of 0.05～0.002 mm), and 13.8%～22.6% of clay (diameter＜0.002 mm). The content of soil nutrients was 8.03～28.62 g/kg for soil organic matter; 0.77～1.66 g/kg for TN; 0.30～1.13 g/kg for TP; 7.70～27.79 g/kg for TK; 37.58～195.71 mg/kg for Kjeldahl nitrogen; 1.10～198.43 mg/kg for available phosphorus and 57.00～285.30 mg/kg for available potassium.

Most slope lands with altitude over 700 m within the monitoring region have been turned into terraced fields with plantation of crop species such as sweet potato, corn, wheat, groundnut and rice. Meanwhile, there are also cash crops such as Chinese chestnut, pear and tea but not in scale. The mountain crop lands with big slope suffering from serious ecological degradation have been planted with trees. There is no significant change in the contents of organic matter, nitrogen, phosphorus and potassium in the soils with elevation over 700 meters.

Setting up sensors for soil monitoring

Most areas in the monitoring region with elevation under 700 m are the bases for citrus plantation. The soil of navel orange orchards is purple soil. The findings of 13-year long-term trial showed some differences in the fertility of soils 0～20 cm underground. Compared with that of control plot, there was 4.46 g/kg and 8.83 g/kg rise respectively of organic matter; 0.18 g/kg and 0.35 g/kg increase of TN; and 0.71 g/kg and 1.99 g/kg rise of TK in the soils of the navel orange orchard plot interplanted with While Clover and navel orange orchard plot with straw coverage.

The water-fertilizer integration technique trial and demonstration have been conducted in navel orange production zones. The monitoring data showed that after application of water-fertilizer integration technique, tree growth enjoyed significant improvement with 23.5 cm rise of height, 26.5 cm increase of canopy diameter, 4.2 cm rise of stem diameter at 40 cm above ground and 59.5 more fruit output per tree compared with that under conventional fertilizer formula. Among them, there were 17.5 increase of the fruit with diameter less than 70 mm and 42.0 increase of the fruit with diameter over 70 mm. There was an average increase of 10.1 kg (41.9%) yield per tree. The integrated management of water and fertilizers was conducive to improvement of soil moisture and nutrient efficiency. The water-fertilizer integration technique increased average soil water content by 1 fold in dry season compared with that of rain irrigation control plot. It effectively improved water supply in topsoil. In addition, the TN content of soil leachate decreased by 19.2%, indicating that it helped reduce nitrogen loss.

8.3 Water-level-fluctuating zone

Investigations on soil physical and chemical properties and vegetation restoration were conducted at 22 monitoring sites of Banan, Changshou, Fuling, Fengdu, Zhongxian, Wanzhou, Kaixian, Yunyang, Fengjie, Wushan, Badong, Zigui and Xingshan in water-level-fluctuating zones (riparian zone) of the Three Gorges Project area after water drawdown (June) and before the impoundment (September) in 2014.

8.3.1 Soil physical and chemical properties

In 2014, the monitoring results of soil particles composition of water-fluctuating-zones of the project area showed the soil in the area had loose texture, with relatively more particles with diameter less than 0.05 mm.

The monitoring data of heavy metal contents in soils showed that the heavy metal contents of most soils met Grade I limit of *Environmental Quality Standard for Soils* (GB15618-1995) except lead and copper. After water recession, the content of arsenic, chromium, lead, copper and iron in soils had gone down by 1.85 mg/kg, 22.60 mg/kg, 0.75 mg/kg, 1.40 mg/kg and 0.33 g/kg respectively; while the content of mercury, cadmium, zinc and manganese had gone up by 0.05 mg/kg, 0.02 mg/kg, 2.03 mg/kg and 0.01 mg/kg respectively compared with that of the same period last year. Before the impoundment, the content of mercury, arsenic, chromium, cadmium, lead, iron and manganese in soils went down by 0.01 mg/kg, 2.50 mg/kg, 14.37 mg/kg, 0.04 mg/kg, 3.94 mg/kg, 0.05 mg/kg and 0.11 mg/kg respectively; while the content of copper and zinc went up by 7.66 mg/kg and 1.09 mg/kg respectively.

The monitoring results showed the relatively high soil nutrient content in the central region of the project area (Fengdu to Zhuyi River in Fengjie) but relatively low content in the head and tail of project area. After water recession, the content of organic matter, TP, available phosphorus and available potassium in soil increased by 1.89 g/kg, 0.01 g/kg, 2.98 mg/kg and 4.61 mg/kg respectively; while TN, TK, NH_3-N and nitrate nitrogen went down by 0.10 g/kg, 2.12 g/kg, 1.05 mg/kg and 7.98 mg/kg respectively compared with that of same period last year. Before the impoundment, the content of organic matter, TP, available phosphorus, available potassium and nitrate nitrogen in soil rose by 1.33 g/kg, 0.09 g/kg, 0.38 mg/kg, 6.76 mg/kg and 5.33 mg/kg respectively; whereas the content of TN, TK and NH_3-N went down by 0.08 g/kg, 2.33 g/kg and 0.70 mg/kg respectively.

8.3.2 Vegetation restoration

In 2014, the post-recession plant community investigation found 57 species of vascular plants in 49 genera of 24 families. There were a large amount of minor genus and monotypic genus species, accounting for 98.3% of the total. Minor genus species took up 85.7% of the total species. Herbaceous plant species dominated the vegetation, 68.4% of which were annual herb species and 21.1% of which were perennial herb species. The percent of arbor, shrub and vine species was relatively low. The composition of vascular plant genera and species in the water-level-fluctuating zone before impoundment was similar to that of after water recession.

Survey on the vegetation in the water–level–fluctuating area

8.3.3 Monitoring of biological media

In 2014, a total of 2,050 rat traps were placed in all monitoring sites in the water-level-fluctuating zone, 13 rat-shape animals were caught with average rat density at 0.63%, slightly higher than that of last year (0.36%). *Apodemus agrarius* was the dominant species, taking up 46.2%, followed by sewer rat at 38.4%. The percent of *Rattus flavipectus* and house mouse was 7.7% respectively. The post-recession average rat density was 0.61%, higher than that of last year (0.35%). The average rat density before impoundment was 0.77%, higher than that of last year (0.38%). The rat density before impoundment was slightly higher than the post-recession rat density. The monitoring data of 2010-2014 showed an overall declining trend of rat density.

In 2014, zapper lamps were placed in all monitoring sites of water-level-fluctuating zone for 74 lamp·times with catch of 328 mosquitoes. The mosquito density was 4.43/zapper lamp·times, less than that of same period last year (6.28/zapper lamp·times). The major mosquito species are *Culex pipiens fatigans* (38.4%), *Armigeres subalbatus* (30.2%), *Anopheles sinensis* (16.2%), *Culex tritaeniorhynchus* (9.5%) and *Aedes albopictus* (2.8%). The 2010-2014 monitoring data showed a rising trend of mosquito density in water-level-fluctuating zone.

In 2014, flytraps were placed in monitoring sites of water-level-fluctuating zone for 71 trap·times, catching 146 flies with average fly density at 2.06/flytrap, slightly lower than that of last year (2.61/flytrap). The key fly species were *Boettcherisca peregrina* (52.7%), *Musca sorbens* (19.9%), housefly (*Musca domestica*) (13.7%) and *Aldrichina grahami* (10.3%).

8.4 Groundwater dynamics and soil gleization

8.4.1 Groundwater dynamics

The groundwater monitoring sections were distributed along the reach between Shimatou Village and Xiaogang Farm of Honghu City in the four-lake region in the downstream of the Dam. The mean annual groundwater table of the observation wells ranged between 21.68 m and 22.60 m and varied between 0.68 m and 2.33 m this year. The confined water table ranged between 21.03 m and 23.00 m, with variation spanning 1.97 m. The phreatic water table ranged between 20.38 m and 23.74 m, with variation spanning 3.36 m. In general, the groundwater table moved up 0.07 m from last year. The mean monthly water table curve showed for the majority of the observation wells, the groundwater table ascended fast from April to May, maintained high between June and August, began to descend since September, and hit rock bottom in December. The groundwater table ascended sharply from a high level at the beginning and descended very slowly.

8.4.2 Soil gleization

The soil gleization conditions of 22 soil profiles were monitored in the summer and winter this year, and the measuring indicators included oxidation reduction potential, the total amount of reductive substances, the content of active reductive substances, and the content of ferrous iron. The monitoring data showed the mean annual oxidation reduction potential ranged between 82 and 585 mV; the mean annual total amount of reductive substances ranged between 0.07 and 7.49 centimol/kg, and averaged out at 2.50 centimol/kg, down 0.03 centimol/kg from last year; the mean annual content of active reductive substances ranged between 0 and 7.10 centimol/kg, and averaged out at 1.54 centimol/kg, up 0.35 centimol/kg from last year; the mean annual content of ferrous iron ranged between 0 and 0.96 centimol/kg, and averaged out at 0.30 centimol/kg, 0.10 centimol/kg more than last year. The soil gleization aggravated from last year especially in the winter.

8.5 Water-salt dynamics and soil salinization in the estuary

8.5.1 Water-salt dynamics

The monitoring of water-salt dynamics and soil salinization continued in the estuary (land-sea interface) of Yangtze River in 2014. There were three monitoring sections (Yinyang section, Daxing section,

and Xinglongsha section) at the north branch of the Yangtze River, about 4 km, 22 km and 35 km away from the north estuary, all stretching from the north to the south and perpendicular to the river bank. There were three monitoring sites at each section with varied distances from the bank. The main monitoring indicators included the conductivity of the Yangtze River waters, conductivity of inland river waters, soil conductivity, groundwater conductivity and groundwater table.

● **Conductivity of the Yangtze River waters**

Monitoring data at the three sections showed that the conductivity of the Yangtze River waters was high in the spring, autumn and winter, and low in the summer. The upstream flow variations and water level fluctuations of the River affected the dynamic change of the salinity of those sections. The Yangtze River received more contributing inflow this year, which pushed up the water level and brought down the conductivity at all monitoring sections compared with that of last year. The conductivity of Daxing section and Xinglongsha section which are farther away from the estuary dropped more significantly than that of Yinyang section which is nearer. The mean annual conductivity of Yangtze River waters recorded at Yinyang section dropped 9.7% from last year but the mean monthly data went up fast in September and October. The mean annual data at Daxing section went down 14.5% from last year, however, with more aggressive seawater intrusion in the first six months, the conductivity went up 3.2%～29.2% compared with the first six months last year. The mean annual data at Xinglongsha section dropped 20.5% from last year, except that the mean monthly data from January through March surpassed that of the same month last year by 23.2%～57.7%.

Water–salt monitoring in the estuary

● **Conductivity of inland river waters**

The conductivity of inland river waters was a little higher near the north bank of the north branch and a little lower near the south bank in 2014. The mean annual conductivity of inland waters was a little higher than that of last year at Yinyang section. The mean monthly conductivity rose quickly from September through November, and went up 65.5% in November from the same month last year. The mean annual conductivity was approximate to that of last year at Daxing section, and down 28.0% from 2011, a dry year. The mean monthly conductivity spiked significantly in September and October and went up 57.8% in October from the same month last year. The mean annual conductivity dropped to a certain extent from last year at Xinglongsha section but rose 21.2% from the year 2010. There was very significantly positive correlation between the conductivity of inland river waters and that of the Yangtze River waters at the three monitoring sections in the estuary.

● **Groundwater depth**

The groundwater depth in the north bank of the estuary has been low in recent years, easily leading to top enrichment of salt in soil. The mean annual groundwater depth dropped from a year earlier at all of the three monitoring sections, affected by the upstream runoff variations and water level fluctuations of the Yangtze River. However, the mean monthly groundwater depth monitored in October was larger due to less rainfall in the month. The mean annual groundwater depth was down 7.1% from a year earlier and 12.1% from 2011- a dry year at Yinyang section, exhibiting a descending trend. The mean monthly groundwater depth was larger in the autumn and winter than the same quarters last year, specifically, by as much as 30.5% in October. At Daxing section, the mean annual groundwater depth went down 23.8% from a year earlier. The mean monthly groundwater depth from October through December was approximate to the same months last year. At Xinglongsha section, the mean annual groundwater depth was close to that of last year. The mean monthly groundwater depth was larger in the autumn and winter, reached as much as 1.49 m from October to December, and went up 22.5% in October from the same month last year.

● **Groundwater conductivity**

The mean annual conductivity of groundwater was at a fairly high level in all of the three sections this year and went up a little from last year. It has been in an

upward trend for years. The mean monthly conductivity of groundwater reached a record high at Yinyang section, up 0.3%～7.5% from the same month last year. The mean annual conductivity of groundwater was up 9.5% from last year and 15.8% from 2011 at Daxing section, so the salinity cumulated year by year. The mean monthly data went up 10.8% in November from the same month last year, and also up from September through November from the same months in 2011, a dry year. The mean annual conductivity of groundwater escalated slightly at Xinglongsha section from last year, so did the mean monthly data from September through December. The groundwater conductivity at Yinyang section was significantly correlated to that of Yangtze River waters, and the closer to the river, the correlation was more significant. The groundwater conductivity of Daxing section and Xinglongsha section was significantly correlated to the conductivity of both Yangtze River and inland river waters.

8.5.2 Soil salinization

In 2014, the mean annual soil conductivity ascended to certain extent at the two sections in the north bank of the north branch of the estuary. The data was approximate to that of last year at Xinglongsha section in the south bank of the north branch. Specifically, the soil salinity increased notably in the autumn and winter compared with the same seasons a year earlier. The mean annual soil conductivity was up 16.8% from last year and 11.5% from 2011 at Yinyang section. The mean soil conductivity rose 36.4% from January through August from the same months last year, and went down 14.0% from September to December from the same months last year. At Daxing section, the mean annual soil conductivity went up 15.0% from last year and 20.7% from 2011, and the mean conductivity went up 9.5% from September through November compared with the same months last year. At Xinglongsha section, the mean annual soil conductivity was approximate to that of last year, while the mean monthly data from September through December swelled, as much as 15.5%, compared with the same months last year. The survey data of recent years showed that there was considerable salt accumulation in top soils in the estuary, and that the soil salinity was fairly high in the waters where the Yangtze River empties into the East China Sea, leading to relatively serious salinization.

8.6 Ecological environment in the estuary

8.6.1 Environmental elements in waters

● **Hydrological elements**

In the spring of 2014, the temperature was high in the surface layer and low in the bottom layer of monitored waters in the estuary. The highest temperature registered 21.13℃ in the surface layer, and 20.75℃ in the bottom layer, and the lowest was 13.97℃ in the surface layer, and 12.89℃ in the bottom layer. In the autumn, the temperature was low near the coastline and high in the infralittoral waters. The lowest temperature was 18.63℃near the coastline, and the highest was 21.17℃ in the infralittoral waters. The temperature plunged 2.0～3.0℃ in the spring from last spring, and in the autumn, the highest temperature was down 0.2℃ and the lowest was down 0.5℃ compared with the data of the same season last year.

In the spring, the diluted waters in the estuary started to extend eastwards along with growing runoff which empties into the sea. In the surface layer, the salinity was often below 27.0 around the estuary mouth, and above 30.0 in the infralittoral waters to the northeast. In the bottom layer, the diluted waters were too weak to extend beyond the estuary month. The salinity was low in the estuary mouth and high in the infralittoral waters to the southeast in the bottom layer, which was very different from the trends of last year. In the autumn, the salinity was often under 20.0 in the surface layer near the estuary mouth of the south branch and above 30.0 in the surface layer of remaining sea waters, and over 30.0 in the bottom layer of most waters, affected by the diluted waters of the Yangtze River and the surface waters of Taiwan warm currents.

The SD of the estuary waters was low in the estuary mouth and near the coastline and high in the infralittoral waters. In the spring, the SD was generally below 1.5 m to the west of 122°30′E, and mostly somewhere between 1.8 m and 4.0 m in sea waters to the east of 122°30′E, which was similar to the data last year. In the autumn, the SD of the monitored waters was generally below 2 m. Specifically, the SD was relatively high in the southern and northern parts of the infralittoral waters, all above 1 m. The SD in the autumn this year was a little higher than that of last autumn, which indicated that the eastward expansion of the diluted waters of the Yangtze River softened.

Table 8–1 Content of nutrient salts in the Yangtze River estuary in the spring and autumn of 2014

Unit: μmol/L

Season	Nutrient salt	Yangtze River waters		Estuary seawaters	
		Surface layer	Bottom layer	Surface layer	Bottom layer
Spring	Phosphate	1.1	1.1	0.43	0.39
	Silicate	141.7	144.2	30.5	22.9
	Nitrate	179.0	175.6	44.7	20.0
	Nitrite	0.7	0.6	0.32	0.23
	NH_3-N	2.8	2.6	2.7	2.4
	TN	193.2	194.6	66.5	56.3
	TP	2.9	3.3	1.5	1.5
Autumn	Phosphate	1.7	1.5	0.69	0.7
	Silicate	214.8	222.6	50.2	47.0
	Nitrate	127.4	129.8	30.8	17.0
	Nitrite	0.1	0.14	0.28	0.23
	NH_3-N	2.9	2.6	2.5	2.4
	TN	159.3	160.7	50.3	45.9
	TP	4.4	5.0	2.0	2.5

● **Hydrochemical elements**

The mean content of dissolved oxygen in the surface layer river waters in the estuary was 8.25 mg/L in the spring and 8.23 mg/L in the autumn. The figure in the surface layer seawaters in the estuary was 8.98 mg/L in the spring and 7.60 mg/L in the autumn. The mean content of dissolved oxygen of river waters in the estuary climbed up in the spring and went down in the autumn compared with last year, while the figure of seawaters in the estuary decreased to a certain extent in both spring and autumn.

The pH value averaged out at 7.92 in the spring and 8.06 in the autumn in the surface layer river waters in the estuary, and 7.90 in the spring and 8.06 in the autumn in the bottom layer river waters. The pH value averaged out at 8.13 in the spring and 7.96 in the autumn in the surface layer seawaters in the estuary and 8.10 in the spring and 7.89 in the autumn in the bottom layer seawaters. The pH value of river waters in the estuary was approximate to that of the same period last year. The pH value was a little lower in the surface layer seawaters and higher in the bottom layer seawaters in the estuary in the spring, compared with the data of last spring. The pH value was much lower in both surface layer and bottom layer seawaters in the autumn, compared with last autumn.

The mean content of COD registered 1.97 mg/L in the spring and 2.30 mg/L in the autumn in the surface layer river waters in the estuary and 1.99 mg/L in the spring and 2.67 mg/L in the autumn in the bottom layer river waters. The mean content of COD was 1.51 mg/L in the spring and 1.53 mg/L in the autumn in the surface layer seawaters in the estuary and 1.24 mg/L in the spring and 1.26 mg/L in the autumn in the bottom layer seawaters. The mean content of COD in river waters went up to a certain extent in the spring and down a little in the autumn. The mean content of COD in seawaters decreased in both spring and autumn, compared with last year.

In terms of horizontal variations, the content of phosphate, silicate, nitrate, TN, and TP was all in a steep

downward trend from the estuary towards the open sea. The horizontal variations of the contents of NH_3-N and nitrite were more complicated.

● **Sediment elements**

The content of suspended matters in the estuary river waters varied little in the autumn (100.08 mg/L on average) from the spring (84.08 mg/L on average). The content of suspended matters in the estuary seawaters ascended to a certain extent in the spring and descended to a certain extent in the autumn, compared with the same periods last year.

8.6.2 Biological elements in waters

● **Chlorophyll-a**

In the spring, the concentration of Chlorophyll-a ranged between 0.29～6.00 μg/L and averaged out at 1.58 μg/L in the top layer seawaters. The patch of waters with high Chlorophyll-a readings was mainly distributed in the eastern part of the monitored seawaters, with primary productivity higher than that of the same period last year. In the autumn, the concentration of Chlorophyll-a ranged between 0.02～1.79 μg/L and averaged out at 0.26 μg/L in the top layer seawaters. The patch of waters with high Chlorophyll-a readings was also mainly distributed in the eastern part of the monitored seawaters, with primary productivity lower than that of the same period last year.

● **Fish zooplankton**

A total of 106 fish zooplankton were caught in the spring, which fell into four species in four families under three orders. The abundance of fish zooplankton was lower than that of last year. *Coilia mystus* and *Trachidermus fasciatus* became dominant species, while *Engraulis japonicas* and *Pseudosciaena polyactis* lost their dominance.

A total of 30 fish zooplankton were caught in the autumn, which included both spawns and larvae and fell into eight species in six families under five orders. *Harpodon nehereus* was the dominant species. The abundance of fish zooplankton plunged from last year, the dominance of *Harpodon nehereus* moved up fast, and *Coilia ectenes* was no longer dominant species.

8.7 Wetlands in the midstream

8.7.1 Dongting Lake

● **Streamflow**

Dongting Lake embraces four inflow rivers (Xiangjiang River, Zishui River, Yuanjiang River, and Lishui River) in the south and empties into Yangtze River in the north (Hubei Province). The contributing inflows of the lake includes the aforementioned four inflow rivers, three bleeders of Yangtze River (Songzi Bleeder, Taiping Bleeder, and Ouchi Bleeder), and interval inflows. The waters converge in the lake and feed to Yangtze River at Chenglingji (Qili Mountain). Dongting Lake is the most important buffering lake of the Yangtze River.

The incoming flow of Dongting Lake waters was on the low side in 2014 compared with average year. The monthly data showed the incoming flow levelled off from January through March and was almost 10% more than average year from April through October. Specifically, it increased by a little margin in April but was still over 10% less than average year. There were multiple floods in May. There were frequent floods in June and the incoming flow was a little lower. The water level surpassed the warning level at Chenglingji Station in July, and the incoming flow was almost 50% more than average year. It was nearly 20% more in August, nearly 10% more in September, and over 20% less in October compared with the average year.

According to the data from Chenglingji Station at the lake outlet, the annual precipitation registered 1,411.0 mm, up 41.0% from a year earlier. The water level maximized at 32.60 m, minimized at 20.38 m, and averaged out at 25.46 m this year. The annual runoff was 4.3% less than historical average and 20.6% more than last year. The annual sediment discharge amounted to 22.6 mil. t, 39.0% less than historical average, and up 22.0% from last year. From the chronological perspective, the majority of the runoff and sediment discharge at Chenglingji Station happened between March and August, with runoff during this period accounting for 68.5%, and the sediment discharge during this period accounting for 71.9% of the whole year. The sediment discharge peaked on May 27, with the maximum discharge at 0.32 kg/m^3.

Statistics on the 60-day flood volume showed the total inflow of the lake was 65.95 bn. m^3 and the total outflow 85.26 bn. m^3, rendering the buffering balance at -19.31 bn. m^3 this year. Analysis data of the flood sources at Chenglingji Station (Qili Mountain) showed the four inflow rivers contributed 71.8% of the incoming flow to the lake in 7 days, 66.8% in 15 days, 65.5% in 30 days, and 73.2% in 60 days of the monitoring period. The three bleeders of the Yangtze River contributed

21.5% of the incoming flow to the lake in 7 days, 28.0% in 15 days, 28.7% in 30 days, and 21.6% in 60 days. The contribution of the interval inflows to the lake ranged between 5.2% and 6.7%. Analysis data of the contributors to monthly runoff at Chenglingji Station showed 79.1% of the Dongting Lake inflow came from the four inflow rivers between June and October, and 69.7% in the remaining months. Over 59.4% of the incoming flow observed at Luoshan Station was contributed by Yangtze River.

● **Water quality**

Among the upstream runoff sources, the four inflow rivers of Dongting Lake enjoyed fairly good water quality in 2014. The monitoring sections where Xiangjiang River, Zishui River, Yuanjiang River, and Lishui River empty into the lake attained mainly Grade Ⅱ water quality standard. The monitoring sections at which the three bleeders empty into the lake attained Grade Ⅲ standard, and the sections at their lake outlets recorded Grade Ⅳ standard. Among the seven monitoring sections across the lake area, the Nanzui section and the section at Major and Minor West Lakes attained Grade Ⅴ standard, and the other five sections attained Grade Ⅳ, all unable to achieve the water quality targets set for these water functional zones. The TP and TN pollution was fairly serious across the lake area, with TP concentration ranging from Grade Ⅱ standard to worse than Grade Ⅴ standard, and TN concentration ranging from Grade Ⅳ standard to worse than Grade Ⅴ standard. The TP pollution was getting worse from last year. From the perspective of geographical distribution, the water quality of the eastern lake waters was the poorest, and that of the western lake waters was fairly good. Up to 45.0% of all the 16 monitoring sections attained Grade Ⅰ～Ⅲ water quality standard, which implied slight pollution. The main pollution indicators were TP, TN, and faecal coliform bacteria.

The Tropical Level Index (TLI) of Dongting Lake ranged somewhere between 44.5 and 60.4 this year. The maximum TLI was recorded at the monitoring section of Major and Minor West Lakes, which was in moderate eutropher. The section at eastern lake was in minor eutropher, and other sections were in mesotrophic state. The lake as a whole was in minor eutropher, aggravating from last year. In terms of geographical distribution, the trophic level of eastern lake waters was higher than that of western and southern lake waters, with TLI going up to a certain extent from last year, resulting in minor eutropher from August through November. The trophic state of western and southern lake waters varied little compared with last year.

A total of 75 genera of phytoplankton species were identified in Dongting Lake, which fell into 7 phyla. Specifically, the Chlorophyta and Bacillariophyta species were the most abundant phytoplankton species, with 33 genera (44.0%) under Chlorophyta and 21 genera (28.0%) under Bacillariophyta; followed by 9 genera (12.0%) under Cyanophyta; and 3 genera (4.0%) each under Euglenophyta, Pyrrophyta, Cryptophyta, and Chrysophyta. The number of phytoplankton species was the smallest in March, and the largest in December. Bacillariophyta and Chlorophyta species were the dominant species in both months. The maximum biomass density of phytoplankton species was recorded in March, followed by that in September, and the minimum density was observed in December. The mean annual biomass density registered 1.61×10^5/L, somewhat lower than that of last year (5.60×10^5/L).

Eighteen Rotifera species, 15 Cladocera species, and Calanoida, Cyclopoidea, and Harpacticoida species under Copepods were identified in Dongting Lake. Specifically, the Rotifera species accounted for 94.9%, Copepods species 3.7% and Cladocera species 1.4%. The Brachionus, Polyarthra, Filinia, and Trichocerca species were the dominant Rotifera species; the Rosmina, Pleroxus, and Sida species were the dominant Cladocera species, and the Cyclops and nauplii species were the dominant Copepods species identified in the Lake. The biomass density of zooplankton was the highest in September and the lowest in March. The mean annual biomass density of zooplankton was 3.46×10^4/m^3, up 215.0% from last year (1.1×10^4/m^3), with significant geological variations.

● **Vegetation**

The stationary observation data on 6 typical islets and shoals (Liumen Gate, Beizhouzi, Tuanzhou, Junshan, Chunfeng, and Jianxing Farm) showed Triarrherca sacchariflora, Carex tristachya and Polygonum flaccidum communities exhibited distinct seasonal differences. Triarrherca sacchariflora among the three representative vegetation communities of the lake had the most diversified species. The number of Triarrherca sacchariflora species peaked in March (28 species); the species richness index was fairly high in March (6.2) and May (6.6), and the lowest in January (4.9); the species diversity index was fairly high in March (0.83) and May (0.79) and at the minimum in October (0.42);

the community coverage was the lowest in January (30.8%) and varied little in other months (constantly at 90.0%); the biomass was the lowest in January (55.5 g/m^2), and peaked in October (1,179.3 g/m^2). As for the Carex tristachya community, the number of species was somewhere between 3～6, the species richness index somewhere between 1.0～2.8, the species diversity index somewhere between 0.09～0.42, community coverage somewhere between 95.0%～120.3%, and biomass between 108.3～363.9 g/m^2. All the above data were fairly high in March and fairly low in other months. As for the Polygonum flaccidum community, the number of species was fairly high in March (8 species) and May (8 species), and fairly low in January (6 species) and October (2 species); the species richness index was fairly high in May (3.0) and low in October (1.2); the species biodiversity index was fairly high in March (0.37) and May (0.44), and low in January (0.21) and October (0.12); the community coverage was fairly high in March (111.2%) and May (125.0%), and at the lowest in January (65.0%); the biomass was the highest in May (904.5 g/m^2), and the lowest in January (107.1 g/m^2).

● **Biodiversity**

Eighty-four species of summer migrant birds were identified in eastern Dongting Lake, down 22 species from a year earlier and they fell into 37 families under 12 orders. A total of 175,096 overwinter water birds were identified, down 7,853 from last year. They fell into 53 species in 13 families under 6 orders, six species less than last year. Specifically, the population of *Anas falcata, Anas strepera*, and *Anser erythropus* dropped the most significantly, down 8,100, 4,147, and 3,151 ones respectively from last year. The population of some overwinter water birds increased significantly. The growth in the population of *Anser fabalis, Tadorna ferruginea*, and *Cygnus columbianus* was the most drastic, up 11,122, 1,263 and 1,111 ones respectively from last year. The analysis data of interspecific distribution pattern of overwinter bird species in the eastern Dongting Lake indicated Anseriformes species were the dominant species, accounting for 44.4% of the total bird species, their main habitats are grass shoals, shallow waters, and islets and shoals, and their main feed are grass and fish. The secondary dominant species were Charadriiformes species, which accounted for 24.5%, and their main habitats are mudflats or shallow waters and main feed are benthos and small fishes. Pelecaniformes and Podicipediformes species were the fewest, each taking up 3.8%.

Eighty-five *Elaphurus davidianus* were identified in the eastern Dongting Lake, and the population was estimated to be somewhere between 70 and 90, a notable growth from last year. *Elaphurus davidianus* was mainly distributed in Heizui (Zhuzi River mouth-Reed field of development zone) (population 50～60) and Piaowei (upper and lower Hongqi Lake) (population 20～30) regions. In Heizui region, the population of *Elaphurus davidianus* was forced to shrink along with rising water level in flood season and bounced back after the flood retreated. In Piaowei region, the population migrated southward along with rising water level and returned after water retreated.

8.7.2 Poyang Lake

● **Streamflow**

As the largest freshwater lake in China, Poyang Lake is located to the south of Yangtze River in the northern part of Jiangxi Province. The lake embraces five major rivers (Ganjiang River, Fuhe River, Xinjiang River, Raohe River, and Xiuhe River) as well as Boyang River, Zhangtian River, Qingfengshan Stream, and Tongjin River as inflow rivers. After convergence in and buffering by Poyang Lake, the river waters empty into Yangtze River through the lake outlet.

The annual precipitation of Poyang Lake registered 1,423.2 mm in 2014, up 5.0% from last year and levelling off with the average year. The precipitation fell mainly from April through June, which accounted for 43.0% of the total precipitation in the year. The water level maximized at 18.68 m, minimized at 7.39 m, and averaged out at 12.81 m this year, as observed at Xingzi Station. In general, the water level was lower than the average year. The combined runoff contributed by the aforementioned five major inflow rivers to the lake reached 124.9 bn. m^3, up 12.0% from last year and 0.5% less than the historical average. The influx of sediments amounted to 5.17 mil. t, up 15.0% from a year earlier and 62.0% less than the historical average. The runoff discharge of the lake through outlet to Yangtze River totaled 152.2 bn. m^3 this year, up 8.0% from last year and 1.0% more than historical average. The sediment discharge of the lake amounted to 12.1 mil. t, up 7.0% from a year earlier, and 21.0% more than historical average.

The Yangtze River waters back flowed into Poyang Lake once within the year. The backflow was observed between 10:00 on September 22 and 16:00 on September 25, with the average discharge at 725 m^3/s, and

maximum discharge at 1,070 m^3/s. The backflow lasted for 78 hours, with backflow volume up to 204 mil. m^3.

The 60-day flood volume recorded from May to July indicated the total inflow of the lake reached 53.627 bn. m^3, up 14.0% from last year; and the total outflow 49.541 bn. m^3, up 15.5%; rendering the buffering balance at 4.086 bn. m^3 this year, down 0.1% from last year. The main contributing runoffs of Poyang Lake included the five major inflow rivers (Ganjiang, Fuhe, Xinjiang, Raohe, and Xiuhe) and interval waters. Specifically, Ganjiang River has always been the dominant inflow river of the lake and contributed 56.5% of the total inflow, seconded by Xinjiang River which contributed 14.8%.

● **Water quality**

The inflow rivers of Poyang Lake enjoyed good water quality this year. The percentage of the river waters which had attained Grade Ⅰ~Ⅲstandard accounted for 94.1%, down 1.7 percentage points from a year earlier. Le'an River was the main river which failed to attain water quality standard, and the main pollutants were NH_3-N and TP. The monitoring section at the lake outlet attained Grade Ⅲ standard in the second quarter; Grade Ⅳ standard in the third quarter, with TP as the main pollutant; and Grade Ⅴ standard in the first and fourth quarters, with NH_3-N and TP as the main pollutants. According to the data from the 15 monitoring sections in the lake area, the percentage of waters which attained Grade Ⅰ~Ⅲ standard ranged between 6.7% and 73.3%, and averaged out at 50.0%, down 21.7 percentage points from a year earlier. The main pollutants were NH_3-N and TP.

The content of nutrient salts in nitrogen forms (TN, nitrate nitrogen, and NH_3-N) in Poyang Lake was notably higher in dry period (January) than that of high flow period, water rising period, and water subsiding period. The content of NH_3-N in the water rising period (April) was significantly lower than that of dry period and water subsiding period. The content of nitrate nitrogen varied little from high flow period (July) to water subsiding period (October). The variation of the content of TN was insignificant except in the dry period. The variation of the content of TP resembled that of phosphate in the dry period, high flow period, water rising period, and water subsiding period. The content of both TP and phosphate was the highest during water rising period, seconded by that in the water subsiding period.

● **Vegetation**

In 2014, the zonary belts of *Artemisia selengensis, Carex cinerascens*, and *Phalaris arundinacea* as well as the mudflats distributed on the islets and shoals were monitored according to the descending order of their elevation. Analysis data of the height of dominant species showed, the average height of *Artemisia selengensis* plants registered 76.4 cm in the spring, higher than last spring, and 82.5 cm in the autumn, a little lower than last autumn; the average height of *Carex cinerascens* plants was 45.7 cm in the spring and 43.7 cm in the autumn, varied little compared with last year; the average height of *Phalaris arundinacea* plants was 67.3 cm in the spring, higher than last spring, and 69.3 cm in the autumn, a little lower than last autumn. From the perspective of importance value (Ⅳ), the Ⅳ was 85 in both spring and autumn for the dominant species in the *Artemisia selengensis* belt, 95 in the spring and 98 in the autumn for the dominant species in the *Carex cinerascens* belt, and 82 in the spring and 85 in the autumn for the dominant species in the *Phalaris arundinacea* belt. The Ⅳs of the dominant species in the above three vegetation belts varied little from year to year. The representative vegetation communities in the islets and shoals of the lake area did not exhibit any notable changes or experience any replacement of communities.

Analysis data of biomass indicated the surface biomass of *Artemisia selengensis* belt averaged out at 2,893.9 g/m^2 in the spring, higher than last spring, and 2,949.3 g/m^2 in the autumn, approximate to that of last autumn; the surface biomass of *Carex cinerascens* belt and *Phalaris arundinacea* belt averaged out at 2,011.4 g/m^2 and 1,662.5 g/m^2 respectively in the spring, a little higher than those of last spring. The surface biomass on the mudflat belt averaged out at 689.2 g/m^2 in the spring, far above that of last spring, which was possibly related to a longer growth spurt for the vegetation on the mudflats this year. Analysis data of community biodiversity (the Shannon-Wiener index) showed mudflat belt recorded the maximum values, which is, 1.228 in the spring, and 1.625 in the autumn, both with unnoticeable changes compared with last year. The community biodiversity of *Phalaris arundinacea* belt was 0.677 in the spring, lower than that of last spring, and 0.782 in the autumn, a little higher than that of last autumn. The community biodiversity of *Carex cinerascens* belt was 0.219 in the spring and 0.159 in the autumn, both approximate to the data of last year. The community biodiversity of *Artemisia selengensis* belt was 0.523 in the spring and

0.412 in the autumn, both higher than the data of last year.

The soil bulk density was 0.94 g/cm^3 in both spring and autumn for *Artemisia selengensis* belt, 0.89 g/cm^3 in the spring and 0.90 g/cm^3 in the autumn for *Carex cinerascens* belt, 0.93 g/cm^3 in both spring and autumn for *Phalaris arundinacea* belt, and 1.11 g/cm^3 in the spring and 1.15 g/cm^3 in the autumn for the mudflat belt. In the spring, the soil moistures in descending order were *Phalaris arundinacea* belt (43.2%), *Carex cinerascens* belt (42.9%), mudflat belt (34.6%), and finally *Artemisia selengensis* belt (34.5%). In the autumn, the soil moisture of *Phalaris arundinacea* belt was the highest at 39.0%, followed by that of *Carex cinerascens* belt at 38.4% and then of *Artemisia selengensis* belt at 35.6% and of mudflat belt at 32.3%.

● **Census on water birds**

Over 533,000 overwinter water birds of 55 species were recorded in the census on overwinter water birds across the lake. The number of bird species on the record was one less than last year, and the population was nearly 120,000 less. As for the population of key species, there were 3,872 *Grus leucogeranus*, 241 *Grus monacha*, 375 *Grus vipio*, 1,630 *Grus grus*, 751 *Ciconia boyciana*, 8,727 *Platalea leucorodia*, 119,376 *Cygnus columbianus*, 73,762 *Anser cygnoides*, and 26,948 *Anser albifrons*. Apart from some growth in the population of swans, the population of large birds including cranes, storks, spoonbills, geese and ducks as well as of waders dropped significantly.

A total of 65 species of water birds in 14 families under 5 orders were observed during the regular censuses on overwinter water birds within Poyang Lake National Nature Reserve. Specifically, 44 species were identified from January through March and 47 from October through December. As for the maximum population of key species, it was 3,654 of *Grus leucogeranus*, 231 of *Grus monacha*, 355 of *Grus vipio*, 1,178 of *Grus grus*, 1,506 of *Ciconia boyciana*, 7,667 of *Platalea leucorodia*, 95,490 of *Cygnus columbianus*, 53,157 of *Anser cygnoides*, 19,919 of *Anser fabalis*, and 22,307 of *Anser albifrons*.

A total of 55 species of water birds were identified in the census on reproductive water birds in the summer, which fell into 13 families under 5 orders. The number of Charadriiformes species (22 species) was the highest among the identified species, followed by Ciconiiformes species (14 species).

8.8 Small watersheds in the upstream

8.8.1 Yangjichong Watershed, Wujiang River Basin (Longli County, Guizhou Province)

Yangjichong Watershed in Longli County, Guizhou Province in Southwest China is an integral part of the Wujiang Waters in the Yangtze River Basin. The watershed sits on the uplands formed by medium and low hills on Yunnan-Guizhou Plateau, and is somewhere between 1,112 m～1,630 m above sea level. The local vegetation is humid, sub-tropical evergreen broadleaf forests growing on sandy soils and clay loams, and the land use there are mainly woodlands and farmlands. The catchment area of the watershed is 11.89 km^2, 3.37 km^2 of which is monitored by the monitoring station at the outlet of the watershed. The soil erosion area reaches 2.01 km^2.

A total of 61 rainfalls were observed across the year, with total precipitation at 1,170.1 mm, up 43.3% against last year. Specifically, the precipitation in the flood season between May and September registered 913.5 mm, accounting for 78.1% of the annual precipitation, with maximum daily precipitation at 170.0 mm, maximum single precipitation 139.5 mm, and maximum monthly precipitation 379.8 mm.

According to the monitoring data, the ranking of runoff yield of slope runoff plots in different land use patterns was: bare land plot＞cropland runoff plot＞woodland runoff plot＞cash tree runoff plot＞grassland runoff plot. The ranking of sediment yield caused by soil erosion in those plots was: cropland runoff plot＞bare land plot＞cash tree runoff plot＞grassland runoff plot＞woodland runoff plot. Moreover, the ranking of erosion modulus in descending order was cropland runoff plot＞bare land runoff plot＞cash tree runoff plot＞grassland runoff plot＞woodland runoff plot.

The monitoring station at the outlet of the watershed observed 15 notable floods throughout the year, mainly between April and October. The flood peak was recorded on September 29, with discharge at 8.75 m^3/s. The annual runoff totaled 1.162 mil. m^3 across the watershed. The bed load at the outlet totaled 1.96 t, added by suspended load of 77.85 t, the annual soil erosion amounted to 79.81 t.

Rainwater harvesting ditch

The monitoring data of soil nutrients showed the ranking of the content of organic matters in descending order was: cash tree runoff plot＞grassland runoff plot ＞woodland runoff plot＞cropland runoff plot＞control plot; the ranking of the TN content was cash tree runoff plot＞woodland runoff plot＞grassland runoff plot＞ control plot＞cropland runoff plot. The ranking of the TP content was cash tree runoff plot＞cropland runoff plot ＞grassland runoff plot＞woodland runoff plot＞control plot. The ranking of the TK content was control plot＞ cash tree runoff plot＞grassland runoff plot＞woodland runoff plot＞cropland runoff plot. The ranking of the content of ammonium nitrogen was woodland runoff plot ＞cash tree runoff plot＞cropland runoff plot＞control plot＞grassland runoff plot. The content of nitrate nitrogen was the highest in cropland runoff plot and the lowest in woodland runoff plot. The content of AP was the highest in cropland runoff plot. The ranking of AK content in descending order was woodland runoff plot＞ cash tree runoff plot＞cropland runoff plot＞grassland runoff plot＞control plot. The content of KN was the lowest in cropland runoff plot. The pH value of soils was the highest in cropland runoff plot.

Calculated by the output concentration variations of the soil nutrients in different forms, the TN yield of the watershed totaled around 896.09 kg, and the TP yield about 106.06 kg this year.

8.8.2 Maojiawan Watershed, Chishui River Basin (Bijie Prefecture, Guizhou Province)

Maojiawan Watershed in Bijie Prefecture of Guizhou Province in southwest China is an integral part of the Chishui River Basin in the upstream of Yangtze River. The watershed covers 3.98 km^2 and ranges between 620 m and 1,340 m above sea level, with the mean altitude at 992.51 m. The slope gradient of the watershed ranges between 0～72.5º, and averages out at 21.9º. The gradient of the largest patch of the watershed, which is up to 1.34 km^2, ranges between 15º～25º. The land use patterns include closed forest land, shrub land, orchard, dry land, rural residential quarters, and land for transportation.

The precipitation in the watershed registered 756.0 mm across the year, up 27.3% from a year earlier. Analysis data of the runoff yields of runoff plots with varied slope gradients indicated the runoff yield was zero in 5º plots; 135.91 m^3 in 15º plots, up 108.19 m^3 from last year; and 179.38 m^3 in 25º plots, up 142.08 m^3 from last year. The runoff yield of 25º plots was much higher than that of 15º plots. Analysis data of sediment yield of different runoff plots indicated the sediment yield was zero in 5º plots, averaged out at 49.63 kg in 15º plots, and averaged out at 58.72 kg in 25º plots. The sediment yield and erosion modulus of 25º plots were notably higher than those of 15º plots.

According to the monitoring data on water quality of the surface runoff in those plots, there was zero runoff in 5º plots. The annual COD yield of runoff (only) from 15º plots was 6,153 mg, TN 4,383 mg, NH_3-N 876 mg, nitrate nitrogen 1,284 mg, and TP 247 mg. The annual COD yield of runoff (only) from 25º plots was 15,711 mg, TN 3,984 mg, NH_3-N 1,369 mg, nitrate nitrogen 2,771 mg, and TP 45 mg. The combined annual runoff yield of COD, NH_3-N, and nitrate nitrogen from the 25º plots was much higher than that of 15º plots.

The monitoring data at the monitoring station of the watershed outlet showed the mean discharge amounted to 1.14×10^{-2} m^3/s, the maximum discharge 0.536 m^3/s, the total runoff 359,000 m^3, the mean annual sediment discharge rate 3.15×10^{-4} kg/s, the maximum sediment discharge rate 0.22 kg/s, and the annual sediment

discharge 9.94 t.

8.8.3 Dawan Stream Watershed, Minjiang River Basin (Yibin Municipality, Sichuan Province)

Dawan Stream Watershed in Yibin Municipality, Sichuan Province in southwest China is an integral part of Minjiang River Basin in the upstream of Yangtze River. The type of landform is shallow gully uplands with average altitude about 430 m and relative relief around 90 m. The soils are sandy soils with a depth ranging between 0.15 m and 1.0 m. A total of 3.3 km^2 catchment area is monitored by the monitoring station at the outlet of the watershed.

Yibin Monitoring Station recorded 180 rainfalls this year, and the combined precipitation amounted to 936.7 mm, down 23.4% from last year. The precipitation in the flood season from June to September registered 667.4 mm, accounting for 71.4% of the annual precipitation.

A total of 21 runoff and sediment yield processes of slopes were monitored across the year, mainly in July and August. The sediment yield of the slope runoff plots in different land use patterns ranged between 1.9 m^3 and 5.0 m^3, 0.5～4.5 folds of last year. Specifically, the runoff yield of maize plot was the highest, and that of the cash tree-fruit tree-woodland runoff plot (citrus) was the lowest. The runoff yield was fairly notable after each of the seven rainfalls on July 3, August 4, August 8, August 12, August 17, September 12, and September 16. The soil erosion of the slope runoff plots in different land use patterns ranged between 1.0 kg and 35.7 kg, 0.5～34 folds of last year. Specifically, the soil erosion of maize plot was the highest, and that of the cash tree-fruit tree-woodland runoff plot (citrus) was the lowest. The soil erosion caused by the each of rainfalls on August 8, August 12, and September 12 was fairly notable.

Runoff plot

According to the data from the monitoring station at the outlet of the watershed, the mean annual discharge of the watershed was 0.219 m^3/s, and the maximum discharge was 1.78 m^3/s. The annual runoff totaled 1.7193 mil. m^3 across the watershed, with the runoff coefficient at 0.56. The mean annual concentration of TN and TP in waters registered 1.41 mg/L and 0.139 mg/L respectively. The sediment discharge totaled 3,379 t, with sediment discharge rate averaging out at 0.1157 kg/m, the erosion modulus at 1,024 t/(km^2·year), and the mean depth of erosion at 0.76 mm.

8.8.4 Xiejiawan Watershed, Jialing River Basin (Suining Municipality, Sichuan Province)

Xiejiawan Watershed is located in Anju District of Suining Municipality, Sichuan Province in southwest China, and the landform is typical uplands. The catchment area of the watershed amounted to 0.0689 km^2, with minimum altitude 280.0 m, maximum altitude 331.6 m, relative relief 51.6 m, and mean longitudinal river slope 2.9%. The historical average temperature registered 18.2℃, and the historical average precipitation 895.5 mm. The rain runoff of the watershed empties into Fujiang River, an A-level tributary of Jialing River. There is one parent material runoff field, five runoff fields with varied gradients, and six runoff fields with different tillage systems in the watershed. The catchment area monitored by the monitoring station at the outlet of Xiejiawan Watershed covered 0.0689 km^2.

The maximum daily temperature across the watershed was 39.8℃ observed on July 15, and the minimum daily temperature was -1.6℃ observed on December 19. The mean annual temperature was 17.1℃. The annual precipitation totaled 841.3 mm, 54.1 mm less than the average year. There were 56 days with rain records throughout the year. The maximum daily precipitation was 107.1 mm as recorded on August 8, and the maximum monthly precipitation 260.3 mm in September. The annual water surface evaporation on land totaled 612.6 mm, with the maximum daily evaporation at 6.5 mm on July 28, and the minimum daily evaporation at 0.0 mm on January 6.

The soil bulk density of the typical farmlands in the watershed ranged between 1.5 t/m^3 and 1.6 t/m^3. The bulk density of the top soil (less than 10 cm underground) was on the low side, and that of bottom layer soil (over 20 cm underground) was on the high side, with the difference

around 6.0%. In the top soil of typical croplands, the content of TN, TP, TK, and organic matters averaged out at 2.96 g/kg, 0.84 g/kg, 24.21 g/kg, and 7.22 g/kg.

Among the runoff fields with varied gradients, the runoff of 5º, 10º, 15º, 20º, and 25º plots was 1.72 m^3, 1.97 m^3, 2.26 m^3, 2.69 m^3, and 3.74 m^3, and their washoff was 4.31 kg, 5.95 kg, 8.18 kg, 19.68 kg, and 36.37 kg respectively. The runoff and sediment yields went up remarkably with growing gradient. As for the six runoff plots with different tillage systems, their runoff was 3.57 m^3, 2.99 m^3, 3.93 m^3, 3.18 m^3, 4.55 m^3, and 5.04 m^3, and the washoff was 33.50 kg, 5.78 kg, 43.40 kg, 6.66 kg, 5.38 kg, and 54.87 kg respectively.

The annual runoff monitored by the monitoring station at the outlet of Xiejiawan Watershed totaled 13,921.75 m^3, and the sediment discharge totaled 10,131.90 kg. The mean annual content of TN and TP in waters was 3.82 mg/L and 0.50 mg/L respectively.

8.9 Algal blooms in main tributaries

In 2014, the algal blooms were monitored in 10 main tributaries, which is, Xiangxi River, Shennong Stream, Daning River, Zhuyi River, Pengxi River, Zhuxi River, Ruxi River, Longhe River, Yulin River, and Hanfeng Lake. A total of 70 stationary monitoring sections were set in the backwaters (one key monitoring section and 3～5 general monitoring sections for each tributary), upstream waters, and adjacent mainstream waters of those tributaries. The monitoring was conducted on a monthly basis, with more frequent monitoring during the sluicing period and impoundment period.

8.9.1 Water environment

In 2014, the mean flow rate of each of the monitoring sections of the 10 main tributaries was much lower than that of the monitoring section of their adjacent mainstream reaches. The flow rate of the former monitoring sections ranged between 0～1.65 m/s. Specifically, the flow rate of Xiangxi River and Daning River in the head region ranged somewhere between 0～0.67 m/s and 0.02～0.05 m/s; that of Pengxi River and Hanfeng Lake in the central region somewhere between 0～0.13 m/s and 0～0.55 m/s; and that of Longhe River in the tail region somewhere between 0.14～0.44 m/s. The flow rate of Yulin River varied greatly from March through June, reaching as much as 1.20 m/s, and was fairly low in remaining months, all under 0.50 m/s.

The temperature of the key monitoring sections in the backwaters of the 10 tributaries ranged between 10.2～31.7℃, with the lowest temperature observed in Yulin River (January) and the highest temperature observed in Pengxi River (July). The highest temperature of each of the tributaries was recorded generally from July to August. The mean annual temperature of the 10 tributaries from the head through the tail region was 19.6℃ for Xiangxi River, 21.8℃ for Shennong Stream, 19.0℃ for Daning River, 20.2℃ for Zhuyi River, 20.0℃ for Hanfeng Lake, 21.8℃ for Pengxi River, 20.8℃ for Zhuxi River, 20.5℃ for Ruxi River, 17.0℃ for Longhe River, and 20.0℃ for Yulin River.

The SD of the key sections of the backwaters of the 10 tributaries ranged somewhere between 0.1～5.9 m, with the highest value observed in Pengxi River (March), and the lowest value recorded in Hanfeng Lake (September) and Yulin River (September). From the head region through the tail region, the mean annual SD of each of the tributaries was 1.9 m for Xiangxi River, 2.0 m for Shennong Stream, 2.7 m for Daning River, 1.1 m for Zhuyi River, 0.6 m for Hanfeng Lake, 1.8 m for Pengxi River, 1.1 m for Zhuxi River, 1.4 m for Ruxi River, 1.5 m for Longhe River, and 1.0 m for Yulin River.

8.9.2 Phytoplankton

The main phytoplankton communities in those tributaries were Bacillariophyta, Chlorophyta, Cyanophyta, Pyrrophyta, and Cryptophyta communities. The dominant species were Cyclotella, Navicula, Melosira, Chlorella, Pandorina, Chlamydomonas, Chroococcus, Merismopedia, Cryptomonas, and Peridiniopsis species.

The composition of phytoplankton communities exhibited distinct seasonal variations among those tributaries in 2014. The algal cell density of the key sections in the backwaters ranged between 0.8×10^4/L～$9,191.9\times10^4$/L, with the minimum density observed in Longhe River in July and the maximum density in Shennong Stream in March.

From the chronological perspective, the algal cell density of the tributaries peaked mostly in March, May, September, and October. The water temperature was fairly low in January and February, so was the algal cell density; Bacillariophyta (Cyclotella, Melosira) and Chlorophyta (Chlorella, Pandorina, Chlamydomonas) species were the dominant species. From March through May, along with rising water temperature, the percentage of Chlorophyta and Cryptophyta communities elevated

and gradually replaced Bacillariophyta as dominant communities. In June, Yangtze River entered the flood season, added by the massive sluicing of the Three Gorges Project, the flow rate of the tributaries escalated, and the algal cell density was lower than that in the spring. From July to August, with further growing water temperature, Chlorophyta became the dominant phytoplankton community. From September through October, the flow rate of the tributaries slowed down due to the impoundment, and the higher content of nutrient salts led to fast growth and reproduction of the algaes, so the algal cell density was at a fairly high level in the year, and Chlorophyta and Bacillariophyta communities regained dominance. Between November and December, with lowering water temperature, the algal cell density was on the decline, and Bacillariophyta species turned out to be the dominant algal species.

From the geographical perspective, the mean annual algal cell density of the key sections of the tributaries in the head and central regions was notably higher than that of tail region of the project area. Specifically, the mean annual algal cell density was 67.54×10^5/L for Xiangxi River and 259.98×10^5/L for Shennong Stream in the head region, 11.89×10^5/L for Longhe River and 6.48×10^5/L for Yulin River in the tail region.

8.9.3 Algal blooms

The outbreak of algal blooms was between March and May in the spring and June in early summer for all of the 10 tributaries. The dominant phytoplankton communities were Cryptophyta, Bacillariophyta, Chlorophyta, and Pyrrophyta. Algal blooms were also observed in a few tributaries in the autumn (September and October), and the dominant species were Cyclotella, Anabaena, Cryptomonas, and Eudorina. Specifically, the algal blooms in Xiangxi River were caused often by more than one dominant species, and the common combinations were Bacillariophyta-Cryptophyta, Bacillariophyta-Chlorophyta, and Bacillariophyta-Cyanophyta. Algal blooms caused by Bacillariophyta species were most common in Xiangxi River this year. For Shennong Stream, the outbreak of algal bloom caused by Cyanophyta (dominated) and other algal species in June was the most serious and prolonged bloom. The dominated species of the bloom were Microcystis, Pandorina, and Ceratium species. The dominated species of algal blooms was Cryptomonas for Daning River, Chlamydomonas and Cyclotella for Meixi River, Microcystis and Ceratium for Pengxi River, Melosira and Synedra for Zhuxi River, Cryptomonas, Cyclotella and Chlamydomonas for Ruxi River, and Peridinium for Longhe River.

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