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

2008

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

May 2008

Content

Summary

In 2007, the principal project of the Three Gorges came to the end further showcasing the comprehensive benefits. The Three Gorges Project began carrying out flood prevention task in its early operation and has played an important role in reducing flood pressure in the mid reach of the Yangtze River. The navigation capacity continuously grew. There was evident rise in power generation compared with that of 2006, so was environmental benefits. The power generation amount in 2007 by the project was equivalent to the reduction of 66 million t of CO_2 if it were generated by coal-fueled power plants. In dry period, the Three Gorges replenished water to the downstream river with gradual ecological benefits.

In 2007, the General Office of the State Council Three Gorges Project Construction Committee launched the "7 + 1" special programs in order to improve relevant policies, systems and mechanism, explore the biological measure, engineering measure and construction mode for the development and conservation of ecological environment of the Three Gorges and study such issues as the distribution of reservoir water resources. There were 8 special projects, including 7 trial and demonstration projects on the development and conservation of ecological environment (treatment of water-level-fluctuating zone, comprehensive control of tributary water environment, guarantee the safety of tributary drinking water sources, development of ecological shelter along reservoir bank, pollution interception and control in rural areas, pollution interception in cities and towns, conservation of biodiversity) and the project on the assessment of ecology of the Three Gorges Project and performance of environmental monitoring system.

In 2007, the Three Gorges reservoir area enjoyed steady rapid social and economic growth with GDP rise by 15.5% compared with that of 2006 based on the comparable price. The industrial structure of the reservoir area was on continuous optimization with the growth of the output in each industry. The living standard rose continuously with good public health.

In 2007, the average air temperature of the Three Gorges reservoir area was clearly higher than the historical average, so was the annual precipitation. There were frequent meteorological disasters. Among them, storms, floods and geological disasters such as landslide and mud-rock flow triggered by them were pre-eminent. Earthquake activities were still at low level. Monitoring and early-warning of geological disasters had obtained achievements and prevention and projects control for emergency response had smooth progress.

In 2007, the total cultivated area and total sown area of the Three Gorges reservoir area went up. The cultivated area multiple crop index increased.

Crop production was still dominated by grain crops. Environmental protection plan for resettlement areas had smooth implementation. There was wide extension of the techniques on the application of fertilizers based on soil testing results. The control of non-point pollution enjoyed smooth development. The first phase project on transferring soil and improving fertility has been finished involving 2142 ha land. A total of 4616 ha cropland had been covered with soil coupled with increasing fertility. Afforestation surrounding the Three Gorges reservoir area was carried out in an all round way with the development of 72800 ha forest. A total of 51000 ha basic cropland had been developed.

In 2007, the fry run-off of the "four major home fishes" of the Yangtze River had some reduction. The resource amount of eel fry and tapertail anchovy in the estuary area went down at different degree. The population of Chinese turtle crab had some increase. The overall quality of major fishery waters of the Yangtze River was good, basically meeting the requirement for fish growth and propagation.

In 2007, total discharged amount of industrial effluent in the Three Gorges reservoir area reached 474 million t. Among them, the amount of COD and ammonia nitrogen was 74800 t and 6700 t respectively. The discharged amount of urban & town sewage was 478 million t. Among them, the amount of COD and ammonia nitrogen was 92600 t and 9300 t respectively. The amount of ship-oil waste water and domestic sewage was 509300 t and 3.58 million t respectively. 94.8% of oil-containing waste water was treated.

In 2007, the quality of most water in the mainstream of the Three Gorges Reservoir met or was superior to Grade III national surface water quality standard. Most waters of tributaries met Grade Ⅳ water quality standard, better than that of the last year. Some tributaries still had water blooms. The overall environmental quality of the construction areas of the Three Gorges Project and resettlement areas was good. The revision of the *Plan for the Prevention and Control of Water pollution in the Three Gorges Reservoir Area and Its Upper Reaches* has been completed. The efforts in the control of pollution sources in the mainstream and tributaries of the Yangtze River have been enhanced. As a result, cities and towns in the Three Gorges reservoir area have built 58 sewage treatment plants and 41 landfill facilities with daily capacity in sewage treatment of 2.5 million t and garbage treatment capacity of over 11000 t. The policy of "subsidy to improve treatment rate" for sewage treatment was carried out. The special subsidy funds were gradually in place. Commercialization of sewage treatment had further development and operation of sewage treatment plants were tended to normal operate condition.

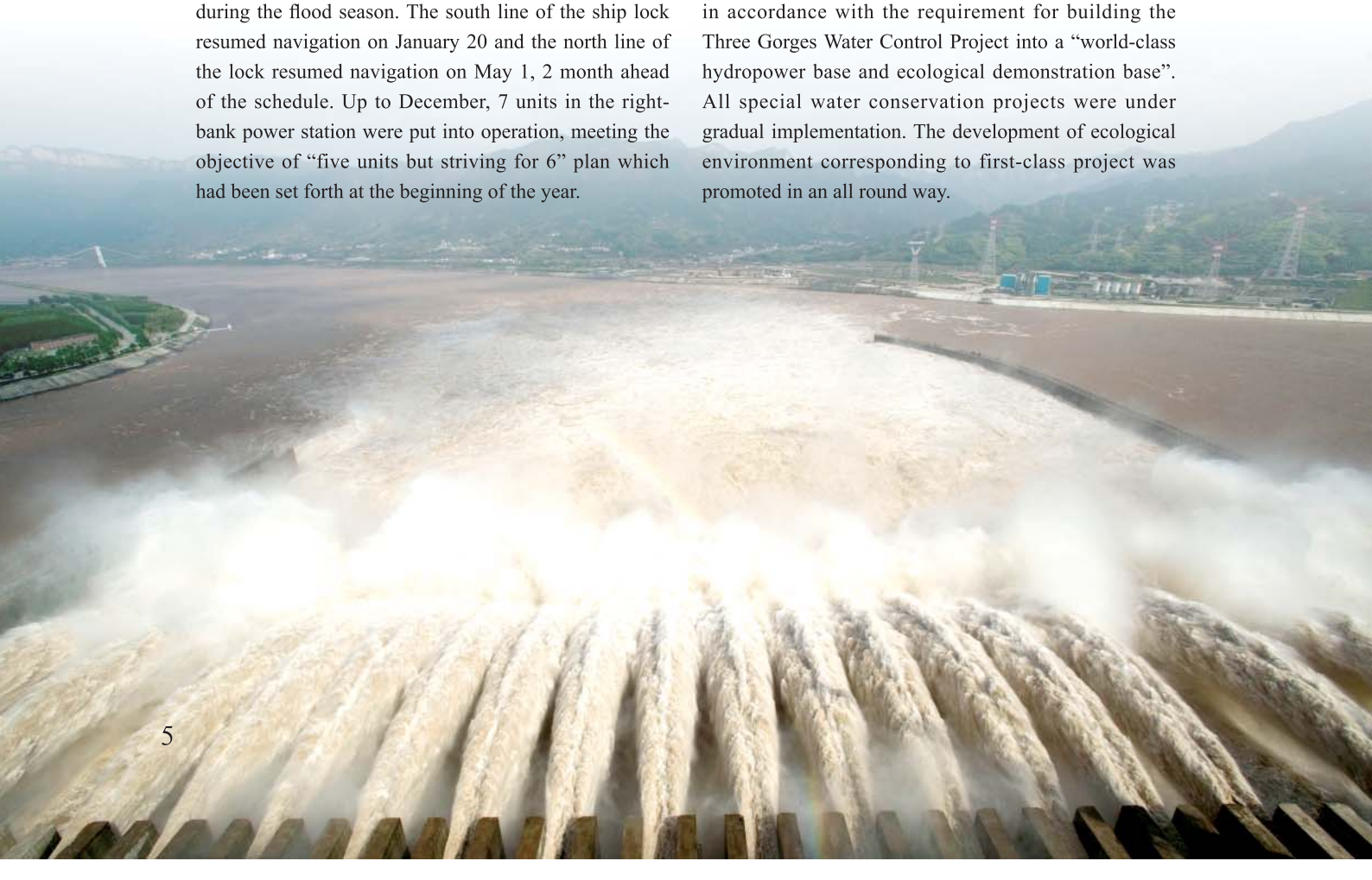
Chapter 1
Progress of the Three Gorges Project

In 2007, the principal part of the Three Gorges water control project of the Yangtze River came to the final stage. According to the requirement of "To be cautious in the end as in the beginning with orderly completion", the management of the project ensured effective operation of the quality & safety management system of the construction projects. Major milestones have been met according to plan or ahead of time. Both the quality and safety of the project have met the management objective of "zero major defect". On February 28, the downstream soil and rock cofferdam of Phase III construction project was blasted successfully. The downstream foundation pits impounded water ahead of time, meeting the requirement of the right-bank unit for debug and power generation. In April, the bottom diversion pass finished the blocking work. The pier of 11 surface holes for flood release before flood season and the restoration of the upper half of the pier of No.2 drift hole were completed according to the schedule, which had made full preparation for the prevention of flood during the flood season. The south line of the ship lock resumed navigation on January 20 and the north line of the lock resumed navigation on May 1, 2 month ahead of the schedule. Up to December, 7 units in the right-bank power station were put into operation, meeting the objective of "five units but striving for 6" plan which had been set forth at the beginning of the year.

In 2007, the engineering work completed in the Three Gorges Project was: digging of 2.0847 million m^3 of earth and stones; concrete pouring of 235300 m^3; 4392.4 t of metal structure and electronic machine buried and installed, and 38500 t of generator sets installed. From January to December, a total of 2944 subprojects of the Three Gorges Project were under quality assessment with 100% meeting the standard and 94.87% good.

In 2007, the Three Gorges water control project began carrying out anti-flood task in its primary operation phase. In the end of July, it successfully carried out an active operation for the prevention of flood with storage a total of 1.043 billion m^3 flood water and reduction flood peak by near 4000 m^3/s. It has played an important role in alleviating flood pressure in the midstream of the Yangtze River.

In 2007, the authority made more efforts in water conservation, afforestation and ecological restoration in accordance with the requirement for building the Three Gorges Water Control Project into a "world-class hydropower base and ecological demonstration base". All special water conservation projects were under gradual implementation. The development of ecological environment corresponding to first-class project was promoted in an all round way.



Chapter 2
Economic and Social Development

2.1 Population, Society and Economy

Up to the end of 2007, the total registered population of the Three Gorges reservoir area was 20.5525 million, up by 1.0% than in 2006. Among them, 13.9255 million lived in rural areas, down by 0.1% compared with that of 2006. 6.627 million lived in cities and towns, up by 3.6%. Urban population accounted for 32.2% of the total, up by 0.7 percentage point than in 2006.

In 2007, local GDP of the Three Gorges reservoir area was 304.213 billion yuan, up by 15.5% than in 2006 based on comparable price. Among them, 287.597 billion yuan came from the reservoir area of Chongqing Municipality, up by 15.6%; 16.616 billion yuan came from the reservoir area of Hubei Province, up by 14.3%. The increased value of the primary, secondary and tertiary industries in the Three Gorges reservoir area was 32.195 billion yuan, 135.229 billion yuan and 136.789 billion yuan, up by 8.1%, 19.9% and 13.2% respectively compared with that of 2006. Among them, the increased value of industry reached 112.607 billion yuan, up by 21.9%. The ratio of increased value of the primary, secondary and tertiary industries was 10.6:44.4:45.0. Based on the amount of permanent residents, GDP per capita of the Three Gorges reservoir area in 2007 was 16115 yuan, up by 17.3% compared with that of 2006.

Table 2–1 Major Statistical Indicators of Economic and Social Development of the There Gorges reservoir Area in 2007

Indicator	Indicator value	Increase over 2006 (%)
Local GDP (1billion yuan)	304.213	15.5
Primary industry	32.195	8.1
Secondary industry	135.229	19.9
# Industry	112.607	21.9
Tertiary industry	136.789	13.2
Fixed assets investment of the whole society (1billion yuan)	244.274	27.6
Total retail value of social consumer goods (1billion yuan)	130.030	19.4
Local financial revenue (1billion yuan)	20.159	43.9
Local financial expenditure (1billion yuan)	43.622	28.5
Savings of urban and rural residents (1billion yuan)	241.967	7.1
Total grain output (10000 t)	647.84	16.0
Oil plant output (10000 t)	24.87	8.8
Total meat output (10000 t)	124.77	3.5

In 2007, the social investment in fixed assets of the Three Gorges reservoir area was 244.274 billion yuan, up by 27.6% compared with that of 2006. Local financial revenue was 20.159 billion yuan, up by 43.9%. Local financial expenditure was 43.622 billion yuan, up by 28.5%. Per capita savings was 11834 yuan, up by 680 yuan compared with that of 2006. Per capita urban disposable income was 12517 yuan, up by 17.7% than

in 2006. Per capita net income of rural farmers reached 3496 yuan, up by 20.3%.

Up to the end of 2007, there were 521200 professionals, up by 10.1% compared with that of last year. The collection of books in public libraries reached 7.779 million, up by 7.9%. Every 10000 middle school and primary school student had 535 full-time teachers, up by 34 people than in 2006. TV coverage reached 97.01%, basically the same as in the last year.

2.2 Migration Settlement

In 2007, the resettlement progress of migrant farmers in the Three Gorges reservoir area was ahead of the schedule. The management of resettlement construction projects was under continuous standardization with good overall quality. Up to the end of 2007, a total of 1.22 million people had finished resettlement, 1.13 million of them would be provided with houses specified in the plan. A total of 46.06 million m^2 various kinds of buildings had been constructed. Among them, 38.394 million m^2 were the floorage that should compensate to migrant people. A total of 12 county cities submerged by the project had basically finished the overall resettlement except Kaixian County. Among the 114 towns, 97 had finished the overall resettlement. A total of 1599 factories and mining companies had been resettled. The excavation, protection and restoration of cultural relics in the Three Gorges reservoir area was close to the end.

● Countryside

A total of 24040 rural residents had been resettled. 32048 farmers had been resettled with job opportunities. A total of 1211 water pools with capacity of 22100 m^3 and two canals with total length of 2800 m had been built for resettled migrants. 71 rural roads with total length of 189.06 km were built in 2007, 7 of them (31.6 km) were the roads surrounding the reservoir. A total of 808600 m^2 houses were constructed in rural areas, all for migrants. 597100 m^2 of buildings were built to compensate the migrants, 593300 m^2 of them were houses.

● Cities & Towns

A total of 30747 people living in cities and towns had been resettled, and 32400 m^2 of urban land were requisitioned for resettlement. Four urban roads with length of 3.77 km were built. 816600 m^2 of houses finished construction, 570500 m^2 of them were urban houses, 246100 m^2 of them were houses in towns and 763600 m^2 were compensated houses.

● Plants, Mines and Other Enterprises

29 plants, mines and other enterprises in the reservoir area had finished the resettlement work in 2007 with 3000 m^2 of houses built.

● Special Facilities

The reconstruction of special facilities had finished the construction of two roads with length of 30.57 km, 2 wharfs, 10 hydropower stations, 42 water pumping stations, 37700m of electricity transmission line, 200000 m of telecommunication lines, and 581000 m of radio & television lines. A total of 123 places of cultural relics in the Three Gorges reservoir area finished excavation and conservation, 48 of them on the ground and 75 underground. The total exploration and excavation area reached 630000 m^2.

● Counterpart Assistance

In 2007, the assistance from other provinces & municipalities had introduced a total of 10.339 billion yuan (247 million yuan for various public welfare projects and 10.092 billion yuan for 351 economic development projects) funds into the Three Gorges reservoir area. Up to the end of 2007, the accumulated assistant funds from other provinces & municipalities reached 42.1 billion yuan, 39.3 billion yuan of them for economic development projects and 2.8 billion yuan of them for projects of public welfare.

Chapter 3
State of the Natural Ecological Environment

3.1 Climate

In 2007, the average air temperature of the Three Gorges reservoir area was clearly higher than the historical average. To be specific, the temperature in winter (December of 2006~February of 2007) and spring was higher than the historical average at the same period, while the temperature in summer and autumn was similar to that of normal years. The annual precipitation was higher than the historical average. To be more specific, the precipitation in winter, spring and summer was higher than that of the same seasons in normal years but in autumn. The annual average wind speed, relative humidity and evaporation were basically the same as the historical average. There was a clear reduction of foggy days in the year. On the whole, acid rain was lighter than that of the last year. It was relatively serious in winter and autumn but not in the spring and summer. There were frequent meteorological disasters. Among them, storms, floods and geological disasters such as landslide and mud & rock flow triggered by storm and flood were rather pre-eminent.

Table 3–1 Monitoring results of meteorological elements of each region in the Three Gorges reservoir area in 2007

Monitoring station	Average temperature (℃)	Precipitation (mm)	Evaporation (mm)	Relative humidity (%)	Average wind speed (m/s)	Sunshine hours (h)	Foggy days (d)	Thunder storm days (d)
Chongqing	19.0	1439.2	1165.3	81	1.3	856.2	23	26
Changshou	18.4	1268.1	1003.7	80	1.0	1165.5	37	34
Fuling	18.6	1082.2	1194.0	80	0.7	1203.7	61	35
Fengdu	18.9	1112.9	1241.7	79	1.2	1369.6	39	43
Zhongxian	18.2	1266.8	1113.4	81	1.1	1093.0	60	37
Wanzhou	18.7	1179.0	1248.8	80	0.7	1174.2	17	40
Yunyang	18.4	1276.0	1177.4	76	1.0	1300.2	9	37
Fengjie	18.7	1079.9	1308.1	75	1.4	1471.1	4	22
Wushan	19.1	1164.8	1347.0	68	0.5	1422.2	2	25
Badong	17.7	1424.6	1528.5	73	1.7	1275.9	30	29
Zigui	16.9	1479.0	1113.3	78	0.9	1463.6	5	40
Bahekou	17.2	1363.6	1236.5	73	1.5	931.5	0	32
Yichang	17.9	1171.6	1393.7	71	1.3	1122.8	26	45

In 2007, the average precipitation of the reservoir area was 1254.4mm, 128.3 mm more than the historical average and falling into the year with more precipitation. Spatial distribution of precipitation showed that the precipitation of each region ranged from 1079.9 to 1479.0 mm, similar to that of the last year. The maximum precipitation occurred in Zigui and minimum in Fengjie. Compared with the historical average, Badong and Chongqing had 31.4% and 30.2% more precipitation; Fuling and Wanzhou had slightly less and other regions basically had similar amount. Precipitation time distribution

showed that 2006/2007 winter had clear more precipitation, up by 81.4% than that of the normal years. The precipitation increased by 14.8% in the spring and 14.2% in the summer, but down by 10.9% in the autumn. The precipitation of August, March and December went down by 35.8%, 29.1% and 27.4% respectively compared with the same month of normal years. However, the precipitation of February, April and July went up by 237.7%, 48.2% and 45.9% respectively than that of the same month of normal years. The precipitation of other months was the same as the historical average. In general, the first 6 months had more precipitation and the second 6 months less compared with that of normal years.

In 2007, the average air temperature of the Three Gorges Project areas was 18.3℃, 0.5℃ higher than the historical average. The spatial distribution of temperature showed that it was higher than the historical average except in Yunyang. Among them, air temperature in Changshou and Yichang was 1.0℃ higher. Temperature time distribution showed that the air temperature of the Three Gorges reservoir area was higher than the historical average in winter and spring but similar in summer and autumn. Among them, the average temperature of 2006/2007 winter reached 9.1℃, 1.2℃ higher than the same season of normal years, second only to that of 1979 winter since 1949, so it is a year with warm winter. Under the influence of rainy season, all regions of the Three Gorges reservoir area were dominated by overcast or rainy days with evident reduction of sunshine hours. In mid and late July, the

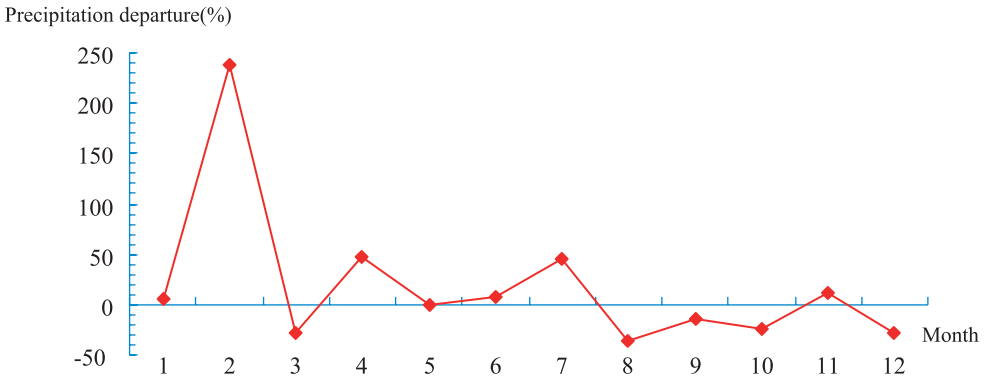


Figure 3–1 Change of the departure percent of monthly average precipitation of the Three Gorges reservoir area in 2007

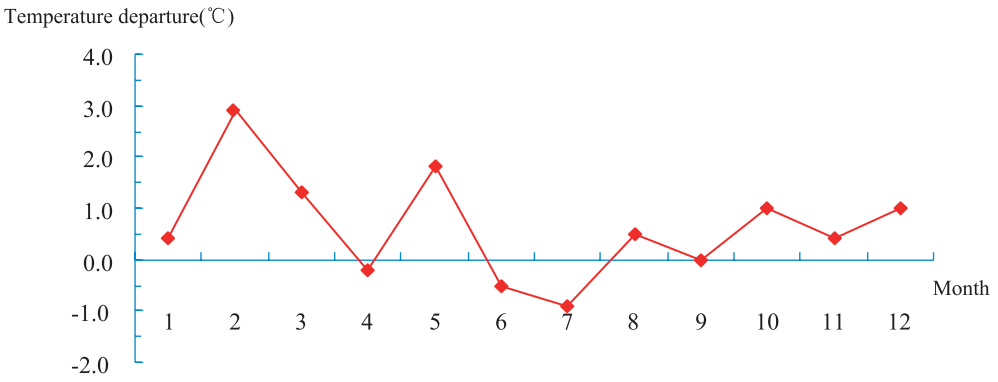


Figure 3–2 Change of the departure of monthly average temperature of the Three Gorges reservoir area in 2007

temperature was quite low leading to cool summer. Except April, June, July and September when their temperature was similar to or lower than the historical average, the monthly average temperature of other months was higher. Among them, the monthly average air temperature in January, August and November was 0.4~0.5℃ higher than the same month of the normal years. the monthly average air temperature in March, May, October and December was 1.0~1.8℃ higher. In February, it was 2.9℃ abnormally higher than the historical average.

In 2007, the wind of the reservoir area was mild with average speed of 1.1m/s, down by 0.2m/s compared with that of normal years. The annual average wind speed of all regions ranged from 1.0 to 2.0m/s except in Wushan at 0.5m/s and Fuling and Wanzhou at about 0.7m/s. The maximum average wind speed occurred in Fengjie at 1.4m/s and minimum in Wushan at 0.5m/s. The maximum monthly average wind speed of the reservoir areas occurred in April and May at 1.3m/s and the minimum in November at 0.8m/s.

In 2007, the average foggy days in the reservoir area was 26, down by 12 days compared with that of the normal years. It had been the 6 consecutive year of less foggy days since 2002. The spatial distribution of foggy days showed that western part of the reservoir area had clearly more foggy days than that of the eastern part. Among them, the amount of annual foggy days was 60 in Fuling and 61 in Zhongxian and less than 5 in Bahekou, Zigui, Wushan and Fengjie. Compared with that of the normal years, there were 2~5 more foggy days in Yunyang, Yichang, Zhongxian and Zigui, while the rest regions had 7~22 days less. Among them, there was 35.9 days less in Changshou, and 35.6 days less in Wanzhou. There were 12.8 foggy days in the winter, 8.5 foggy days in autumn, 3.8 foggy days in the summer and 2.3 foggy days in the spring. The amount of foggy days in the spring, summer and autumn was 3~4 days less than the historical average, while it was similar in the winter.

In 2007, the average relative humidity of the reservoir area was 77%, similar to that of normal years. The average relative humidity of the western part of the reservoir area was higher than that of the eastern part. Among these regions, the relative humidity was about 80% from Chongqing to Wanzhou, 71%~78% in most regions from Wanzhou to Yichang. The relative humidity in the spring was relatively low at 70%. It had little change in the summer, autumn and winter, ranging from 78% to 80%.

In 2007, the average evaporation of the reservoir area was 1236.3mm, similar to that of normal years. The annual evaporation of the eastern part of the Three Gorges reservoir area was 10%~35% more than that of normal years, while it went down by 10%~30% in western part. Among them, Badong had the biggest annual evaporation at 1528.5mm. The annual evaporation was 1393.7 mm in Yichang, 1347.0mm in Wushan and 1308.1mm in Fengjie. The annual evaporation of other regions ranged from 1000.0mm to 1250.0 mm. Compared with the evaporation of normal years, there was relatively big seasonal change of evaporation in the reservoir area with maximum at 477 mm in the summer, 360 mm in the spring, 284 mm in the autumn and 118 mm in the winter. The evaporation in the spring and autumn was about 10% more than in the same season of normal years, while it was similar to or slightly less than the historical average in the winter and summer.

In 2007, the annual average pH value of the precipitation of the 6 monitoring stations of the reservoir area was 4.73, falling into the range of acid rain, but less acidity than that of the last year. Among them, Chongqing and Yichang were areas with relatively heavy acid rain. Fuling, Wanzhou, Fengjie and Badong were the areas with ordinary acid rain. Compared with the last year, the acidity of acid rain in Chongqing, Wanzhou and Badong had some reduction, while it went up a little in Fuling, Fengjie and Yichang. There was small seasonal change of acid rain in the reservoir area. Winter was the season with the heaviest acid rain and summer the slightest in the year.

In 2007, there were frequent meteorological disasters in the reservoir area and its neighbouring areas. Among them, storms, floods and geological disasters such as landslide and mud & rock flow triggered by floods were pre-eminent. Other meteorological disasters like thunder, heavy fog, drought and hail were relatively serious.

Storms and Floods: During April～September of 2007, there were frequent strong precipitation during April to July in the reservoir area and its neighboring

areas with huge rainfall, leading to serious storm and flood disasters. There were four regional storms on April 1 and April 21, June 29, August 1~2 and September 27~28 in the reservoir area. There were another six regional storms on May 23~24, May 30~June 1, June 16~23, July 8~12, July 16~20 and July 28~30 respectively, causing serious storm & flood disasters. According to rough estimate, the large scale intense rainfall on May 23~24 in the reservoir area affected 2.891 million people in 20 counties (districts) of Chongqing Municipality including Pengshui, Fengjie, Fuling and Fengdu and 4 counties (cities or districts) of Hubei Province including Tuanfeng, Yidu, Lichuan and Shennongjia forest area with 11 deaths, 113,000 ha cropland damaged and direct economic loss at 673 million yuan. On July 17 in Chongqing Municipality, daily precipitation was 179.5 mm in Tongliang, 258.0 mm in Bishan and 262.8 mm in Shapingba, the biggest value in local meteorological record. And 262.8 mm had been the maximum daily precipitation in Shapingba since the year of 1892. Extreme heavy storm led to the collapse of the wall and destruction of prison ward of "Zhazidong" — martyr tomb historic site — a famous tourist site in Chongqing, which had been subject to the biggest storm disaster since 1949 when the People's Republic of China was founded.

Geological Disaster: During April~July of 2007, intense precipitation caused many geological disasters in the reservoir area and its neighboring areas including continual landslide and mud & rock flow, leading to over 10 deaths and more than 100 million yuan economic loss. In April, the landslide and mud & rock flow mainly occurred in Pengshui County and Fengjie County of Chongqing Municipality. In May, it mainly occurred in Qingtaiping Town and Shuibuya Town of Badong County in Enshi City; Gaoyang Town, Gaoqiao Township and Shuiyuesi Town of Xingshan County in Yichang City; Jingyang Section in Jianshi County of Enshi City in Hubei Province; Hanjia Town of Pengshui County in Chongqing Municipality, Shuibuya of Guandukou Town of Badong County in Hubei Province. In June, it occurred in Wufeng Tujia Autonomous County, Qingtaiping Town of Badong County in Hubei Province, and Tongnan County, Pengshui County and Wanzhou District of Chongqing Municipality. In July, landslide and mud & rock flow mainly occurred in Liangping County and Tongnan County of Chongqing Municipality. On June 22, a total of 118 places in Wufeng Tujia Autonomous County had relatively large landslides within several hours.

Thunder Strike: During April~August of 2007, there were several thunder strikes in the reservoir area and its neighboring areas in particular Chongqing Municipality, leading to 21 deaths with heavier economic loss compared with that of the previous years. Among them, thunder strike in Dianjiang and Jijiang of Chongqing on April 1 led to 5 deaths. On May 23, thunder strike in Xingye Village Primary School in Yihe Town of Kaixian County in Chongqing resulted 7 deaths, 19 seriously injured and 25 slightly injured.

Gale and Hail: In 2007, there were frequent strong convection weather like gale and hail in many places of the reservoir area and its neighboring areas from the spring to summer, leading to heavier loss compared with that of 2006. According to statistics, a total of over 50 county/times were subject to the strike of strong local convection like gale and hail, resulting in 3 deaths, over 2.3 million people affected, more than 83000 houses damaged or destructed with economic loss over 380 million yuan.

Dense Fog: During 2006/2007 winter and late autumn, there were frequent dense fogs in most western part of the reservoir area. These fogs affected the traffic of highways, railway, flight and navigation at different degrees, caused inconvenience for the travel during Spring Festival, triggered major traffic accidents, led to degradation of air quality and effected human health. On February 7, a big traffic accident occurred at Hefeng County section in Enshi City of Hubei Province due to rainfall and dense fog, leading to 16 deaths and 16 injured. On November 9, a dense fog blocked off Chongqing Airport, causing to the delay of 30 flights, cancel of 4 flights and 4000 passengers detained in the airport within just one hour. Eight expressways including Chengdu — Chongqing expressway and Chongqing — Yibin expressway carried out traffic regulation one after another. The Chaotianmen — Sandu ferry-boat line stopped navigation for 4 hours.

Drought: In 2007, the reservoir area had slight drought in general. During 2006/2007 winter, the reservoir impoundment and paddy field water reservation

in Chongqing Municipality had clear reduction with widespread low river water level and sharp decline of groundwater table due to follow-up impacts of extreme high-temperature drought in Sichuan Province and Chongqing in 2006 summer. The water storage of water conservancy projects across Chongqing was less than 50% of the same period historical average of the storage. A total of 1.5 million people and 980,000 big livestock in the Municipality had temporary difficulty in getting access to drinking water. A total of 116,000 ha cropland were subject to drought, water supply for agricultural and industrial production as well as domestic use in some parts of the reservoir areas had difficulty.

3.2 Terrestrial Plants

Masson pine forest is one of the main components of forests in the Three Gorges reservoir area with wide distribution at mountainous areas with elevation of 100~1500 m, mainly concentrating on the mid and bottom slope of mountains less than 1200m or the upper slope of hillside. Masson pine forests are dominated by artificial forest and secondary forest due to strong artificial influence. There is big difference in environmental conditions in the reservoir area. Therefore, there is very big difference in the composition and stratification structure of Masson forests under different biotopes. Based on the species dominance of arbor, bushes and grass coupled with practical situation, Masson forests in the reservoir area could be classified into 21 community types of two categories.

Category 1 is the Masson Pine forests with many bushes including Chinese Loropetalum (*Loropetalum chinense*) and azalea. The species of arbor communities is Masson pine, most being pure Masson pine forests with occasional appearance of such species as *Quercus serrata var. brevipetiolata*, fir, *Quercus variabilis, Quercus griffithii, Quercus aliaena, Liquidambar formosana, Albizzia kalkora (Roxb.) Prain* and *Dendrobenthamia* in sampling spots. There were rich under-tree bush species with Chinese Loropetalum, azalea, *Pyracantha fortuneana, Viburnum utile and V. ichangense* dominating most sample plots and the common associated species including *Myrsine Africana, Vaccinium, Lespedeza Formosa (Vog.) Koehne, Rhus chinensis Mill (China Sumac), Abelia macrotera (Graebn, et Buchw) Rehd, Coriaria sinica, Rhododendron, Quercus variabilis Bl. and Rosa cymosa Tratt. (R. microcarpa Lindl.)* etc. The dominating species in grass communities include *Dicranopteris linearis*, Chinese silvergrass, chestnut-brawn sedge. The common grass species include *Woodwardia prolifera, Stenoloma chusanum (L) Ching, Pogonatherum paniceum (lam.) hack, Veronicastrum axillare (Sieb. Et. Zucc) Yamazaki* etc.. Common inter-strafication plant species include sweet potato, *Rhizoma Smilacis Chinesis and S. ferox* etc.

Flower of Chinese dove tree

Category 2 is the Masson Pine forests with *Quercus*. They usually form sparse forests at arid and barren mountain slope. Arbor communities have only Masson pines. The dominating bush community species are deciduous oak trees (*Quercus*) including *Quercus fabric Hance* and *Quercus serrata var. brevipetiolata* and most are copse forests. Common associated species include *Quercus griffithii, Lindera glauca (Sieb. Et Zucc) Blume, Quercus variabilis, Quercus acutissima Carr., Palbergia hupeana Hance* and *Vitex negundo L.* etc.. *Dicranopteris linearis, Miscanthus floridulus (Labill.) Warb* and Chinese silvergrass are the dominating species in herbaceous species. The common herbaceous species include *Cynura crepidioides Benth, Thelypteris glanduligera (Kunze) Ching, Hicriopte ris laevissima* and *Cyperus compressus L.* etc.. The common inter-stratification plant species are *Rhizoma Smilacis Chinesis* and *Milletiapachycarpa* etc..

3.3 Terrestrial Animals

Bird: The findings of the investigation on overwinter water birds in the Three Gorges reservoir area showed

that the change of hydrological conditions results in evident change of the distribution of overwinter water birds. In cold winter of January of 2008, the population of mandarin ducks (Grade Ⅱ national protected animals) had sharp reduction compared with the same period of 2006. Only 7 mandarin ducks were observed in Daning River where mandarin duck population keeps relatively high level for many years (24 were observed in January of 2007). And no mandarin duck was observed in the mainstream of the Yangtze River (36 were observed in the same period of 2007). Apart from mandarin ducks, the population of other wild goose and ducks in the mainstream of the Yangtze River went down at different degree. In some tributaries, however, both the species and population of winter water birds in the Pengxi River (Kaixian ~ Yunyang) had evident increase. Among them, the population of coot (taking waterweeds as main food and is hard to see before the 156m impoundment) had the biggest increase with the statistic population of over 100. The population of mandarin ducks went up from 6 in the same period of 2007 to 13 in 2008. In January of 2008, professionals observed and shot swan (not appeared for quite a few years) and new species of *Threskiornis melanocephalus* in Beibei.

Heron is a kind of *Ardeidae* with relatively big body, no propagation place was found in the reservoir area in the monitoring & investigation of the past years. However, 20 pairs of parent birds of heron were found at an old Bishop wood (*Bischofia polycarpa*) in Shiqiao Town of Wulong in the spring of 2008. The herons choose to have nest here in early February. They laid and hatched eggs from late February to early March. From late March to Early April, the nestling came into being. At the same time, a fish-hunting raptor — fish hawk (Grade Ⅱ national protected animal) was found here, which is rare in the Three Gorges reservoir area, it probably has nests at the Furong River.

Mammal: The identification of the distribution of *Macaca thibetana* in the Three Gorges reservoir area has been based on baseline survey and monitoring data. During July~August of 2007, professionals heard the call of *Macaca thibetana* at Wulong Bank of the Furong River. They witnessed Macaca thibetana at the same place on March 29, 2008, making sure its existence in the reservoir area. In addition, the amount of Pousargues communities went up from 2 to 3 at the Tiaotang~Baicha river section of the Furong River.

The two big forest projects, i.e. the conservation of natural forests and "grain for green" that have been carried out for many years in the reservoir area, have evident roles in the protection and restoration of the habitat of terrestrial wild vertebrate. The population of musk deer (Grade Ⅰ national protected animal), having no appearance in most areas for many years, resumed in some local areas. Inspectors of Xuebaoshan Nature Reserve in Kaixian County saw musk deer (*Moschus berezovskii*) in the field several times from the end of 2007 to early 2008 and took photos with their mobile phone. The population of other hoof animals such as *Muntiacus reevesi, Naemorhedus goral* and *Capricornis sumatraensis* had good recovery and development, too. Among them, population growth of wild boars has resulted in serious damage to crops in some areas and even threatened the life of local residents in some places. Therefore, it becomes an important issue for the reservoir area to adopt scientific measures to maintain, control and use wild life resources including wild boar.

Naemorhedus goral

3.4 Fishery Resources and Environment

3.4.1 Fishery Resources

In 2007, the total catch of natural fish in the Three Gorges reservoir area, downstream section of the Three Gorges dam, the Dongting Lake, Poyang Lake and estuary area was 56400 t, up by 2.5% compared with that of 2006. The fry run-off of the four major native

fishes at Jianli monitoring section downstream the Dam went down compared with that of 2006, and the fry fishing season was not clear. The population of eel fry and tapertail anchovy (*Coilia mystus*) in the estuary area went down at different degree,while the population of Chinese turtle crab (parent crab) had some increase.

Use square-shaped fishing net with wooden or bamboo poles as supports to catch fish

● Reservoir Area

In 2007, the total catch of natural fish in the reservoir area was 2410 t,up by 14% compared with that of 2006. The composition of the catch was 487 t of catfish, 450 t of bronze gudgeon (*Coreius heterodon*),397 t of common carp, 308 t of silver carp, 100 t of grass carp, 91 t of yellow catfish (*Pelteobagus fulvidraco*) and 59 t of largemouth bronze gudgeon (*Coreius guichenoti*).

Bronze gudgeon, silver carp, carp, catfish, yellow catfish, largemouth bronze gudgeon and grass carp accounted for 78.5% of the total catch and were main economic fish species in the reservoir area.

● Downstream Section

In 2007, the total catch of natural fish in the downstream section of the Three Gorges Dam reached 1402 t, down by 19.9% compared with that of 2006. Based on the composition of the catch, it was estimated that the catch of bronze gudgeon was 389 t, carp was 323 t, catfish 265 t and yellow catfish 98 t.

Among the catch, bronze gudgeon, catfish, carp and yellow catfish accounted for 76.7% of the total and were main economic fish species in downstream section of the Three Gorges Dam.

● Spawning Site of the "Four Major Home Fishes"

During May～July of 2007, the fry run-off of the "four major home fishes" at Sanzhou monitoring section in Jianli County downstream the Dam was 89 million, down by 61.5% compared with that of 2006, only 3.5% of the average amount before the impoundment (1997~2002) and the fry catch season was not clear.

The "four major home fishes" was still dominated by silver carp, taking up 60.2%; followed by grass carp,taking up 39.4%; variegated carp ranked the third, taking up 0.3%; no black carp was caught.

● Dongting Lake

In 2007, the total catch of natural fish in the Dongting Lake was 21400 t, slightly less than in 2006. Among them, the catch was 6400 t in the east Dongting Lake, 7800 t in south Dongting Lake and 7200 t in west Dongting Lake, accounting for 29.9%, 36.4% and 33.6% respectively of the total catch.

The catch was dominated by local fish species like carp, crucian carp and catfish and the "four major home fishes". They took up 52.2% and 4.7% respectively of the total catch.

● Poyang Lake

In 2007, the total catch of natural fish in the Poyang Lake was 31000t, up by 8.4% compared with that of 2006. The dominating species were local fishes like carp, crucian carp and yellow catfish and the "four major home fishes". They took up 61.5% and 5.2% respectively of the total catch.

● Estuary Area

In 2007, the time span of catch season for parent crabs and eel fry in estuary area was longer than that of 2006, but evidently shorter for tapertail anchovy (Coilia mystus). The average amount of operation days of both tapertail anchovy and eel fry monitoring ships was less than that of 2006 but more for parent crab monitoring

ship. The amount of issued tapertail anchovy catch license was similar to that of 2006. However, the amount of issued catch license for parent crab and eel fry went down by 31.3% and 8.0% respectively.

In 2007, the average catch of tapertail anchovy per ship during the entire catch season in the estuary area was 1675 kg and its total catch was 226.0 t in the catch season, down by 44.6% compared with the same period of last year. The average catch of parent crabs per ship during the entire catch season was 371.2 kg and the total catch was 4083.0 kg, up by 339.3% and 202.0% respectively compared with the same period of last year. The average catch of eel fry per ship during the entire catch season was 7783 tails and the total catch in the season was 21.481 million tails (equivalent to 3071.8 kg), up by 61.9% and 63.7% respectively compared with that of 2006.

3.4.2 Fishery Environment

In 2007, seven monitoring stations (Yibin, Banan, Wanzhou, Jingzhou, Yueyang, Hukou and Hekou) were established in the mainstream of the Yangtze River, Dongting Lake, Poyang Lake and estuary area to monitor the quality of major fishing waters of the Yangtze River basin. The assessment of water quality complies with the Water Quality Standard for Fisheries (GB11607-89). The unmentioned items would be assessed according to corresponding water function class specified in the Environmantal Quality Standard for Surface Water (GB3838-2002). Monitoring results showed that the overall quality of major fishery waters in the Yangtze River basin was good in 2007, basically meet the requirement for fish growth and spawning. However, some waters were under certain degree pollution with major pollutants being copper, total nitrogen and total phosphorus.

Hutiao Gorge of the Jinsha River

Main pollutant in fishery waters in Yibin and Banan in the upper reaches of the Yangtze River was copper. All the monitored copper concentration value during fish spawning period, growth period and winter exceeded Fishery Water Quality Standard, while the monitoring data of other pollutants did not exceed the standard. In Wanzhou fishery waters, all monitoring data met national water quality standard.

The quality of fishing waters of Zhicheng and Jingzhou in the mid reaches of the Yangtze River was good during fish growth and reproduction periods. In Jingzhou, the copper concentration of 50% water samples exceeded national water quality standard during winter. In the fishing waters of Chenglingji, the concentration of total nitrogen failed to meet Grade III national surface water quality standard during fish reproduction, growth and overwinter periods. The going-beyond-standard rate of total phosphorus (TP) was 100.0% during fish reproduction period. At the Chinese sturgeon (*Acipenser sinensis*) spawning site in Yichang, 33.3% of the concentrations of ammonia nitrogen and TP of the monitoring data failed to meet Grade III national surface water quality standard during the reproduction period of Chinese sturgeon, while other monitoring data met national standard. In Zhicheng, Guanyinci and Sanzhou, the spawning sites of the “four major home fishes”, all monitoring data met national water quality standard during their reproduction period.

Main pollutants in the mouth of lakes were non-ion ammonia, copper and TP. During overwinter period, reproduction period and growth period, the going-beyond-standard rate of non-ion ammonia was 33.3%, 100.0% and 100.0% respectively. The going-beyond-standard rate of copper was 33.3%, 66.7% and 100.0% respectively. The going-beyond-standard rate of TP was 33.3% during fish reproduction and growth period.

Major pollutants in fishing waters of the Dongting Lake were TN, permanganate value and TP. The going-beyond-standard rate of TN was 33.3% in reproduction period, 77.8% in growth period and 88.9% in overwinter period. The going-beyond-standard rate of permanganate value was 77.8% during fish reproduction period and

22.2% during fish growth period. The going-beyond-standard rate of TP was 11.1% in reproduction period and 100.0% in overwinter period.

Major pollutants in water body of the Poyang Lake were copper, TP, non-ion ammonia and ammonia nitrogen. Copper going-beyond-standard rate was 33.3% in winter, 33.3% in fish reproduction period and 88.9% in growth period. The going-beyond-standard rate of TP was 100.0% in winter, reproduction period and growth period. The off-standard rate of non-ion ammonia was 55.6% in fish reproduction and growth periods. The going-beyond-standard rate of ammonia nitrogen was 44.4% in winter and 11.1% in fish reproduction period.

Pollutant in fishing waters of the Yangtze River estuary area was TN, 100.0% waters samples taken during the catch seasons of eel fry, tapertail anchovy and parent crabs failed to meet national water quality standard in terms of total nitrogen.

3.5 Endemic Fish Species and Rare Aquatic Animals

3.5.1 Endemic Fish Species in the Upper Reaches of the Yangtze River

In 2007, a total of 118 fish species were collected in fish resource monitoring activities conducted in Panzhihua and Yibin sections downstream of the Jinsha River; Hejiang, Mudong and Wanzhou sections in the upper reaches of the Yangtze River and Yichang section in the mid reach of the Yangtze River. Among them, there were 25 endemic fish species in the upper reaches of the Yangtze River. Six alien fish species were found during the investigation, they were *Ictalurus Punctatus, Lctalurus melas, Micropterus salmoides, Tilapia, Gambusia affinis* and *Colossomabrachypomum*.

Panzhihua section of the Jinsha River

There was no clear change of the composition of fish species in each river section under investigation compared with that of previous years. Endemic fish species still had a considerable proportion in the catch of nearly all sections of the Yangtze River except Wanzhou section. Among them, there was most endemic fish species (13) in the catch of the Hejiang～Mudong section, accounting for 27.1% and 19.7% respectively of the total. The amount of endemic fish species in Yichang section was the smallest (5 species), accounting for 11.9% of the total. The proportion of endemic fish species was the biggest in Yibin section, accounting for 76.6% of the total catch by trammel net in autumn and 67.1% of the total fish catch by boulter. Whereas in Wanzhou section, the proportion of endemic fish species was the smallest, taking up 0.5% of the total net catch in the spring and 0.2% of the total net catch in the autumn.

Compared with that of the previous years, the length, weight, gender ratio and age structure of the endemic fish species of each river sections continued their trend of body becoming smaller and younger. In the fish catch at Panzhihua section, Yibin section and Hejiang section, over 50.0% of largemouth bronze gudgeon was one-year old. Among the caught *Rhinogobioventralis Savage et Dabry* at Panzhihua section and Yibin section, more than 60.0% was only one-year old. Among the fish catch at Mudong River section, over 90.0% largemouth bronze gudgeon and *Rhinogobioventralis Savage et Dabry* was one or two year's old.

In 2007, less than one-year young fish of largemouth bronze gudgeon was found at the 109 km river section from Yudong to Lianzituo of Dabao Village of Chongqing. According to estimate based on ship trawling, total resource of largemouth bronze was 220436～7629922 tails. It is analyzed that largemouth bronze gudgeon has batched spawning during the reproduction season. It probably begins reproduction in April and lasts to July with peak in June. The population of largemouth bronze gudgeon in autumn and winter was less than that of summer with certain fluctuation, which may have something to do with such factors as its life process, environment hydrological conditions and availability of food.

Wanzhou section of the Yangtze River

3.5.2 Rare Fish Species

Based on the analysis of fish detector data, Chinese sturgeon was mainly appeared in the 5 km river section from Gezhou Dam to Miaozui in 2007 with small distribution in river section from Miaozui to the end of Yanshou Dam. No Chinese sturgeon was found in river section downstream the river mouth of the Aijia River. Based on the ratio of water volume of water body of different river section to the detected water body volume, it was estimated that there were about 203 tails of Chinese sturgeon before spawning and 102 tails after spawning, which was 50% of the amount before spawning.

Judging on the distribution of the egg-hunting fish species that eat the eggs of Chinese sturgeon and were caught during the reproduction period of Chinese sturgeon, the spawning range of Chinese sturgeon was the same in 2007 as in the last year, which was located in the Gezhouba — Miaozui section. No Chinese sturgeon was found spawning at Mojishan — Wulongjiang section and Huyatan section downstream of Miaozui. Eight fish species including *Pelteobagrus vachellii*, bronze gudgeon, largemouth bronze gudgeon, *Leiocassis crassilabris, Pelteobagrus nitidus, Rhinogobio typus, Gobiobotia ichangensis Fang, Rhinogobio ventralis Savage et Dabry* were found eating the eggs of Chinese sturgeon. Among them, bronze gudgeon took up 55.7% of the total.

In 2007, Chinese sturgeons laid their eggs only once from the afternoon of November 23 to early morning of November 24, when a slight down of air temperature and water temperature at 18.3℃. There was an increase of river flow and water level downstream the Gezhou Dam in the afternoon of the spawning day, this might be the factor stimulating Chinese sturgeons to spawn. It was estimated that total egg amount of Chinese sturgeons was 2.395 million. 3.71 tails of female Chinese sturgeon laid eggs, more than that of the last year, but clearly less than the amount before the impoundment.

In 2007, there was no accidental catch of Chinese sturgeon, *Psephurus gladius and Acipenser dabryanus* during catch investigation. A total of 5 tails of less-than 1 year young fish of Chinese sucker (*Myxocyprinus asiaticus*) were accidentally caught at Wanzhou river section. At Yibin section, young individual Chinese suckers were monitored. They were thought as the individuals released in downstream in the spring, not the ones from natural reproduction. Interviews at Xianshi river section of the Chahui River found that there was accidental catch of young Chinese suckers.

3.6 Agricultural Ecology

In 2007, investigations on agricultural production and rural living conditions were conducted in 150 township & towns of 19 districts (counties) of the Three Gorges reservoir area, same amount of township & towns as in 2006.

3.6.1 Ecological Environment of Agricultural Fields

In 2007, the total of arable land area and crop sown area of the Three Gorges reservoir area went up, while the forest area, orchard area and planted area of cash crop declined at different degree. The total area of grain crops had slight increase with rise of multiple crop index. Agricultural production was still dominated by grain crops.

In 2007, total arable land of the Three Gorges reservoir area was 192672 ha, 0.048 ha per person, up by 1.9% and 4.3% respectively compared with that of 2006. Among the arable land, the area of paddy field was 82716 ha and that of dry land was 109956 ha, accounting for 42.9% and 57.1% respectively. The proportion of dry land went up by 4 percentage points compared with that of 2006. Paddy field was dominated by double cropping, taking up 56.1%, down by 1.1 percentage points than that of the last year. Whereas 59.5% of dry land practiced

triple cropping, down by 2.7 percentage points compared with that of 2006.

In 2007, multiple crop index of arable land in the Three Gorges reservoir area was 275.86%, up by 40 percentage points compared with that of the last year. Total sown area was 526054 ha, up by 21.3% than in 2006. Among them, 403421 ha were sown area for grain crops and were as 122633 ha were sown area for cash crops, accounting for 76.7% and 23.3% respectively of the total. The proportion of grain crops went up by 3.8 percentage points compared with that of the last year.

In 2007, there was evident increase of the area of terraced fields developed from slope and the area of "grain for green" in the Three Gorges reservoir area. A total of 36912.36 ha of cropland were resumed to forest or grassland, and 12752.87 ha of slope were transformed into terraced fields, both doubling that of 2006. The area of different kinds of arable land had two rising and two downward trend, which was opposite to that of the last year. The percent of arable land with less than 10o and ranging from 10° to 15° was 21.7% and 29.8% respectively, down by 0.6 and 1.5 percentage points. The percent of arable land with slope of 15°～25° and more than 25° was 31.8% and 17.7%, up by 1.7 and 1.3 percentage points respectively compared with that of 2006.

3.6.2 Rural Energy

In 2007, energy mix in rural areas of the Three Gorges reservoir area continued its improvement. The annual output of biogas kept on growing, but the dominant fuel of local farmers was still firewood and straw. Compared with that of 2006, the amount of small hydropower stations dropped by 10.4 percentage points, and the use of biogas went up by 7.03 percentage points.

In 2007, the development of biogas was accelerated in the Three Gorges reservoir area. There were 108436 biogas pits with total annual capacity of 59.8853 million m^3, 10.49 pits per 100 households on the average, up by 25.9% than in 2006.

3.6.3 Crop Disease and Insect Pests

There was big increase of the area of cropland subject to plant disease and insect pests in 2007 with more economic loss. However, there was not outbreak of any kind of crop disease and insect pests or major damage, nor any new kind of crop disease and insect pests. The total area of plant disease and insect pests was 544227 ha·times, up by 41.0% compared with that of 2006. Among them, 327040 ha·times were subject to insect pests and 217187 ha·times subject to plant diseases, up by 30.8% and 59.8% respectively compared with that of 2006.

A total of 505094 ha·times were under the prevention and control of plant disease and insect pests, accounting for 92.8% of the total, down by 8.4 percentage points than in 2006. Among them, 307007 ha·times were under the prevention and control of insect pests, and 198087 ha·times under the prevention and control of plant disease, taking up 93.9% and 91.2% respectively of the total area, down by 10.9 and 3.6 percentage points compared with that of 2006. Actual grain loss was 40551.83 t, up by 4656.72 t compared with that of 2006; a total of 173196.55 t of grain loss was saved.

Table 3–2 Major crop disease and insect pests of the Three Gorges reservoir area in 2007

Type of crop disease and insect pests	Area affected (ha·times)	Area controlled (ha·times)	Loss saved (t)	Actual loss (t)	Degree
Rice borer	917.60	863.93	29946.04	6640.59	Medium
Rice blast	201.60	362.47	30871.71	3329.19	Lighter than medium
Corn leaf blight & spot	151.87	103.60	1824.20	1027.38	Lighter than medium
Potato late disease	177.27	121.20	6311.99	2537.99	Lighter than medium
Corn banded sclerotial blight	349.73	256.47	4699.20	1631.47	Lighter than medium
Damage by rats	1081.80	673.27	25200.20	20646.83	Heavier than medium

3.7 Geological Disasters

3.7.1 Earthquake

In 2007, there were a total of 1402 earthquakes with $M_L \geqslant 0.0$ from the head to the central part of the Three Gorges reservoir area (East longitude 108°20'～112°00', north latitude 29°55'～31°45'). Among them, 551 quakes were at $0.0 \leqslant M_L \leqslant 0.9$, 751 at $1.0 \leqslant M_L \leqslant 1.9$, 96 at $2.0 \leqslant M_L \leqslant 2.9$ and 4 at $3.0 \leqslant M_L \leqslant 3.9$ Richter scale. The strongest earthquake measuring $M_L=3.2$ occurred at Xiqiuwan Town of Badong County at 17:53 of July 10 of 2007.

Earthquakes in the head to the central part of the Three Gorges Project areas were mainly concentrated on Hongfeng in Badong, and Zhoupingxi and Xintan in Zigui County with clear rise of quakes at $2.0 \leqslant M_L \leqslant 2.9$ Richter scale. With the change of water level of the Three Gorges Reservoir, there was some change of slight quakes in the region but remained normal. That is, It was still featured by multiple-factor earthquakes with high-frequency but low Richter scale.

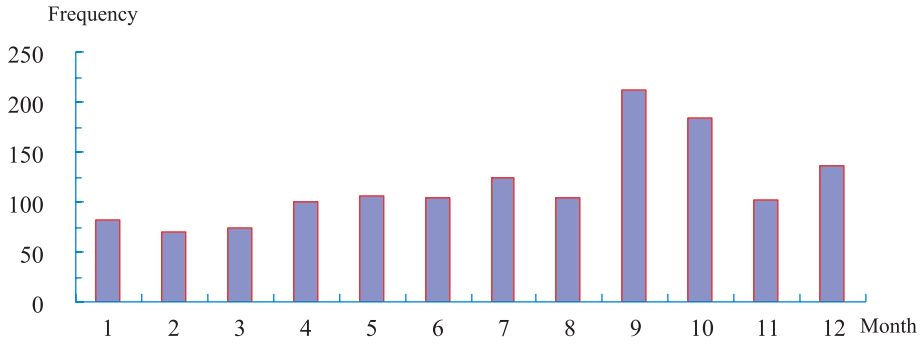


Figure 3–3 Frequency of earthquakes in the head to the central part of the Three Gorges reservoir area in 2007

3.7.2 Collapse, Landslide and Mud–rock Flow

● Monitoring and Early Warning

In 2007, the monitoring and early warning of collapse, landslide and mud-rock flow in the Three Gorges reservoir area was mainly based on public and community efforts. Professional monitoring was focused on important places and places subject to serious damage of collapse, landslide and mud-rock flow. There were two phases of monitoring and early warning project, i.e. phase II and phase III. Phase II monitoring and early warning project finished construction and put into operation in June of 2003 with 1216 places (sections) under community monitoring and prevention program involving over 310,000 residents. Among them, 129 places (sections) were under professional monitoring. Based on Phase II project, Phase III monitoring and early warning project finished construction and put into operation in 2007. A total of 1897 places (sections) subject to collapse and landslide and reservoir bank were identified as monitoring sites by local communities involving over 260000 people. Professionals would monitor 122 places (sections). At present, total amount of community-based monitoring sites across the reservoir area in Phase II and III projects was 3113, 251 of them were under monitoring by professionals. All collapse, landslide and mud-rock flow with potential geological disasters basically were covered by the monitoring program, which greatly strengthened the capacity in monitoring and control.

In 2007, 50 sites (or deforming bodies) subject to

Crack of Huanglianshu landslip in Fengjie County

collapses, landslides and bank sections in the Three Gorges reservoir area under monitoring program had clear deformation. Among them, 27 sites were Phase II monitoring project and 23 sites in Phase III monitoring project. 12 sites occurred in Hubei Province and 38 in Chongqing Municipality. The area of landslide deforming area involved 3540 people, who mainly were distributed along the bank of the Yangtze River and resettlement areas of migrants. These landslides or landslips had clear deformation due to the occurrence of heavy storm once in 100 years in Chongqing. Among the 50 sites, 7 of them had dangerous situation during the rainy season. They were Baishuihe landslide and Laoshewo landslip in Zigui County of Hubei Province; Tangli landslide in Wushan County, Huanglianshu landslide and Changwu landslide in Fengjie County, Mabeiling landslide in Zhongxian County and No.1 landslide in Tangjiao Village of Wanzhou in Chongqing. Early warning was issued for 7 sites with danger according to warning grade, which ensured the resettlement of 645 residents in time under the guidance of local government to avoid landslides.

● Prevention and Control Projects

Under 156 management impoundment, there were 232 places (sections) subject to collapses, landslides and instability in Phase III program of the Three Gorges reservoir area on emergency response to the prevention and control of collapses and landslides geological disasters. Among them, 59 places (sections) were in Hubei Province and 173 places (sections) in Chongqing. The prevention project commenced in February of 2006 and 221 places (sections) finished the construction be the end of 2007, accounting for 93% of the total. Among them, 56 places (sections) were in Hubei Province and

Rock surface consolidation project for the prevention of bank failure in Shengbao of Yunyang County

165 places (sections) in Chongqing. The built projects of Phase III program on emergency response to the prevention and control of collapses and landslides geological disasters had met many challenges such as water level rise during 156 m impoundment (September ～October of 2006), water level drop before rainy season (May of 2007) and storms in rainy season of 2007 with good effects. There have no bank collapses and landslides in more than 100 resettlement cities and towns in the Three Gorges reservoir area since 156 m impoundment on September of 2006.

Phase III program of the Three Gorges reservoir area on the prevention and control of collapses and landslides geological disasters, which is designed for the prevention and control of any collapses, landslides and bank failure subject to the impacts of 175 m impoundment, began the activities stage by stage and group by group. A total of 51 such projects had finished the primary design and bid invitation & bidding work by the end of 2007, 14 were in Hubei Province and 37 in Chongqing Municipality.

River bank failure prevention and control project from Toudaogou to Erdougou in the city of Wushan County

Chapter 4
Discharge of Pollution Sources

4.1 Discharge of Industrial Effluent and Urban Sewage

Environmental statistics showed that the discharge of waste water from industrial sources in the Three Gorges reservoir area was 474 million t in 2007; 458 million t of them were in reservoir area in Chongqing and 17 million t in reservoir area of Hubei Province, accounting for 96.5% and 3.5% of the total respectively. In the discharged industrial effluent, COD was 74800 t and ammonia nitrogen 6700 t.

In 2007, total discharge of sewage from cities and towns in the Three Gorges reservoir area (TGRA) was 478 million t, 463 million t of them were in Chongqing and 15 million t in Hubei Province, taking up 96.9% and 3.1% respectively. In the discharged domestic sewage, the amount of COD was 92600 t and ammonia nitrogen 9300 t.

Table 4–1 Discharge of industrial waste water of the Three Gorges reservoir area in 2007

Area		Waste water (100 million t)	COD (10000 t)	Ammonia nitrogen (10000 t)
TGRA in Hubei		0.17	0.10	……
TGRA in Chongqing		4.58	7.38	0.67
TGRA		4.74	7.48	0.67
Among them	Chongqing City	2.17	3.85	0.30
	Changshou District	0.59	1.04	0.08
	Fuling District	0.41	1.21	0.16
	Wanzhou District	0.23	0.17	0.01

Table 4–2 Discharge of urban sewage of the Three Gorges reservoir area in 2007

Area		Waste water (100 million t)	COD (10000 t)	Ammonia nitrogen (10000 t)
TGRA in Hubei		0.15	0.16	0.02
TGRA in Chongqing		4.63	9.10	0.90
TGRA		4.78	9.26	0.93
Among them	Chongqing City	3.21	5.94	0.52
	Changshou District	0.14	0.14	0.03
	Fuling District	0.24	0.40	0.04
	Wanzhou District	0.32	1.29	0.12

4.2 Investigation and Monitoring on the Discharge of Industrial Effluent and Urban Sewage

4.2.1 Investigation and Monitoring on Industrial Effluent

In 2007, a total of 252 million t of waste water were discharged from 271 industrial pollution sources in the Three Gorges reservoir area that was directly discharged into rivers. Among them, the discharge of Changshou District, Fuling District, Dadukou District and Jiangjin District was relatively big, accounting for 19.0%, 12.6%, 12.0% and 11.2% of the total respectively.

Total weight of various pollutants in the discharge was 49000 t. Among them, COD was 44200 t, ammonia nitrogen 4742.62 t, and petroleum 64.69 t, taking up 90.2%, 9.7% and 0.1% respectively. COD and ammonia nitrogen were the main pollutants with accumulated

Table 4–3 Discharge of indnstrial waste water of the Three Gorges reservoir area in 2007

District (county)	Effluent (10000 t)	COD (t)	Ammonia nitrogen (t)	Oil (t)	Hg (kg)	Cd (kg)	Cr^{6+} (kg)	As (kg)	Pb (kg)	Volatile phenol (kg)	Cyanide (kg)
Jiangjin	2835.3	1919.2	220.4	6.9	-	-	3.6	-	-	-	-
Ba'nan	692.1	407.9	12.3	1.8	-	-	1.3	-	6.0	-	-
Dadukou	3037.7	1159.9	13.2	5.4	-	-	18.6	-	101.0	1030.0	500.0
Jiulongpo	1396.0	4720.8	1219.0	15.2	-	-	-	-	-	-	-
Yuzhong	47.8	19.2	-	0.3	-	-	16.8	-	-	-	-
Nan'an	1486.0	3059.1	56.0	0.6	-	-	133.2	-	209.0	-	-
Jingkai	179.9	123.8	12.3	5.9	-	-	13.6	-	7.1	1.3	-
Beibei	1296.5	2972.3	164.1	0.3	0.3	-	0.8	-	6.3	0.5	-
Shapingba	1286.0	2402.0	91.4	14.0	-	-	995.2	-	-	-	-
Jiangbei	2152.2	5919.0	285.2	5.9	-	-	186.7	-	1311.0	-	-
Yubei	513.1	4221.6	694.6	1.3	-	-	-	-	-	140.4	3.0
Changshou	4793.2	8605.2	715.7	5.2	-	-	374.0	-	-	47.1	-
Fuling	3173.1	5578.5	1135.3	1.1	-	-	2.0	-	-	5.0	-
Fengdu	89.6	401.8	25.2	-	-	-	-	-	-	-	-
Wulong	108.1	59.7	54.7	-	-	0.2	-	17.8	22.3	-	-
Zhongxian	82.2	304.3	31.6	0.3	-	-	-	-	-	0.9	-
Wanzhou	1974.1	1298.2	8.3	0.5	-	-	21.4	-	-	-	-
Yunyang	3.4	5.7	0.8	-	-	-	-	-	-	-	-
Kaixian	9.2	281.5	2.6	-	-	-	-	-	-	-	-
Fengjie	1.2	0.5	-	-	-	-	-	-	-	-	-
Wushan	15.3	52.4	-	-	-	-	-	-	-	-	-
Badong	67.5	666.8	-	-	-	-	-	-	-	-	-
Zigui	8.0	15.0	-	-	-	-	-	-	-	-	-
Total	25247.5	44194.4	4742.7	64.7	0.3	0.2	1767.2	17.8	1662.7	1225.2	503.0

equivalent standard pollution load ratio at 98.0%. Major pollution discharge areas include Changshou District, Fuling District, Jiulongpo District, Yubei District, Jiangbei District, Beibei District and Nan'an District with accumulated equivalent standard pollution load ratio at 83.0%.

4.2.2 Investigation and Monitoring on Urban Sewage

In 2007, the amount of urban sewage from 21 districts (counties) of the Three Gorges reservoir area that was directly discharged into the mainstream and major tributaries of the Yangtze River was 508 million t. Among them, 325 million t were from six urban districts of Chongqing City, 33 million t from Wanzhou District and 31 million t from Fuling, accounting for 64.0%, 6.4% and 6.2% of the total respectively.

The total weight of various pollutants in waste water was 117900 t. Among them, 71751.2 t were COD, 35070.1 t were BOD, 7554.9 t were ammonia nitrogen, 1236.61 t were TP, 1388.69 t were animal & plant oil and 904.29 t were anion surfactant, accounting for 60.8%, 29.7%, 6.4%, 1.0%, 1.2% and 0.8% of the total respectively. TP, BOD and COD were major pollutants. The accumulated equivalent standard pollution load ratio was 85.3%. Six urban districts of Chongqing City, Fuling and Fengjie were the areas that discharged most water pollutants.

Table 4–4 Discharge of urban sewage of the Three Gorges reservior area in 2007

District (county)	Waste water (10000 t)	Pollutant discharged amount (t)					
		COD	BOD	Ammonia nitrogen	TP	Animal & plant oil	Anion surfactant
Jiangjin	1591.8	2185.6	1078.1	269.5	32.75	35.76	32.91
Banan	1171.7	2263.5	1046.3	266.1	27.20	28.70	24.30
Six urban districts	32514.0	52367.5	25568.5	5113.4	923.96	1020.45	625.70
Yubei (Luoqi)	130.0	281.2	144.7	36.3	4.20	5.30	4.50
Changshou	1262.2	1632.4	342.4	161.8	20.50	18.80	13.10
Fuling	3131.8	3210.8	1671.8	411.4	42.60	51.60	37.29
Fengdu	620.5	180.7	65.7	8.2	6.60	3.30	2.20
Zhongxian	1176.1	1702.8	1142.0	170.5	36.33	31.46	16.45
Wanzhou	3274.4	73.6	29.8	7.7	0.98	0.70	1.58
Yunyang	1896.4	1542.3	727.3	236.0	34.05	38.24	17.03
Fengjie	988.9	1848.2	1033.2	299.1	33.98	70.12	57.70
Wushan	773.5	1578.5	863.2	216.6	25.55	31.66	27.07
Badong	1204.5	1734.6	839.0	217.9	28.10	32.00	27.10
Xingshan	737.4	818.9	374.0	100.5	14.00	14.74	12.45
Zigui	335.8	325.0	142.8	39.3	5.71	5.78	4.85
Yiling (Taipingxi)	14.6	5.6	1.3	0.6	0.10	0.08	0.06
Total	50823.6	71751.2	35070.1	7554.9	1236.61	1388.69	904.29

Note: Six urban districts of Chongqing City refer to Dadukou District, Shapingba District, Jiulongpo District, Yuzhong District, Nan'an District, and Jiangbei District.

4.2.3 Investigation on Urban Garbage

In 2007, there were 2.278 million t of domestic garbage in 19 cities and towns of the Three Gorges reservoir area, 1.8091 million t were disposed, taking up 79.4%. Another 469100 t were discharged in a non-

concentrated way, accounting for 21.6%. Investigation findings of 15 garbage disposing facilities in the Three Gorges reservoir area showed that they all adopt landfill method except Tongxing Garbage Disposal Facility in Shapingba District utilizing incineration technology. On the average, 70% of urban garbage was collected.

Table 4–5 Urban domestic garbage of the Three Gorges reservior area in 2007

District (County)	Urban permanent population (10000 people)	Domestic garbage (10000 t)	Disposed amount (10000 t)	Scattered discharge (10000 t/y)
Jiangjin	22.22	8.11	6.21	1.91
Banan	17.15	6.26	5.68	0.58
Six urban districts	356.31	130.05	107.50	22.55
Yubei(Luoqi)	2.68	0.98	0.68	0.30
Changshou	17.6	6.42	5.48	0.95
Fuling	42.41	15.48	10.59	4.89
Fengdu	9.07	6.57	5.84	0.73
Zhongxian	19.4	7.08	5.62	1.46
Wanzhou	57.55	21.01	14.60	6.41
Yunyang	19.13	6.98	4.38	2.60
Fengjie	18.4	6.72	6.21	0.51
Wushan	13.1	4.78	4.29	0.49
Badong	8.0	2.92	1.64	1.28
Zigui	12.17	4.44	2.19	2.25
Total	615.19	227.80	180.91	46.91

4.3 Pesticides and Fertilizers

In 2007, the findings of investigation on the application of fertilizers and pesticides in 150 townships of 19 districts (counties) of the Three Gorges reservoir area showed that there was a slight rise of the application of fertilizers leading to higher non-point pollution pressure caused by fertilizers. There was more evident phenomenon of focusing on the application of nitrogenous & phosphorus but potash fertilizer. There was a slight reduction of the application amount of pesticides. However, high-toxicity pesticides such as organophosphorus pesticide was still used widely. The drain of fertilizers went up. In particular, the drain of nitrogen and phosphorus becomes one of pollution sources for water bodies.

4.3.1 Fertilizers

In 2007, a total of 166,000 t of fertilizer (pure) were applied in the Three Gorges reservoir area, up by 7.4% compared with that of 2006. Among them, 111,000 t were nitrogenous fertilizer, 43000 t were phosphorus fertilizer, and 12000 t potash fertilizer, accounting for 66.9%, 25.9% and 7.2% of the total respectively. Fertilizer application amount per hectare was 1.0 t, up by 22.3% compared with that of 2006. The application ratio of nitrogenous, phosphorus and potash fertilizers in the Three Gorges reservoir area was 1:0.39:0.11 with serious lack of the application of potash fertilizer. The phenomenon of focusing on nitrogenous and phosphorus fertilizers but potash fertilizer was more obvious.

Total drain of fertilizers in the Three Gorges reservoir area was 13800 t, up by 14.0% compared with that of 2006. Among them, the drain of nitrogenous fertilizer was 11100 t, phosphorus fertilizer was 2100 t and that of

potash fertilizer 600 t, taking up 80.4%, 15.2% and 4.4% respectively of the total.

4.3.2 Pesticides

In 2007, 654.12 t of pesticides (pure equivalent) were applied in the Three Gorges reservoir area, down by 0.2% than in 2006. Among them, 294.07 t were organophosphorus pesticides, 110.59 t were organic nitrogen pesticides, 112.96 t were pyrethroids, 63.14 t were herbicides, 73.34 t were other kinds of pesticides; accounting for 45.0%,16.9%, 17.3%, 9.6% and 11.2% respectively of the total. Compared with in 2006, the application of the organophosphorus and herbicide went up by 2.9% and 4.1% respectively, while the application amount of organonitrogenous pesticides, pyrethroids and other pesticides dropped by 6.7%, 2.3% and 2.1% respectively. The application amount of pesticides per hectare was 3.4 kg, down by 2.0% compared with that of 2006. The application of organophosphorus pesticides was the biggest and on the rise followed by organonitrogenous pesticide and pyrethroids, which indicates that the application of high-toxicity pesticides in the Three Gorges reservoir area was still popular.

The total drain of pesticides in the Three Gorges reservoir area was 41.29 t, down by 13.9% compared with that of 2006. Among them, the drain of organophosphorus was 23.48 t, organonitrogenous pesticide 5.51 t, pyrethroids 5.62 t,herbicides 3.13 t and other pesticides 3.54 t; accounting for 56.9%, 13.3%, 13.6%, 7.6% and 8.6% respectively of the total.

4.4 Monitoring on Mobile Pollution Sources

In 2007, there were near 8500 registered ships in the reservoir area, slightly less than that of 2006. Ships in use continuously became more standardized and bigger. The change of ship size has further reduced transportation cost and raised efficiency.

In 2007, there were over 6700 ships in the Three Gorges reservoir area, which generated pollution due to oil-containing waste water from engine room, no obvious change compared with that of 2006. However, there was some change of the amount of various kinds of ships. Among all the ships, the amount of tourist ship and passenger ship had some increase, while the amount of cargo ship and towboat went down and no change for other kind of ships.

4.4.1 Ship Transportation

In 2007, the passenger transport volume of the permanent ship lock of the Three Gorges Dam reached 849000 people·times, down by 47.6% compared with that of 2006. A total of 46.859 million t of cargo passed the lock, up by 19% than in 2006. The total annual port cargo capacity of main ports with certain scale in the Three Gorges reservoir area was 51.56 million t, up by 18% compared with that of 2006. Total annual passenger capacity was 7.63 million people·times, down by 8.8%. A total of 60.565 million t of goods passed the Dam, up by 21.3%.

4.4.2 Oil–containing Waste Water from Ships

In 2007, inspectors checked water pollution of 432 ships caused by oil-containing waste water from engine room and found that 73.1% of the discharged waste water met national pollution discharge standard, up by 6.1 percentage point compared with that of 2006. All the oil-water separators on ships basically operated normally, which effectively reduced the impacts of oil pollution on water quality in reservoir waters. The discharge of oil-containing waste water of 90% of tourist ships, 82% passenger ships, 82% towboat, 69% other ships and 68% cargo ships met national standard for the discharge of waste water.

In 2007, there were about 6753 ships navigating the Three Gorges Reservoir waters which generated oil-containing waste water. Based on this figure, it is estimated that the annual amount of oil-containing waste water from the ships of the Three Gorges Reservoir waters was 509300 t; 483100 t of them were under treatment, accounting for 94.8%. After the treatment, 407200 t of waste water met the national pollution discharge standard with the meeting-the-standard rate of 84.3%. Compared with in 2006, there was little change of the generation, treatment and discharge of oil-containing waste water from the ships. The rank of generating amount of oil-containing waste water from various ships was similar to that of the last year: 269300 t from cargo ships, 180600 t from passenger ships, 32500

t from towboat, 20600 t from other ships and 6300 t from tourist ships; accounting for 52.9%, 35.5%, 6.4%, 4.0% and 1.2% respectively of the total. Cargo ships generated most oil-containing waste water, accounting over 50% of the total, while tourist ships generated the least such water, taking up only 1.2%. The main reason was large amount and high tonnage of cargo ships, while the amount of tourist ships was small.

Among the discharged oil-containing waste water, the discharge of petroleum was 39.54 t, up by 41.1% than that of 2006. Among various ships, petroleum discharge was 33.52 t for cargo ships, 5.20 t for passenger ships, 0.42 t for towboats, 0.33 t for other ships, and 0.07 t for tourist ships; accounting for 84.7%, 13.2%, 1.1%, 0.8% and 0.2% respectively of the total. Compared with in 2006, petroleum pollutant discharge from cargo ships, tourist ships and passenger ships went up by 52.4%, 40.0% and 20.9% respectively; while the petroleum pollutant discharge from other ships and towboats dropped by 63.3% and 45.5% respectively. Cargo ships were still the main type of ship causing most petroleum pollution in the reservoir waters followed by passenger ships. Therefore, the control of petroleum discharge from cargo ships was the key to the prevention and control of ship pollution in the Three Gorges reservoir area.

Table 4–6 Discharge of oil–containing waste water from ships in the Three Gorges reservoir area in 2007

Ship		Oil-containing waste water						Petroleum	
Type	Amount	Discharge (10000 t)	Percent (%)	Treatment amount (10000 t)	Treatment rate(%)	Amount meeting the standard (10000 t)	Meeting-standard rate (%)	Discharge (t)	Percent (%)
Tourist ship	50	0.63	1.2	0.60	95.2	0.53	88.3	0.07	0.2
Passenger ship	2380	18.06	35.5	17.88	99.0	15.91	89.0	5.20	13.2
Cargo ship	3110	26.93	52.9	25.31	94.0	19.99	79.0	33.52	84.7
Towboat	262	3.25	6.4	2.67	82.2	2.51	94.0	0.42	1.1
Other ships	951	2.06	4.0	1.85	89.8	1.78	96.2	0.33	0.8
Total	6753	50.93	100.0	48.31	94.9	40.72	84.3	39.54	100.0

4.4.3 Ship Sewage

In 2007, 40 ships in the Three Gorges reservoir waters were investigated on the discharge of domestic sewage. Among them, the sewage of 10 ships did not discharge until it was treated and the concentration of suspended substances met national standard. BOD discharge of 7 ships met national pollutant discharge standard; COD discharge of 5 ships met national standard; 2 ships met national standard for the discharge of TP, TN and E-coli respectively. The sewage of 30 ships was discharged without any treatment. Apart from the concentration of suspended substance of 18 meeting national standard for pollution discharge, all other monitored pollutants failed to meet national standard.

Based on investigation findings and monitoring results as well as the amount of various ships, annual generation amount of ship sewage, passenger amount, crew number, ship annual operation time, and the percentage of different tonnage ships, it was estimated that the amount of domestic sewage from ships in the Three Gorges Reservoir waters in 2007 was about 3.58 million t, up by 7.8% than that of 2006. Among them, the amount of sewage from passenger and tourist ships was 2.455 million (1.99 million from passenger ships and 465000 t from tourist ships), accounting for 68.6% of the total sewage, down by 14.2% than that of 2006. The amount from non-passenger carrying ships was 1.125 million t, taking up 31.4%.

In the discharged sewage, total weight of various pollutants was amount 2353.0 t, up by 27.3% compared with that of the last year. Among them, COD was 1201.4 t, suspended substance 427.0 t, BOD 409.2 t, TN 278.2 t, and TP 37.2 t; accounting for 51.1%, 18.1%, 17.4%,

11.8% and 1.6% respectively of the total. TP, TN and COD were the main pollutants with accumulated equivalent standard pollution load ratio at 83.5%.

4.4.4 Ship Garbage

In 2007, there were still 6 ships collecting the garbage from the ships of the waters of the Three Gorges reservoir area, 16 organizations received the pollutants, 14 of them collecting ship garbage, the remaining two received both garbage and residual oil. A total of 7364 t ship garbage were collected, up by 1.4% than in 2006. The collected amount of oil-containing waste water was about 1109 t.

In 2007, inspectors boarded 60 ships to investigate garbage generation and treatment. Based on the crew number, passenger amount, annual navigation time, annual garbage amount and the percentage of the amount of subject ship to total ship amount of the reservoir waters, it was estimated that total garbage amount of the ships in reservoir waters was 36000 t in the year, only 20% having been collected.

4.4.5 Ship Accidents

In 2007, there were 11 ship pollution accidents in the reservoir waters, all resulting from ship traffic accidents, which lead to 6 sunken ships, 6 ships subject to collision damage, 4 deaths, 16 lost, 4 people falling into water, and economic loss of 2.97 million yuan. The amount of sunken ship went down by 3 and death toll down by 2 people compared with that of 2006 with less economic loss.

In terms of environmental protection, there was no major pollution accident. That is, there was no large amount of spill oil, nor was chemical leakage into waters of the reservoir areas. For small amount spill oil, local authorizes immediately dispatched people to establish oil fence to recover the spilled oil. Therefore, oil spill did not cause any big threat to reservoir waters due to prompt response and appropriate measures.

Chapter 5
Status of Water Environmental Quality

In 2007, monitoring of the quality of water environment of the Three Gorges reservoir area included the monitoring on water quality of both mainstream and tributaries of the Yangtze River and water bloom of primary tributaries. The assessment of water quality complies with Environmental Quality Standard for Surface Water (GB3838-2002). The assessment of comprehensive nutrition status of water bodies complies with the Technical Regulations on Eutrophication Evaluation Method and Grading for Lakes (Reservoirs) developed by China National Environmental Monitoring Center.

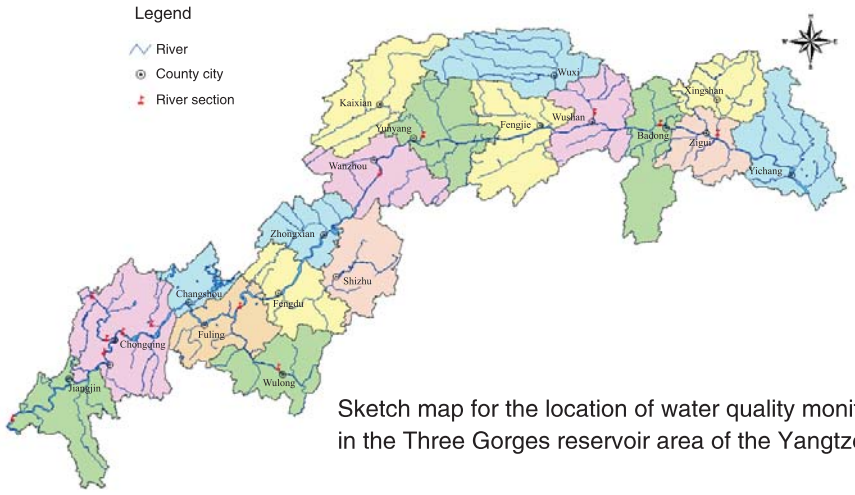
5.1 Water Quality Monitoring

In 2007, a total of 13 water quality monitoring sections were established at both mainstream and tributaries of the Yangtze River in the reservoir area. Among them, 6 sections were at the mainstream and located at Zhutuo, Tongguanyi and Cuntan of Chongqing Municipality; Qingxichang in Fuling; Tuokou in Wanzhou; and Guandukou in Badong County. Seven monitoring sections were at primary tributaries of the Yangtze River, they were Beibei section and Linjiangmen section of Jialing River; Wulong section at Wujiang River, mouth of the Yulin River, mouth of Pengxi River, mouth of Daning River and mouth of Xiangxi River respectively. The assessment of water quality had 13 items, including pH, dissolved oxygen, permanganate value, BOD_5, ammonia nitrogen, petroleum, TP, Hg, Cd, As, Cu, Pb and Cr^{6+}.

5.1.1 Water Quality of the Mainstream

In 2007, the overall water quality of the mainstream of the Yangtze River was better than that of 2006. Among the 6 sections, Tuokou section and Guandukou section met Grade Ⅱ national surface water quality standard; while Zhutuo section, Tongguanyi section, Cuntan section and Qingxichang section met Grade Ⅲ national surface water quality standard. Among them, water quality of Zhutuo section and Cuntan section went up from Grade Ⅳ in 2006 to Grade Ⅲ. The water quality of the remaining 4 sections kept stable.

Water quality was the best during February～May and in October. All sections met Grade Ⅱ or Ⅲ national standard in each month. It was relatively good in January, November and December, 5 sections met Grade Ⅱ or Ⅲ standard in each month except one section falling into Grade Ⅳ due to petroleum pollution. Water quality was relatively poor in June and September. In June, 2 sections only met Grade Ⅴ national surface water quality standard due to petroleum pollution. In September, the water quality of 3 sections was Grade Ⅳ due to the impacts of total phosphorus. Water quality in July and August was the poorest with TP, permanganate value and petroleum as main pollutants.



Sketch map for the location of water quality monitoring sections in the Three Gorges reservoir area of the Yangtze River

Table 5–1 Water quality of the mainstream of the Yangtze River in the Three Gorges reservoir area in 2007

Section name	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Whole year
Zhutuo	Ⅳ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅴ	Ⅳ	Ⅴ	Ⅳ	Ⅲ	Ⅲ	Ⅲ	Ⅲ
Tongguanyi	Ⅲ	Ⅱ	Ⅲ	Ⅲ	Ⅲ	Ⅴ	Ⅳ	Ⅴ	Ⅳ	Ⅲ	Ⅲ	Ⅳ	Ⅲ
Cuntan	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅳ	Ⅴ	Ⅳ	Ⅲ	Ⅳ	Ⅲ	Ⅲ
Qingxichang	Ⅱ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅳ	Ⅴ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ
Tuokou	Ⅲ	Ⅲ	Ⅱ	Ⅱ	Ⅲ	Ⅲ	Ⅴ	Ⅳ	Ⅲ	Ⅲ	Ⅱ	Ⅱ	Ⅱ
Guandukou	Ⅱ	Ⅱ	Ⅲ	Ⅲ	Ⅱ	Ⅱ	Ⅲ	Ⅴ	Ⅲ	Ⅱ	Ⅱ	Ⅱ	Ⅱ

Table 5–2 Percent of different grades of water quality of the sections of the mainstream of the Yangtze River in the Three Gorges reservoir area in 2007 (%)

Water quality	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Whole year
Ⅰ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ⅱ	33.3	33.3	16.7	16.7	16.7	16.7	0.0	0.0	0.0	16.7	33.3	33.3	33.3
Ⅲ	50.0	66.7	83.3	83.3	83.3	50.0	16.7	0.0	50.0	83.3	50.0	50.0	66.7
Ⅳ	16.7	0.0	0.0	0.0	0.0	0.0	66.7	16.7	50.0	0.0	16.7	16.7	0.0
Ⅴ	0.0	0.0	0.0	0.0	0.0	33.3	16.7	83.3	0.0	0.0	0.0	0.0	0.0
＞Ⅴ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ⅰ～Ⅲ	83.3	100.0	100.0	100.0	100.0	66.7	16.7	0.0	50.0	100.0	83.3	83.3	100.0

5.1.2 Water Quality of the Tributaries

In 2007, the overall water quality of the tributaries of the Yangtze River in the Three Gorges reservoir area was relatively poor, but slightly better than that of 2006. Among the 7 monitoring sections, Beibei section met Grade Ⅱ water quality standard. Linjiangmen section and Wulong section met Grade Ⅲ standard, whereas the other four sections met Grade Ⅳ standard due to the pollution by total phosphorus. Among them, the water quality of Beibei section improved from Grade Ⅲ in 2006 to Grade Ⅱ, and that of Linjiangmen section improved from Grade Ⅳ in 2006 to Grade Ⅲ in 2007.

At least 2 sections failed to meet Grade Ⅲ national surface water quality standard in each month. The percent of monitoring sections meeting national water quality standard ranged from 28.6% to 71.4%. The failure of the 4 monitoring sections at river mouth to meet national water quality standard was quite common due to the impacts of TP.

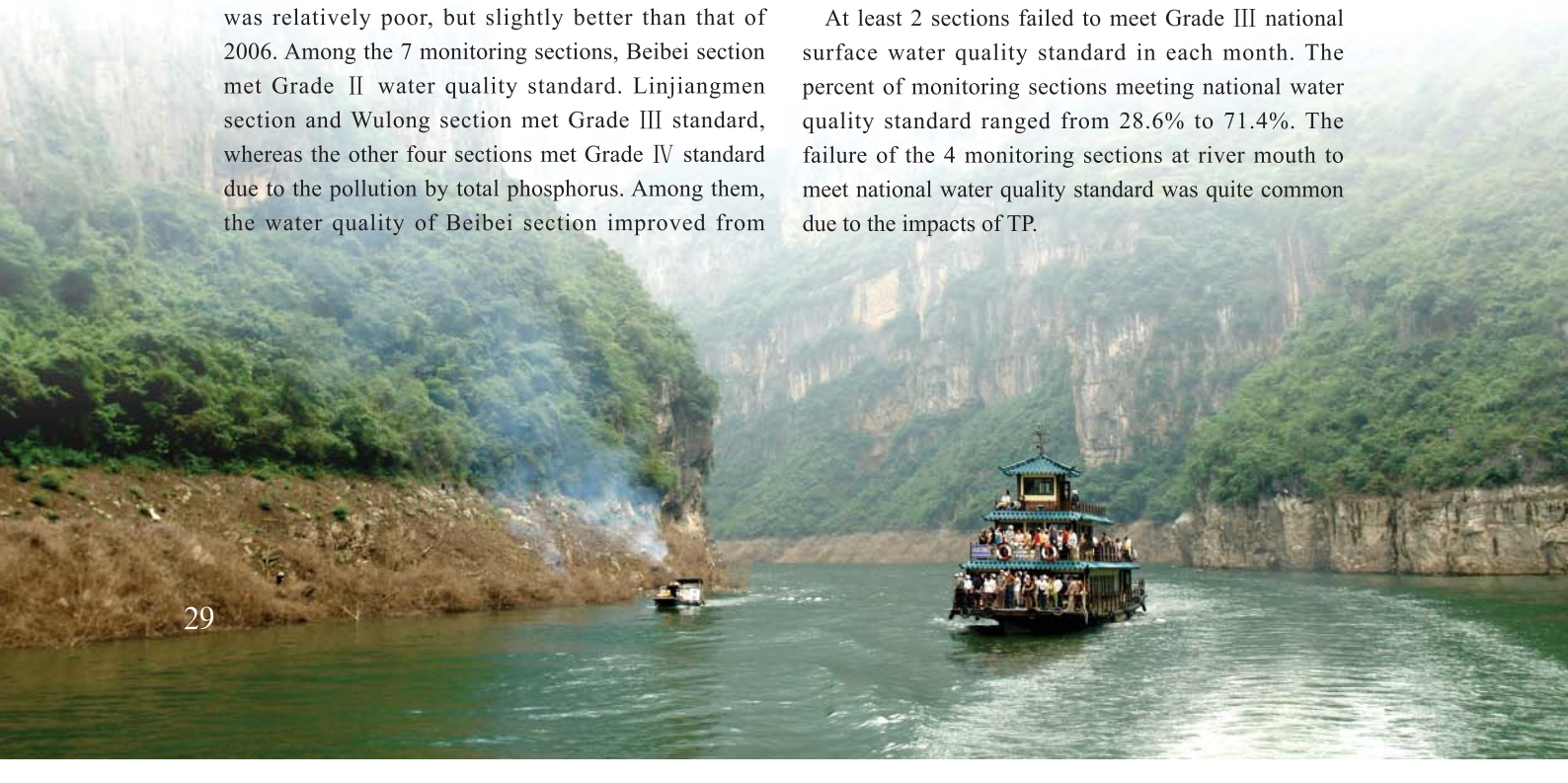


Table 5–3 Water quality of the sections of primary tributaries of the Yangtze River in the Three Gorges reservoir area in 2007

Section name	River name	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Whole year
Beibei	Jialing River	II	II	II	II	II	II	II	II	II	III	II	II	II
Linjiangmen	Jialing River	III	III	IV	II	II	II	IV	II	II	IV	III	III	III
Wulong	Wujiang River	III	III	II	II	II	IV	III	III	III	III	III	III	III
Mouth of Yulin River	Yulin River	IV	III	IV	IV	III	IV	IV	IV	IV	V	IV	III	IV
Mouth of Pengxi River	Pengxi River	IV	IV	IV	IV	IV	IV	IV	IV	III	III	IV	IV	IV
Mouth of Daning River	Daning River	IV	IV	IV	IV	IV	IV	IV	IV	IV	IV	III	IV	IV
Mouth of Xiangxi River	Xiangxi River	IV	IV	IV	IV	III	IV	IV	IV	III	IV	IV	IV	IV

Note: The assessment of water quality of river month sections shall comply with the lake and reservoir standard specified in Environmental Quality Standard for Surface Water (GB3838–2002).

Table 5–4 Percent of different grades of water quality of the sections of the primary tributaries of the Yangtze River in the Three Gorges reservoir area in 2007 (%)

Water quality	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Whole year
I	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II	14.3	14.3	28.6	42.9	42.9	28.6	14.3	28.6	28.6	0.0	14.3	14.3	14.3
III	28.6	42.9	0.0	0.0	28.6	0.0	14.3	14.3	42.9	42.9	42.9	42.9	28.6
IV	57.1	42.9	71.4	57.1	28.6	71.4	71.4	57.1	28.6	42.9	42.9	42.9	57.1
V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	0.0	0.0	0.0
>V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
I ~III	42.9	57.1	28.6	42.9	71.4	28.6	28.6	42.9	71.4	42.9	57.1	57.1	42.9

5.2 Monitoring of Water Bloom and Nutrition Status of Primary Tributaries

5.2.1 Early Warning Monitoring for Water Bloom

During March~October of 2007, 82 early warning monitoring sections for water bloom were established at the primary tributaries of the Yangtze River affected by impoundment. Five indicators including chlorophyll-a, TP, TN, permanganate value and transparency were employed to assess the comprehensive nutrition status of the water bodies.

The findings showed that 9.5%~25.6% of the sections of the primary tributary waters of the Yangtze River in the Three Gorges Project area were under eutrophication during March~October with monthly average of 15.9%, evidently better than that of the last year. 4.9%~11.0% of the sections were under oligotrophic condition and 69.5%~84.4% under mesotrophic status with monthly average at 6.5% and 77.6% respectively.

The eutrophication of tributary backwater zones of the Three Gorges Project area was evidently heavier than that of non- backwater zones due to the impact of impoundment. 14.0%~33.3% of their sections were under eutrophication with monthly average of 21.0%, about 13.2 percentage points higher than that of the non-backwater zones.

Table 5–5 Nutrition status of primary tributary waters of the Yangtze River in the Three Gorges reservoir area during March~October of 2007

Nutrition status	Percent of sections under different nutrition status (%)								
	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Average
Oligotrophic	6.1	6.1	6.8	5.2	4.9	4.9	7.3	11.0	6.5
Mesotrophic	81.8	81.8	83.8	84.4	75.6	69.5	70.7	73.2	77.6
Slight eutrophication	9.1	9.1	6.8	7.8	17.1	22.0	13.4	8.5	11.7
Intermediate eutrophication	1.5	1.5	2.7	2.6	2.4	3.7	6.1	4.9	3.2
Heavy eutrophication	1.5	1.5	0.0	0.0	0.0	0.0	2.4	2.4	1.0
Total	12.1	12.1	9.5	10.4	19.5	25.6	22.0	15.8	15.9

5.2.2 Site Monitoring of Water Bloom

In 2007, water blooms occurred at 7 primary tributaries of the Yangtze River in the Three Gorges reservoir area, which were the Ruxi River, Huangjin River, Pengxi River, Modao River, Meixi River, Daning River and Xiangxi River. The dominant algae species were *Cyclotella* of *Bacillariophyta*, *Peridinaceae* of dinophyta, *Eudorina* of Chlorophyta, *Cryptomonas* of *cryptophyta* and *Microcystis flos-aquae (Wittr) Kirchner* of *Cyanophyta* etc.. In general, the dominant water-bloom algae species of some tributaries in the Three Gorges reservoir area showed a trend turning from river type (diatom, *dinophyceae* etc.) into lake type (green algae, *cryptophyceae* and blue-green algae etc.).

Monitoring results showed that the concentrations of nitrogen and phosphorus in tributary waters of the Three Gorges reservoir area were relatively high, falling into the range of mesotrophic – eutrophication with relatively high eutrophication in some waters in some period. In water bloom areas, pH value was 8.4～9.4 with chlorophyll-a concentration at 42.4～291.7 μg/L and algae density at 2.1×10^{6}～1.3×10^{8}/L.

Chapter 6
Environmental Quality in Construction Area

6.1 Hydrology and Meteorology

6.1.1 Hydrological Characteristics

In 2007, the statistics analysis on the monitoring data at Huanglingmiao Hydrological Station downstream the key water control project of the Three Gorges showed that the annual average flow was 12600 m^3/s; annual maximum flow at 50100 m^3/s occurring on July 31; minimum flow at 3880 m^3/s on January 12; annual average sand transportation rate at 1.62 t/s, average sand concentration at 0.129 kg/m^3. The section maximum average sand level was 1.52 kg/m^3 on August 3; the section minimum average sand level was 0.001 kg/m^3 on March 19. River flow in the construction area of the Three Gorges Project had some increase compared with that of last year with dramatic rise of both annual sand transportation rate and average sand concentration.

Table 6–1 Monthly river flow of Huanglingmiao Hydrological Station in 2007

Unit: m^3/s

Time	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Whole year
Avg.	4100	4360	4440	6560	8910	18300	31900	24000	24200	11900	7770	4660	12600
Max.	4310	4760	4740	10700	13600	42000	50100	44600	35600	13700	12400	5500	50100
Min.	3880	4050	4300	4400	5970	9140	15600	14800	12500	10600	4470	4160	3880

Table 6–2 Monthly sand concentration of Huanglingmiao Hydrological Station in 2007

Unit：kg/m^3

Time	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Whole year
Avg.	0.003	0.004	0.002	0.003	0.004	0.047	0.189	0.355	0.142	0.015	0.006	0.003	0.129
Max.	0.004	0.004	0.004	0.004	0.006	0.145	0.557	1.52	0.233	0.043	0.012	0.005	1.520
Min.	0.002	0.004	0.001	0.002	0.003	0.005	0.020	0.022	0.038	0.008	0.005	0.002	0.001

6.1.2 Climate Characteristics

In 2007, the main climate characteristics of the Three Gorges construction area was excessive rainfall with relatively big difference among the four seasons. The air temperature of each month was normal.

● **Precipitation**

The annual precipitation of the construction area was 1367.6 mm, up by 17.9% than the historical average. However, there was uneven distribution in every month. Precipitation mainly concentrated in April～September with maximum daily precipitation of 103.7 mm on July 20. The longest continuous precipitation period in the year lasted for 7 days, occurring during July 19～25. The longest continuous non-precipitation period in 2007 was 14 days occurring during November 20～December 3.

● Temperature

The annual average temperature of the construction area was 17.2℃, same as the historical average. The annual extreme maximum temperature was 36.2℃ on August 10 and 20 respectively. The annual extreme minimum temperature was -1.0℃ on January 8.

● Wind Speed

The annual average wind speed in the construction area was 1.5 m/s with maximum wind speed at 15.1m/s on July 1. The wind direction was changeable in the year with NNW in dominance at the frequency of 31%.

Table 6–3 Meteorological indicators of the Three Gorges construction area in 2007

Time		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Whole year
T	Temperature (℃)	5.8	10.2	12.4	16.9	23.2	24.8	26.1	26.7	22.1	18.0	12.5	8.1	17.2
	Departure(℃)	0.1	2.1	0.6	-0.9	1.3	-0.5	-1.4	-0.1	-1.1	0.2	-0.2	0.3	0.0
P	Precipitation(mm)	26.3	84.5	50.3	99.3	124.5	174.2	423.4	151.8	105.4	38.9	71.4	17.6	1367.6
	Departure (%)	16.9	112.8	-1.8	16.4	-14.0	17.0	97.9	-23.2	-0.8	-54.1	54.2	-6.9	17.9
Wind speed	Avg.(m/s)	1.8	1.4	1.5	1.5	2.0	1.2	1.0	1.0	1.5	1.4	1.8	1.8	1.5
	Max.(m/s)	6.9	6.2	7.3	8.8	7.2	8.4	9.5	8.4	6.3	6.1	5.6	7.5	9.5
	Extreme(m/s)	11.8	10.1	11.3	13.3	12.6	14.3	15.1	13.5	10.5	11.8	9.6	13.5	15.1

6.2 Air Quality

The assessment of ambient air quality of the construction area (office & residential areas as well as construction area) complies with Ambient Air Quality Standard (GB3095-1996).

In 2007, the annual SO_2 concentration of the construction area was 0.024mg/m^3, meeting Grade II national air quality standard. The daily SO_2 concentrations all met Grade I or II national standard, accounting for 90.3% and 9.7% respectively of the total. The annual NO_2 concentration was 0.026 mg/m^3, meeting Grade I national air quality standard. All the daily concentrations of NO_2 met Grade I or II air quality standard, taking up 99.7% and 0.3% respectively. The annual average of total suspended particles (TSP) was 0.148 mg/m^3, meeting Grade II national air quality standard. Among them, 48.6%, 50.0% and 1.4% of daily average concentration of TSP in office & residential areas met Grade I, II and III national air quality standard respectively; 33.1%, 57.8%, and 7.7% of daily average concentration of TSP in construction areas met Grade I, II and III national air quality standard, while 1.4% of that failed to meet Grade III air quality standard.

In 2007, the overall air quality of the construction area was good. The annual average concentrations of SO_2, NO_2 and TSP dropped by 11.1%, 3.7% and 19.1% respectively compared with that of 2006. Major pollutant was still TSP.

6.3 Water Quality

According to the Environmental Quality Standard for Surface Water (GB3838-2002), 13 items were chosen to evaluate water quality in construction area, which included pH, dissolved oxygen, ammonia nitrogen, COD, permanganate value, BOD_5, volatile phenol, cyanide, arsenic, Cr^{6+}, copper, lead and cadmium. Anion surfactant indicator was added for the assessment of the quality of near bank waters.

In 2007, the water quality of each section of the mainstream of the Yangtze River and near-bank waters

in the construction area was good, all met or were superior to Grade Ⅱ national surface water quality standard. Compared with in 2006, E-coli concentration of Taipingxi section at the mainstream of the Yangtze River, waters near the auxiliary dam, sampling site at upward approach waterway had some increase. The concentrations of other pollutants under monitoring were relatively stable with no obvious change.

Table 6–4 Water quality of the mainstream sections of the Yangtze River in the construction area in 2007

Section name	The first quarter	The second quarter	The third quarter	The fourth quarter	Whole year
Taipingxi	Ⅰ	Ⅱ	Ⅱ	Ⅰ	Ⅱ
Letianxi	Ⅰ	Ⅰ	Ⅱ	Ⅰ	Ⅱ

Table 6–5 Water quality of near–bank waters of the Yangtze River in the construction area in 2007

Sampling site		The first quarter	The second quarter	The third quarter	The fourth quarter	Whole year
Left bank (30m to the bank)	Upward approach waterway	Ⅰ	Ⅰ	Ⅱ	Ⅰ	Ⅰ
	Downward approach waterway	Ⅰ	Ⅰ	Ⅱ	Ⅰ	Ⅰ
Right bank (30m to the bank)	Auxiliary dam	Ⅰ	Ⅰ	Ⅱ	Ⅰ	Ⅰ

6.4 Noise

In 2007, the average daytime noise and night noise of the office & residential areas of the construction area was 58.0 dB and 52.6 dB respectively. Its daytime noise met Grade II criteria of Standard of Environmental Noise of Urban Area (GB3096-93), while night noise met Grade III. The noise of operation areas met the noise limits for workshops and operation sites specifies in national *Specifications for the Design of Noise Control System in Industrial Enterprises* (GBJ87-85). The noise level at sensitive boundary sites met the requirement of Noise Limits for Construction Site (GB12523-90).

The daytime average environmental noise of the office & residential areas dropped by 0.2 dB and night average environmental noise went up by 2.5 dB compared with that of 2006. In the construction operation area, daytime environmental noise went up by 2.7 dB and night average environmental noise increased by 2.5 dB. The annual average of traffic noise of the construction areas was 67.1 dB, down by 2.0 dB compared with that of 2006.

Chapter 7
Status of Public Health

7.1 Basic Situation

In 2007, the monitoring site distribution of public health was same as in 2006. They included the basic monitoring stations or sites in such areas as Chongqing City, Fengdu County, Wanzhou District and Fengjie County in Chongqing Municipality and Yichang City of Hubei Province. Total population under health monitoring in 2007 was 617214, 2912 more than in the last year. Among them, 314836 were male and 302378 were female with a male/female ratio of 1.04:1. 338279 were urban residents and 263917 the rural.

In 2007, there were a total of 333 medical institutions at various levels in the monitoring region, up by 45 compared with that of 2006. There were 4486 hospital beds in these medical institutions, up by 767 than in 2006. There were 3553 various medical staff at different various levels, down by 1133 compared with that of 2006, mainly due to restructuring of medical institutions in the Three Gorges reservoir area.

7.2 Life Statistics

7.2.1 Birth and Death

In 2007, 4552 babies were born within the monitoring area, among them 2343 were male and 2209 female with a male/female ratio of 1.06:1. The birth rate was 7.38‰, up by 15.31% compared with that of 2006. There were 3673 death cases within the monitoring area with death rate at 5.95‰, up by 19.00% compared with that of 2006. Among the death, 2131were male and 1542 were female, with death rate at 6.81‰ and 5.05‰, up by 17.41% and 1.00% respectively than in 2006. In Chongqing, Fengdu, Wanzhou and Yichang, the birth rate was 6.86‰, 12.98‰, 5.70‰ and 5.58‰; while the death rate was 6.36‰, 6.64‰, 4.98‰ and 6.96‰ respectively. The birth rate of Chongqing, Wanzhou and Yichang went up by 43.94%, 21.42% and 2.01% respectively compared with that of 2006, while it dropped by 3.06% in Fengdu. The death rate of Chongqing, Yichang and Wanzhou went up by 43.89%, 19.18% and 17.73% respectively; while it went down by 1.04% in Fengdu compared with that of 2006.

In 2007, a total of 42 baby deaths were reported in the monitoring area. 22 of them were male and 20 female. Baby mortality was 9.23‰, down by 13.66% compared with that of the last year.

7.2.2 Analysis of Death Cause

According to ICD-10 Disease Classification Standard, the top five diseases causing death in the Three Gorges reservoir area in 2007 were circulatory system diseases (203.98/100,000), malignant tumors (169.31/100,000), respiratory system diseases (80.85/100,000), injury & poisoning (70.48/100,000) and digestive system diseases (16.53/100,000). The percent of death resulting from the above five major diseases was 34.28%, 28.45%, 13.59%, 11.84% and 2.78% respectively, totaling at 90.94%.

Compared with in 2006, there was no change of the rank of the top 5 killer diseases and little change in death structure. There was slight increase of the death percent of circulatory system diseases, malignant tumors and injury & poisoning; while the death percent of respiratory system diseases had some decline. The mortality of the above 4 diseases went up except that of respiratory system diseases with 17.63% reduction. Among them, the mortality of tumors went up by 44.25%; injury & poisoning up by 46.77%; the mortality of digestive system diseases up by 6.92% and that of circulatory system diseases up by 25.43%.

The rank of top 5 death causes of both male and female was same as the general population with male mortality higher than that of female. In different regions, the rank of death cause varied. The rank of death cause

in Chongqing and Fengdu was consistent with the general. In Wanzhou, however, tumor ranked No.1 followed by circulatory system diseases and respiratory system diseases. Whereas in Yichang, circulatory system diseases became No.1 killer, injury & poisoning went up to No.2 and tumor dropped to No.3.

7.3 Monitoring of Diseases

7.3.1 Monitoring of Infectious Diseases

In 2007, there were a total of 4280 cases of category B and C infectious diseases across all monitoring sites. Total morbidity was 693.44/100,000, up by 8.83% compared with that of 2006. There were 7 deaths, total mortality at 1.13/100,000, up by 73.85% than in 2006. There was no report of Category A infectious diseases such as plague and cholera and no outbreak of epidemics. There were infectious disease cases in all monitoring sites of every month. Except low occurrence of Category B infectious disease in December, there was no big fluctuation of reported cases in other months. There was relatively high occurrence of Category C infectious diseases in August, September and November, mainly due to acute hemorrhagic conjunctivitis and other infectious diarrhea.

All monitoring sites reported 14 kinds of Category B infectious diseases with 2861 reported cases (excluding HIV), the morbidity was 463.53/100,000, up by 2.80% compared with that of 2006. The morbidity (order from high to low) was 824.48/100,000 in Fengdu, 454.05/100,000 in Chongqing, 344.28/100,000 in Wanzhou, and 338.12/100,000 in Yichang. It went up by 34.16% in Yichang and 13.52% in Chongqing compared with that of 2006. The morbidity dropped by 8.40% in Wanzhou and 2.66% in Fengdu. There was some change of the type and order of top 5 infectious diseases compared with that of 2006. Tuberculosis went up to No.1 (185.84/100,000), virus hepatitis dropped to No.2 (175.95/100,000), measles ranked No.3 (30.78/100,000) followed by dysentery (29.65/100,000) and lymphopathia (21.71/100,000). Compared with that of 2006, epidemic hemorrhagic fever, kala-azar (afferent case) and malaria were added in the type of infectious diseases, whereas whooping cough, AIDS and leptosprirosis were removed from the list. The morbidity of virus hepatitis, dysentery, typhoid, scarlet fever and type B meningitis had some reduction; while that of other types of diseases had some increase. The morbidities of infectious diseases such as hepatitis A, dysentery and typhoid with water as the medium and relevant to the impoundment had relatively low level. The morbidity of type B meningitis (5 cases) with natural epidemic focus having something to do with the change of insect media dropped by 50.31%.

5 types of Category C infectious diseases were reported in all monitoring sites with 1419 cases and morbidity at 229.90/100,000, up by 23.45% compared with that of 2006. The morbidity with the order from high to low was 511.20/100,000 in Fengdu, 237.90/100,000 in Chongqing, 164.81/100,000 in Yichang and 114.90/100,000 in Wanzhou. The morbidity went up by 155.36% in Yichang and 38.94% in Chongqing, but declined by 17.74% in Wanzhou and 2.51% in Fengdu compared with that of 2006.

7.3.2 Monitoring of Endemic Diseases

In 2007, iodine deficiency monitoring was carried out in Chongqing, Wanzhou and Fengdu. Palpation method was employed to investigate iodine deficiency in local communities with sampling of 1001 children aged 8～12, 100 of them had Io thyromegaly, taking up 9.99%, slightly up compared with that of 2006, falling into the range of slight epidemic. Thyromegaly rate was 15.00% in Wanzhou, 10.00% in Fengdu, 8.81% in Chongqing and 1.87% in Yichang. The thyromegaly rate in Wanzhou and Yichang went up by 1.25 and 0.16 percentage point compared with that of last year, while it dropped by 2.50 percentage points in Fengdu and 1.25 percentage points in Chongqing. A total of 1691 households were sampled for the test of edible salt, 1659 of them ate iodine added sale, accounting for 98.11%, up by 1.68 percentage points than in 2006. 1578 of them ate qualified iodine added sale, taking up 95.12%; the application rate of qualified iodine added sale was 93.32%, up by 2.12 and 3.64 percentage points respectively. Because of the implementation of the local public health program for the prevention and control of iodine deficiency supported by special central budget and measures including comprehensive prevention and control of iodine deficiency dominated by widespread health education in rural areas and middle and primary

schools, iodine added sale coverage, qualification rate and the application rate of qualified iodine added sale went up.

In 2007, Fengjie monitoring site conducted the monitoring on fluorine endemic disease. A total of 283 people were investigated, 143 cases were found with positive rate at 50.53%.

7.4 Monitoring of Biological Media

7.4.1 Monitoring of Rats

In 2007, the indoor and outdoor rat density of all monitoring sites was 3.11% and 3.16%, up by 0.94 and 1.25 percentage points respectively compared with that of 2006, but both were lower than the 5-year average indoor and outdoor rat density (3.94% and 4.22%) before 135 m impoundment. In the spring, indoor rat density was 2.73% and outdoor rat density 2.54%, outdoor rat density was lower than that of indoor. In the autumn, rat density was 3.63% indoor and 3.86% outdoor, the outdoor rat density was higher than the indoor, both were higher than in the spring. The order of indoor and outdoor rat density at each monitoring site was the same, with the sequence of Fengdu (6.73% and 10.19%), Wanzhou (4.40% and 4.83%), Yichang (3.97% and 3.01%) and Chongqing (1.13% and 1.54%).

Indoor rat was still dominated by brown house mouse (*Rattusnorvegicus*), taking up 46.02%, down by 15.42 percentage points compared with that of 2006; small home mouse (*Musmusculus*) ranked the second, taking up 31.86%, up by 0.53 percentage point. In the field, the small insectivore (mostly short-tail shrew) was the dominant species, accounting for 48.47%, down by 18.88 percentage points compared with that of 2006. Black strip rat (*Apodemusagrarius*) ranked the second, taking up 18.40%, up by 10.24 percentage points. As the host animal of epidemic hemorrhagic fever and leptospiral pathogens, *Apodemusagrarius* kept on the increase of it proportion on the bases of the rise of last year and ranked No.2 dominant species. The reduction of the percents of dominant indoor species brown house mouse and outdoor dominant species small insectivore was closely related to the rise of indoor *Rattusflavipectus* and outdoor amount of black strip rat.

In 2007, each monitoring site tested the pathogens of epidemic hemorrhagic fever and leptospirosis on rat lung and kidney samples. 2.70% samples from Chongqing, 2.82% samples from Fengdu and 7.04% samples from Wanzhou found the epidemic hemorrhagic fever pathogen with no report case in Yichang. As for the test of leptospiral pathogen, all monitoring sites were negative except one positive which sampled from Yichang.

7.4.2 Monitoring of Mosquitoes

In 2007, the overall adult mosquito density in livestock pens was 137.38/pen·artificial hour, higher than 101.9/pen·artificial hour of last year, but still lower than the 5-year average (198.57/pen·artificial hour) before 135 m impoundment. The overall indoor adult mosquito density was 45.82/ room·artificial hour, higher than 30.88/room·artificial hour of the last year, but lower than the 5-year average before 135 m impoundment (63.97/room·artificial hour). Compared with that of the last year, the overall adult mosquito density in both livestock pen and houses of all monitoring sites had some increase except in Chongqing with slight reduction. In Wanzhou, Fengdu and Yichang, the overall adult mosquito density in livestock pens went up by 98.89%, 37.29% and 24.90% respectively, while indoor adult mosquito density increased by 161.52%, 82.89% and 10.11% respectively compared with that of 2006. The rise of mosquito density might have something to do with serious flood and resulting increase of mosquito breeding sites in Chongqing area in 2007.

10-day change trend of indoor adult mosquito density during May～September was similar to that of the adult mosquito density in livestock pens. The peak of indoor adult mosquito density was the earliest in Yichang occurring in early June, while its peak time was the latest in Chongqing occurring in late July. The peak of indoor adult mosquito density in Fengdu and Wanzhou occurred in late June. The peak of livestock-pen adult mosquito density was the earliest in Yichang and Fengdu occurring in early June with the latest in Wanzhou occurring in early August, while the peak of livestock-pen adult mosquito density in Chongqing occurred in late July.

Among all monitoring sites, the order of indoor adult

mosquito density from high to low was Wanzhou (98.96/ room·artificial hour), Chongqing (42.66/room·artificial hour), Fengdu (27.8/ room·artificial hour) and Yichang (9.15/room·artificial hour). The order of livestock-pen adult mosquito density from high to low was Wanzhou (258.40/pen·artificial hour), Fengdu (153.16/pen·artificial hour), Yichang (128.80/pen·artificial hour) and Chongqing (80.39/pen·artificial hour).

The composition of mosquito species showed that *Armigeres subalbatus* was the dominant mosquito species in both houses and livestock pens, accounting for 77.49% and 75.26% of the total. *Culex pipiens fatigans* ranked No.2 as indoor mosquito species, taking up 8.76%, *Culex pipiens Pallens, Anopheles sinensis* and *Culex triaenio-rhynchus* ranked the third, fourth and fifth respectively. Among the livestock pen mosquito species, Anopheles sinensis ranked No.2 and took up 8.28%, *Culex pipiens fatigans, Culex pipiens Pallens* and *Culex triaenio-rhynchus* ranked No.3, 4 and 5 respectively. Compared with that of the last year, the percent of *Armigeres subalbatus* in both indoor and livestock mosquito species went up, while the percent of other mosquito species dropped at some degree.

Chapter 8
Environmental Quality of Resettlement Area

In 2007, comprehensive environmental monitoring was carried out in 15 resettlement districts (counties) of Chongqing Municipality in the Three Gorges reservoir area, which included water quality monitoring, monitoring on ambient air quality and noise monitoring.

8.1 Water Quality Monitoring

In 2007, monitoring contents on the water quality in resettlement areas included three components, i.e. quality of surface water, water quality of sensitive backwater zones and water quality of drinking water source areas. The assessment of water quality complies with Environmental Quality Standard for Surface Water (GB3838-2002). The assessment of comprehensive nutrition status of waters complies with the Technical Regulations on Eutrophication Evaluation Method and Grading for Lakes (Reservoirs) developed by China National Environmental Monitoring Center.

8.1.1 Surface Water Quality

122 river sections were setup in 50 tributaries of the Yangtze River in 15 districts (counties), down by 26 compared with that of 2006. The water quality evaluation covered 20 items such as pH, dissolved oxygen, permanganate value, COD, BOD_5, ammonia nitrogen, copper, zinc, fluoride, selenium, arsenic, cadmium, mercury, hexavalent chromium, lead, cyanide, volatile phenol, petroleum, anion surfactant and sulfide.

In 2007, the overall quality of the surface water of the resettlement area kept stable with 105 sections meeting or superior to Grade Ⅲ national water quality standard, accounting for 86.1%. Eight sections met Grade Ⅳ standard, 3 sections met Grade Ⅴ standard and 6 sections failed to meet Grade Ⅴ standard, accounting for 6.6%, 2.5% and 4.9% of the total respectively.

The water quality in low, level and high flow periods was good with the section proportion meeting or superior to Grade Ⅲ national surface water quality standard being 89.1%, 83.6% and 90.0% respectively, up by 2.0, 0.5 and 4.3 percentage points respectively compared with that of 2006. River sections failing to meet Grade Ⅲ standard were mainly distributed in Banan District and Wanzhou District.

8.1.2 Water Quality of the Backwater in Sensitive Areas

58 monitoring sections were established in 35 rivers of 11 districts or counties, up by 11 compared with that of 2006. The monitoring covered 11 items such as water turbidity, water temperature, pH, dissolved oxygen, permanganate value, BOD_5, TN, ammonia nitrogen, nitrate, chlorophyll-a and total phosphorus.

● Water Quality

Six indicators including pH, dissolved oxygen, permanganate value, BOD_5, ammonia nitrogen and TP were employed to assess water quality.

In 2007, the overall surface water quality of the backwater in sensitive areas of the resettlement area was good with 51 sections meeting or superior to Grade Ⅲ standard, taking up 87.9% of the total, down by 1.4 percentage points compared with that of 2006. There were 5 Grade Ⅳ sections, 1 Grade Ⅴ section and 1 section failing to meet Grade Ⅴ standard, accounting for 8.6%, 1.7% and 1.7% of the total. Main pollutants were TP, ammonia nitrogen and BOD_5.

The proportion of monitoring sections in backwater sensitive zones meeting or superior to Grade Ⅲ standard during March, April and May was 83.4%, 92.6% and 91.1% respectively, down by 2.3 percentage points in March, up by 11.4 percentage points in April and 2.2 percentage points in May compared with the same period of last year. The sections with relatively poor water quality mainly located in Wanzhou District, Fuling District and Changshou District.

● **Nutrition of Water Bodies**

Five indicators including chlorophyll-a, TP, TN, turbidity and permanganate value were employed to evaluate nutrition status of the water bodies.

In 2007, 14 river sections of the backwater sensitive zone of the resettlement area were under eutrophication, accounting for 24.1% of the total. Among them, 10 sections were under slight eutrophication, 4 sections intermediate eutrophication, accounting for 17.2% and 6.9% respectively. Two sections were under oligotrophication and 42 sections were under mesotrophic conditions, taking up 3.4% and 72.4% of the total. The comprehensive trophic state index ranged from 20.81 to 69.51.

8.1.3 Water Quality of Drinking Water Sources

A total of 118 monitoring sites were established at 97 major centralized drinking water sources of 15 districts (county cities) and Class I towns, same as in 2006. Water quality assessment covered 25 items including water temperature, pH, dissolved oxygen, permanganate value, COD, BOD_5, ammonia nitrogen, TP, Cu, Zn, fluoride, selenium, As, Hg, Cd, Cr^{6+}, Pb, cyanide, volatile phenol, petroleum, anion surfactant, sulfide, sulfate, chloride and nitrate.

In 2007, the water quality of the major collective drinking water sources of the county cities and Class I towns of the resettlement area was relatively good with 96.9% of them meeting the functional requirement for water quality as drinking water source areas, same as that of 2006.

8.2 Air Quality Monitoring

In 2007, environmental air quality monitoring of the resettlement area mainly included the monitoring of urban air quality and precipitation quality.

8.2.1 Environmental Air Quality

29 ambient air quality monitoring sites and 29 dust monitoring sites were established in the 15 districts (counties) . The main monitoring items included sulfur dioxide (SO_2), nitrogen dioxide (NO_2), inhalable air particulates and dust. The Ambient Air Quality Standard (GB3095-1996) was applied in the assessment of the environmental air quality.

In 2007, there was certain improvement of urban air quality in the resettlement area with 10.8% reduction of integrated air pollution index compared with that of 2006.

The annual average SO_2 concentration was 0.037 mg/m^3, meeting Grade II national air quality standard. The daily average SO_2 concentration was 0.001～0.225 mg/m^3, with 0.7% of the total failing to meet national air quality standard. The highest daily average was 1.5 time of the limit. Among the 15 districts (counties), the annual average SO_2 concentration of 13 districts (counties) met Grade II national air quality standard, accounting for 86.7%, up by 13.4 percentage points compared with that of 2006.

The annual average NO_2 concentration was 0.027mg/m^3, meeting Grade II national air quality standard. The daily average NO_2 concentration was 0.001～0.112 mg/m^3. All the annual average NO_2 concentrations of 15 districts (counties) met Grade II national air quality standard, same as in 2006.

The annual average concentration of inhalable particulates was 0.086 mg/m^3, meeting Grade II national air quality standard. The daily average particulates concentration ranged from 0.010 to 0.376 mg/m^3 with 4.7% of 365 days going beyond daily limit. The highest daily average exceeded the limit by 1.51 times. Among the 15 districts or counties, the annual average particulates level of 14 met Grade II standard, taking up 93.3%, same as in 2006.

The annual average level of falling dust was 5.93 t/km^2 ·month, 0.6 times higher than the reference limit. The maximum level exceeded the limit by 1.54 times. Among the 15 districts or counties, the annual average level of falling dust of only Wushan County, Shizhu County, Wulong County and Fengdu County was lower than the reference standard, accounting for 26.7%, up by 13.4 percentage points compared with that of the last year.

8.2.2 Precipitation Quality

In 2007, 18 precipitation monitoring sites were

established in 15 districts (counties) with the collection of 755 rain samples, 430 of which were acid rain samples. The acid rain frequency was 57.0% and amount of acid rain took up 63.1% of total precipitation, up by 1.6 and 4.8 percentage points compared with that of the last year. The monitored pH value of the precipitation ranged from 3.64 to 7.83 with the average at 4.78. Among the 15 districts or counties, the annual average pH of the precipitation of 9 districts or counties was less than 5.60, taking up 60.0%.

8.3 Monitoring of Acoustic Environment Quality

In 2007, the monitoring of acoustic environmental quality in the resettlement areas included the monitoring of regional environmental noise, traffic noise and functional area noise. The evaluation work complied with the Standard of Environmental Noise of Urban Area (GB3096-93).

8.3.1 Urban Area Noise

A total of 1,429 monitoring grids were established in cities and towns of the 15 districts or counties for the monitoring of environmental noise of urban area, covering 173.02 km^2 of built area. 2～4 times monitoring were carried out in 2007.

In 2007, the overall regional acoustic environment of the resettlement area was good with the equivalent sound level at 54.6 dB. Among them, Fengjie County had the highest equivalent sound level at 58.4 dB, but 1.5 dB down compared with that of 2006. Changshou District remained the lowest level at 51.2 dB. The noise source was dominated by domestic noises, taking up 62.8% followed by traffic noise that took up 24.1%. Among the 1429 noise monitoring grids, 1264 met national noise standard accounting for 88.5%, up by 4.0 percentage points compared with that of 2006. The percent of monitoring grids meeting Class I, II, III and IV function areas was 38.5%, 90.6%, 100.0% and 98.9% respectively. Compared with that of the last year, the meet-the-standard rate dropped by percentage points in Class I function area, but went up by 3.9 percentage points in Class II function area and 1.0 percentage point in Class IV function area, while it kept the same in Class III function area. Among the 15 districts or counties, 4 of them had good regional acoustic environment quality, taking up 26.7%.

8.3.2 Traffic Noise

A total of 233 road sections in the cities (towns) of 15 districts or counties were established to monitor traffic noise with total length of 303.35 km. The traffic noise was monitored 2～4 times.

In 2007, the overall road traffic noise of the resettlement area was relatively good with average equivalent sound level at 67.8 dB. The average traffic flow was 1,078 vehicles per hour. The total length of trunk road with equivalent sound level over 70 dB was 66.85 km, accounting for 22.0% of the total monitored length. 11 districts (counties) out of the 15 had good and relatively good traffic noise level, taking up 73.3%.

8.3.3 Noise of Functional Areas

34 monitoring sites were set up in the cities and towns of the 15 districts (counties) to monitor the noise of functional areas, which covered an area of 87.09 km^2. The monitoring was conducted 2～4 days, once an hour.

In 2007, the daytime and night equivalent sound level of the functional areas of the resettlement area was 56.5 dB and 47.3 dB respectively, and the day-night equivalent sound pressure was 56.8 dB; down by 1.2, 1.0 and 1.1 dB respectively compared with that of 2006. The equivalent sound level of all functional areas met relevant national noise standard for day-night equivalent sound pressure with the exception of that (57.2 dB) of Class IV functional area during night, which was 2.2 dB higher than the limit. The equivalent sound pressure level of 9.7% of daytime hours and 26.5% of night hours went beyond the standard, lower than that of 2006.

Chapter 9
Monitoring and Studies on Ecological Environment

9.1 Monitoring on Ecological Environment of Wanzhou Model Zone

Standard run-off comparison trial for the study and monitoring of ecological environment of Wanzhou model zone continued in 2007 to monitor soil water content, nutrients and soil erosion under different modes of land use.

9.1.1 Trial of compound farming of grain crops, cash crops and fruit trees on ridges of slope cropland

The pattern of compound farming of grain crops, cash crops and fruit trees on ridges of slope farmland (Pattern I) has been developed for 6 years with evident improvement in soil water retention capacity. The findings on comparison trial among Pattern I, compound farming of grain crops, cash crops and fruit trees on non-ridge farmland (Pattern II) and the planting of only grain crops on non-ridge farmland (Pattern III as the control pattern) showed that Pattern I had the highest water content, followed by Pattern II and Pattern III. The comparison of soil water content at different monitoring time shows that soil water content of Pattern I on 2, 4, 8 and 16 days after raining day was 22.94%, 18.81%, 12.83% and 17.47% more respectively than that of the control group. The soil water content of Pattern II on 2, 4, 8 and 16 days after raining day was 8.97%, 10.42%, 5.15% and 4.93% higher than that of the control group. The soil water content after rainfall had the maximum change in Pattern III (control group), followed by Pattern II and Pattern I. On the same monitoring day, the water and soil retention effect was the best in Pattern I, followed by Pattern II and Pattern III regardless of the rainfall amount that generated run-off. Compared with that of the control pattern, surface run-off of Pattern I reduced by 80.44% on the average and soil erosion reduced by 92.52% on the average. The surface run-off of Pattern II reduced by 32.85% on the average and soil erosion went down by 54.58% on the average.

With no or little tillage and the application of three-dimension planting and straw returning to cropland, Pattern I enjoyed obvious improvement in soil physical characteristics and nutrition. Compared with that of the control pattern, the bulk density of the soil of 0～30 cm layer of the ridges of Pattern I dropped by 9.86% and porosity went up by 11.00%. It was estimated that effective capacity of soil increased by 135.7 m3/ha. After cultivation and the application of fertilizers, furrow soil improved its structure. In particular, the bulk density of cultivated layer soil (0～15 cm) went down by 3.85% with 1.22% increase of porosity and 10.52% increase of clay particles whose diameter was＜0.002 mm.Under the same application of fertilizers, the concentrations of various nutrients in the soil of Pattern I farmland were obviously higher than that of the soil of Pattern II and III. Compared with the soil of Pattern III, the soil of Pattern I had 32.54% more organic matter, 37.09% more TN, 14.19% more TP, 25.07% more Kjeldahl nitrogen, 13.15% more quick-acting phosphorus and 11.57% more quick-acting potassium. In Pattern II, the level of organic matter, TN, TP, Kjeldahl nitrogen, quick-acting phosphorus and quick-acting potassium in soil went up by 16.52%, 6.62%, 10.97%, 12.28%, 9.92% and 2.55% respectively compared with that of the soil of control pattern.

9.1.2 Trial of the Pattern of Steep Slope with Biological Fence (Fence Pattern)

The pattern of steep slope fenced with shaddock-king grass hedgerows (Fence Pattern) increased vegetation coverage and reduced the evaporation of soil water. Bush crown and grass hedge helped the interception of rainfall, grass hedge roots and cut-down stems and leaves improved soil penetration and infiltration capacity, leading to continual rise of water reservation capacity of soil and evident increase of soil moisture.

There were 11 rains monitored in 2007. The soil moisture of the Fence Pattern increased by 6.70%, 19.32%,

8.75% and 32.68% respectively 2, 4, 8 and 16 days after the rain compared with that of the control pattern.

The soil physical characteristics and nutrition have evident improvement after 6-year development of the Fence Pattern. Compared with the soil of the control pattern, soil bulk density decreased by 12.22%, porosity went up by 12.02%; the percent of clay particles with diameter ＜0.002 mm went up by 11.83%; the concentration of nutrients such as organic matter, TN, TP, TK, Kjeldahl nitrogen, quick-acting phosphorus and quick-acting potassium increased by 47.05%, 68.18%, 36.00%, 10.25%, 16.04%, 16.28% and 39.66% respectively.

Fence Pattern has evidently reduced water and soil erosion compared with the control pattern. Among the 8 typical monitoring of water and soil erosion across the year, 5 of them did not generate run-off in the trial plots of the Fence Pattern. Among the 3 rains generating run-off in the trial plots, the amount of run-off was reduced by 88.74% and soil erosion decreased by 91.08% on the average compared with that of the control pattern.

9.2 Monitoring on Ecological Environment of Zigui Model Zone

In 2007, Zigui Model Zone continued its monitoring on water and soil erosion as well as the drain of nitrogen and phosphorus from typical run-off field of the slope land in upstream areas of the Three Gorges Project, studying on the effects of typical land-use pattern on water and soil erosion as well as the drain of nitrogen and phosphorus, and identifying the effects of the application of plant fences, stalk & mulch covering and grass coverage on the prevention and control of soil erosion and loss of soil nutrients.

9.2.1 Monitoring on Water & Soil Erosion and Nutrient Drain under Different Land Use Pattern

In 2007, 37 precipitation with ≥10 mm were observed across the year; 15 of them generating obvious run-off and soil erosion. In May～July, soil erosion in upstream areas of the Three Gorges Dam was serious. Nitrogen and phosphorus loss of slope land of run-off field of navel orange orchard showed a peak with maximum drain occurring in June. This has something to do with the application of fruit fertilizers in June coupled with water & soil erosion resulting from strong rainfall. The maximum peak of nitrogen and phosphorus loss of dry slope land occurred during May 25～July 25, earlier than that of navel orange orchard. The second peak occurred in April ~ early May. The annual average loss of total nitrogen in waters and in sediments of the slope of the run-off plots of dry slope farmland and navel orange orchard accounted for 44.02% and 65.98% respectively of total nitrogen loss. The annual average loss of total phosphorus in waters and in sediments of slope farmland and navel orange orchard accounted for 22.96% and 77.04% respectively of total loss. Ammonia nitrogen is easy to dissolve in water and moves with waters. Therefore, the loss of water nitrogen has some proportion. Phosphorus is easy to be fixed by soil particles with low dissolvement in water. Therefore, Phosphorus loss is mainly through soil erosion.

The run-off, sediment and slope N-P loss of navel orange orchard were evidently higher than that of cultivated cropland. Under 2o less slope condition, the run-off, run-off sediment and N-P loss of the slope of the plots of naked navel orange orchard were 1.36, 1.27, 4.24 and 1.85 times respectively of that of wheat — groundnut plots, basically consistent to the 6-year monitoring results. Although vegetation cover of navel orange orchard is stable with relatively lower cultivation frequency, the actual fertilizer utilization efficiency was not high due to relatively interception wash force of the navel orange crown even though fertilizer application

Blossom of navel orange tree

amount is much higher than that of dry slope cropland. Therefore, water and soil erosion and N-P loss of the slope of navel orange orchard were higher than that of slope cropland. In particular, its nitrogen loss was much than that of slope cultivated cropland. The navel orange orchards of the Three Gorges Project area were mainly distributed in river valley with elevation less than 500 m and in the vicinity of water-level-fluctuating zone. Therefore, local authorities attached more importance to the prevention and control of water and soil erosion and N-P loss and strengthened the N-P management of navel orange orchards.

Navel orange orchard on slope land

9.2.2 Monitoring on the Effects of Ecological Measures on the Control of Water & Soil Erosion and Nutrient Loss of Slope Land

The application of plant fence enjoyed most remarkable effects on the control of the loss of water, soil, and nitrogen & phosphorus nutrients of both navel orange orchards and dry slope cropland. Compared with that of groundnut — wheat plot (control plot), the run-off coefficient of groundnut — wheat with Chinese toon fence plots and groundnut — wheat with alfalfa fence plots dropped by 34.0% and 28.9% respectively; soil loss went down by 88.07% and 88.32%; slope nitrogen loss dropped by 33.15% and 26.33%; phosphorus loss dropped by 61.18% and 58.76% respectively. The annual run-off coefficient, soil loss, nitrogen loss and phosphorus loss of navel orange plot interplanted with day lily fence went down by 31.33%, 49.50%, 4.95% and 39.74% respectively compared with that of navel orange plot without any cover (control plot).

Navel orange orchard with straw mulch coverage or interplanted with perennial forage grasses also helped the control of water & soil erosion and N-P loss. Compared with that of naked navel orange plot, the annual runoff coefficient of the navel orange plots interplanted with white flower clover or with straw mulch coverage went down by 13.97% and 21.08% respectively; soil loss dropped by 45.45% and 14.96%. The total N-P loss of navel orange orchard plot interplanted with perennial white flower clover dropped by 46.04% and 26.18% respectively. The total N-P loss of navel orange plots with straw mulch coverage was similar to that of navel orange plots without any cover, showing no obvious control effect. The annual run-off coefficient, soil loss and nitrogen loss of navel orange plot buried with contour anti-seepage film dropped by 43.37%, 38.99% and 23.71% respectively, showing its effective control of both water & soil erosion and N-P loss.

During the fruiting period, it was not appropriate for navel orange orchards to interplant crops requiring frequent plough and sowing. The annual run-off coefficient, soil loss, nitrogen loss and phosphorus loss of navel orange orchard plot interplanted with wheat — groundnut went up by 20.80%, 49.18%, 47.80% and 48.14% respectively compared with that of naked navel orange plots. This is mainly because the addition of two deep plough in this kind of plot in 2007 which lowered the anti-impact capacity of the soil and additional application of fertilizers, resulting in the rise of both water & soil erosion and N-P loss of the slope land.

9.3 Monitoring on Groundwater Table and Soil Gleization

The monitoring on groundwater table change and the observation of gleization indicators of the soil from Shimatou to Xiaogang Farm of the Honghu Lake located at the “Four lakes” at the middle reaches of the Yangtze River continued in 2007.

9.3.1 Monitoring of Groundwater Table

The groundwater monitoring section consisted of

10 long-term observation boreholes in 5 groups. The distances from the 5 groups of boreholes marked with the code of A, B, C, D and E to the bank of the Yangtze River was 1.5 km, 3.0 km, 5.0 km, 8.5 km and 13.0 km respectively with borehole internal diameter of 0.11 m. The depth of boreholes of confined water was about 35 m while that of phreatic water boreholes was 5～7 m.

The monitoring results showed that the annual average groundwater level of all observation boreholes ranged from 21.45 m to 22.48 m with annual maximum of 21.94～23.34 m and minimum of 20.71～21.72 m. The annual fluctuation was 1.03～1.98 m. The phreatic surface changed from 21.18～23.24 m and the water table of confined groundwater varied from 20.71 m to 23.34 m with maximum change at 2.06 m and 2.63 m respectively. The water table of confined groundwater was slightly lower in borehole A, B and E but slightly lower in borehole C and D than that of the 2006 and 2005, which was contrary to that of last year. The water table change of phreatic surface boreholes was similar to that of confined groundwater with slightly higher water table in C and D than in 2006.

The monthly average of the phreatic surface of all phreatic surface boreholes was 21.29～22.95 m and the water table of all observation boreholes for the monitoring of confined groundwater ranged from 21.28 m to 23.00 m. The time distribution of monthly maximum and minimum water table was the same as that of the last year with highest water table in June～August. Among the boreholes, borehole A and B had the highest in July, while borehole C, D and E in August. The lowest water table occurred in January and February dominating in January. High water table period occurred during May～October and low water table from December to March. Borehole E was quite abnormal with similar change trend of phreatic surface and confined water table and obvious drop of water table after August. The groundwater table in autumn and winter was lower than that of the last year, which was conducive to soil degleization in the winter.

In 2007, the analysis of the dynamic correlations among the confined groundwater table, phreatic surface and the water level of the Yangtze River indicated that both the confined groundwater table and phreatic surface have very significant correlation with the water level of the Yangtze River except that of Borehole E.

Table 9–1 Groundwater table of each observation borehole from Shimatou to Xiaogang Farm of the Honghu Lake in 2007

Unit: m

Boreholes	Confined water table					Phreatic surface				
	A	B	C	D	E	A	B	C	D	E
Annual average	22.48	21.57	21.79	21.45	21.90	22.15	22.40	22.22	22.00	21.91
Maximum	23.34	22.14	22.70	21.94	22.44	23.16	23.24	22.75	22.42	22.72
Minimum	21.58	21.11	21.04	20.71	21.41	21.18	21.69	21.72	21.64	21.42
Change	1.76	1.03	1.66	1.23	1.03	1.98	1.55	1.03	0.77	1.30

9.3.2 Monitoring on Indicators of Soil Gleization

In 2007, 8 soil monitoring sections were arranged from Xiaogang Farm to Shimatou in order to continue the monitoring of such indicators as soil moisture, pH, oxidation reduction potential, the total amount of reduction material, active reduction materials and the level of ferrous iron of the soil under light, intermediate and heavy gleization. The monitoring was conducted once in the winter and once in summer.

Monitoring results showed that the total amount of reduction materials was 0.18～13.58 cm·mol/kg with the average at 3.01 cm·mol/kg. The concentration of active reduction materials was 0.05～11.04 cm·mol/kg with the average at 2.29 cm·mol/kg. The ferrous concentration

was 0.018～0.889 cm·mol/kg with average at 0.333 cm·mol/kg. Compared with that in 2006, there was evident reduction of the total concentration of reduction materials and active reduction materials and slight drop of ferrous concentration. There was evident difference of the monitored gleization level in the winter and summer. The total amount of reductive materials (4.94 cm·mol/kg) and level of active reduction materials was 4.57 and 5.65 times of that of the winter. The ferrous concentration was higher than that of the winter, while oxidation reduction potential showed the opposite change. Meanwhile, the fluctuation of monitored soil gleization value in summer was higher than that of the winter.

9.4 Monitoring on Terrestrial Plant Communities

Investigations on the plant communities in 145～156 m water-level-fluctuating zone of the Three Gorges reservoir area during June～October in 2007, which mainly focused on such districts (counties) as Zigui, Badong, Wushan, Fengjie, Yunyang, Wanzhou, Zhongxian and Fengdu.

Community sample investigation method was employed，and a total of 61 types of plant communities were found within 145～156m water-level-fluctuating zone, most were annual herbage dominated by fieldweeds or alien species, which rapidly reproduce by seeds and develop into dominating communities. Among them, crabgrass communities, barnyard grass communities, moleplant communities and Siberian cocklebur communities etc. were the most common types of plant communities within water-level-fluctuating zones.

Barnyard grass community

Perennial herb communities mainly include *Alternanthera philoxeroides* community, Bermuda grass community, reed community, *Hemarthria altissima* community, *Leersia hexandra Swartz* community, nut grass community, *Equisctum ramosissimum Desf*. Community and *Polygonum japonicum Meisn* community etc. These communities could survive from long-term water logging. Among them, *Alternanthera philoxeroides* and Bermuda grass community had the strongest anti-water-logging capacity and could tolerate long-term water logging of over 10m. Reed community was able to tolerate over 10 m water flood but with poor growth. No woody plant community was found in the investigation. Bushes such as five-leaved chaste tree and *Coriaria sinica*, which originally existed in the water-level-fluctuating zones, were not found in 2007.

Bermuda grass community

A total of 189 species of higher plants in 56 families were found in water-level-fluctuating zones. Among them, grass family was the most at 27 species followed by *Compositae* at 22 species. Other families with relatively big species amount included *Cyperaceae* at 13 species; *Euphorbiaceae* at 10, *Leguminosae* at 10, *Polygonaceae* at 10, *Solanaceae* at 7 and *Amaranthacae* at 6. Among them, all *Amaranthacae* species and part of *Compositae* species were alien. Among the 189 species of plants, there were 13 species of woody plants including mulberry tree, *Celastrus variabilis Hemsley. J. Linn., Lespedeza cuneata*, five-leaved chaste tree and papyrifera. All others were herb plants with annual herb in dominance but

relatively less perennial herb species. Among the woody plant species, mulberry tree was able to tolerate long-term water-logging with the depth of over 10m and had relatively good growth after water receded. *Celastrus variabilis Hemsley. J. Linn*. and five-leaved chaste tree could tolerate certain degree of water-logging, too. But it would be hard for them to form their communities. Other species were occasionally seen at the top edge of water-level-fluctuating zones or only appeared as seedlings.

There was an expansion trend of the alien species communities in the water-level-fluctuating zones. In particular, *Alternanthera philoxeroides* has strong anti-water-logging capacity and rapidly grows and reproduces in the summer as soon as it is emerged from water surface with the trend of its competitive force exceeding that of native species of Bermuda grass (*Cynodon dactylon (Linn.) Pers*). Other alien species with relatively big threat included *Eichhornia crassipes, Amaranthus retroflexus, Bidens bipinnata L*. and *Conyza Sumatrensis (Retz.) Walker* etc..

Alien species–Astersubulatus Michx community

9.5 Comprehensive Monitoring of Ecological Environment of the Estuary

9.5.1 Water and Salt Concentration Trend

In 2007, monitoring work at the estuary (land-sea interface) continued to focus on the monitoring on dynamic change trend of salt concentration of the water at land-sea interface. Three monitoring sections were established at the north tributary of the Yangtze River, about 4 km, 22 km and 35 km from the land-sea interface respectively, all perpendicular to the river bank. At each section, 3 south-north monitoring points were arranged. Major monitoring items included the water conductivity of the Yangtze River, water conductivity of inland river section, soil conductivity, soil negative pressure, groundwater table and groundwater conductivity.

In 2007, the dynamic change pattern of the conductivities of the water of the Yangtze River, groundwater and soil of each section at the estuary area was similar within the year. The sections near the river mouth recorded higher salinity. The monitored conductivity would gradually decrease inward the river with the highest at Yinyang section, followed by Daxing section and Xinglongsha section. In the first 6 months of 2007, the water level of the Yangtze River estuary was relatively low, leading to evidently more invasion of sea water and its water conductivity reaching or approaching to the highest figure since there was monitoring record.

● Water Conductivity of the Yangtze River

In the first 6 months of 2007, the dynamic change pattern of water conductivity of the Yangtze River at the estuary area reached the highest figure of the same period since 1998 with some reduction in late 2007. The water conductivity of Yinyang section was higher than the historical average since 1998 but with slight drop compared with that of 2006. The water conductivity of Daxing section and Xinglongsha section had evident rise in the first 6 months, reaching the highest in the same period since 1998.

● Groundwater Table

In 2007, the dynamic change pattern of the groundwater table of all sections in the estuary area was basically the same, relatively low in the winter and spring, but high in the summer and autumn. The groundwater table of Yinyang section was higher than that of Daxing section. The monthly groundwater table was smaller than the historical average. The change pattern of groundwater table was similar to that of water level of the Yangtze River with some time lag and smaller fluctuations.

● Groundwater Conductivity

The groundwater conductivity of each section of

the estuary area in the first 6 months of 2007 was higher than that of the same period since 2003, but lower in the second 6 months. The dynamic change of groundwater conductivity of Xinglongsha section, which was different from that of Yinyang section and Daxing section, showed gradually rising trend in the year with very small fluctuation in monthly average. In general, the groundwater conductivity of Yinyang section was higher than that of Daning section; while the groundwater conductivity of Xinglongsha section ranged between that of Yinyang section and Daxing section. Generally speaking, the groundwater conductivity was in reverse ratio to the distance from the monitoring site to the embankment of the Yangtze River.

● Conductivity of Inland River

The conductivity of inland river had close relationship with the conductivity of local section of the Yangtze River. At the same time, the conductivity of inland river had significant impacts on local groundwater conductivity. The conductivity of inland river of each section at the estuary area kept gradual rise trend year on year. The conductivity of inland river at Yinyang section and Daxing section in the first 6 months of 2007 reached the highest over the past years. The conductivity of inland river at Xinglongsha section had no big change within the year, the highest in each month since 2003.

● Soil Conductivity

The conductivity of topsoil at Yinyang section, which was the closest to the estuary, was affected most by low flow year and seawater tide. The monitored value during January ~ August of 2007 was 36.1% higher than that of the same period of 2006 with slight improvement in the autumn and winter. The salt concentration of the topsoil at Daxing section and Xinglongsha section, which were relatively far from the estuary of the Yangtze River, was less affected by low flow year and seawater tide and kept on reduction. Soil conductivity usually went up with the decrease of the distance between the monitoring site and the embankment of the Yangtze River.

Investigation of soil salt concentration of cropland

Sampling in cropland

9.5.2 Non–biological Environment of the Waters

● Hydrology

In 2007, the water temperature of monitored waters showed the distribution characteristics of low in near coast but high off the coast with evident seasonal change. In the winter, the water temperature of coastal waters was lower than 8.0℃ and the water temperature of off-coast waters was higher than 10.0℃. The near-bank water temperature was lower but off-coast water temperature higher compared with the same period of 2004. In the spring, the water temperature was higher than 17℃, the water temperature of coastal surface layer was about 2.0℃ lower than that of 2004 and 1～2℃ lower for the bottom layer. The water temperature was over 26℃ at surface layer and over 18.5℃ at the bottom in the summer, the coastal water temperature was slightly higher than the same period of 2004. The water temperature of southeast sea waters was slightly low. In

Investigation on sea waters

the autumn, the water temperature was lower than 18.5℃ in coastal waters but higher than 20℃ in off-coast waters. Water temperature basically had perpendicular and even distribution. However, influenced by air temperature, the surface water temperature was slightly lower than that of deep water layer. This seasonal change was mainly due to seasonal changes of meteorological factors and interactions of various currents (current of the Yangtze River and Taiwan warm current, etc.).

The seasonal change of salt concentration of the waters under investigation was quite complex, showing evident regional characteristics. This has something to do with seasonal change of influencing factors such as the inflowing run-off the Yangtze River, Taiwan warm current, mixed water in the Yellow Sea, precipitation and evaporation. In the winter, the Yangtze River current may expand eastward as far as 122°30'E and meet high-salt water of the open sea, forming relatively big salinity gradient with maximum salinity ratio 0.27 higher than that of 2004. In the spring, with the increase of the flow from the Yangtze River, the diluting water from the Yangtze River expanded to the northeast taking the tongue shape with the maximum salinity ratio 0.31 lower than the same season of 2004. In the summer, the surface water of sea waters under investigation was basically controlled by low-salt water with eastward expansion scope much larger than the same period of 2004. The autumn, the salinity of sea waters under investigation basically showed the characteristics of low in coastal waters but high in off-coast waters. Its maximum salinity was slightly lower than that of 2004, but 0.45 higher than that of 2002.

● Water Chemistry

In 2007, the average level of dissolved oxygen of surface and bottom layer of the inland river section of each season was lower than the same period of 2004, while the average dissolved oxygen concentration of the surface layer of coastal sea waters was higher than the same period of 2004. The average dissolved oxygen concentration of the bottom layer of coastal sea waters had some differences, it was similar in the winter, higher in the spring but lower in summer and autumn.

The pH of both river water and sea waters at the Yangtze River estuary of each season was higher than the same season of 2004. It was higher than the same period before the impoundment in both spring and autumn. In the winter, spring, summer and autumn, the average pH of the surface layer of river waters was 8.09, 8.13, 7.99 and 8.05 respectively; while there was small difference of the pH of bottom water in different seasons.

COD level of the estuary in different seasons was evidently higher than the same period of 2004 except spring. Among the four seasons, COD (1.31mg/L) in the spring was lower than 1.52 mg/L level occurred 2001 before the impoundment. COD level at 1.38 mg/L in the autumn was higher than 1.13 mg/L in 2002 when it was before the impoundment. The concentrations of phosphate and TP in all seasons and silicate concentration in the winter and spring were higher than the same period of 2004, but lower than that of years before the impoundment. Nitrate concentration as well as nitrite and total nitrogen in the surface layer were higher than that of 2004 and the average before the impoundment, while ammonia nitrogen level had remarkable drop.

● Silt

In 2007, the average concentration of suspended matter of the estuary was 144.3mg/L in the winter, 45.0 mg/L in spring, 76.6 mg/L in summer and 136.2 mg/L in autumn. The average concentration of suspended matter was evidently higher in the winter and autumn, slightly lower in the spring and significantly lower in the summer compared with the same period of 2004. The

average concentration of suspended matter in the spring was evidently lower than the same period of 2001 and average concentration of suspended matter in the autumn was lower than the same season of 2002 when both were the time before the impoundment.

The loss of ignition of sea waters near the estuary was relatively high and the proportion to total suspended matter was relatively low, which indicated that the suspended matter near the Yangtze River estuary was still dominated by silt. The loss of ignition of the sea waters outside the estuary and east to 123°30'E was relatively low but had high proportion in total suspended matter, indicating that this water area was subject to less impacts of the silt from the Yangtze River.

9.5.3 Biological Environment

● Chlorophyll–a

In 2007, the concentration of chlorophyll-a of the estuary of the four seasons from low to high was 1.50 μg/L in the summer, 1.05μg/L in spring, 0.56μg/L in autumn and 0.42μg/L in winter. The chlorophyll-a level of both inside and outside of the estuary of the Yangtze River was low in the summer. In the spring, the chlorophyll-a concentration of the surface water of estuary and open sea was relatively high, but low in the winter and autumn.

● Zooplankton

In 2007, the biomass of zooplankton of the waters under investigation in winter and spring was 55.3 mg/m^3 and 428.3 mg/m^3 respectively. The peak of biomass of zooplankton in the winter occurred inside the estuary of the Yangtze River, but lower in the deep waters outside the estuary. In the spring, the biomass of zooplankton was relatively low inside the estuary but relatively high outside the estuary and in deep waters.

Sampling of fish zooplankton

The level of fish zooplankton had slight rise in 2007 compared with that of 2004, but much lower than the level before 135m impoundment. A total of 4031 fish eggs and 2432 tails very young fish were caught in four investigations. They belonged to 28 families of 12 orders. Among them, *Perciform fishes* and *Clupeiforms* had the most species with dominating species such as anchovy, *Coilia mystus*, lizardfish, silverside, *Salangidae, Symechogobius hasta* and *Trachidermus*. The species and amount of fish was the least in the winter with only the catch of only 2 young fish and no eggs, but most in the summer with large amount of fish eggs.

● Zoobenthos

In 2007, the species amount of zoobenthos in the waters under investigation was 62 in the winter, 86 in spring, 100 in summer and 124 in autumn with abundance being 71.47/m^2, 143.18/m^2, 157.06/m^2 and 216.47/m^2, respectively and biomass of 3.11g/m^2, 6.96 g/m^2, 4.71g/m^2 and 20.91g/m^2 respectively. Compared with the same period of 2004, the species amount of zoobenthos dropped by 51.2% in the winter and 21.8% in the spring, but went up by 37.0% in the summer and 33.3% in the autumn. The abundance of zoobenthos in the waters under investigation dropped by 81.9% in the winter, 77.0% in spring, 47.8% in summer and 72.3% in autumn.

9.5.4 Fishery Resources

In 2007, both the species and amount of fishery resources of the estuary of the Yangtze River were higher than the same period of 2004 with some improvement of ecosystem biodiversity but still less than that of the year before the impoundment. In the winter, the composition of dominant fish species kept the same with some percent rise of *Coilia mystus* and drop of *Setipinna taty*. In the spring, *Cyanea* still dominated invertebrate species but with declining

influence on fishery resources in the estuary of the Yangtze River. In fish resources, little yellow croaker, *Setipinna taty*, ribbon fish and silvery promfret resumed their dominance position. In the autumn, ribbon fish continued its No.1 dominance in fish species with some rank rise of little yellow croaker.

9.6 Study on Endemic Fish Species

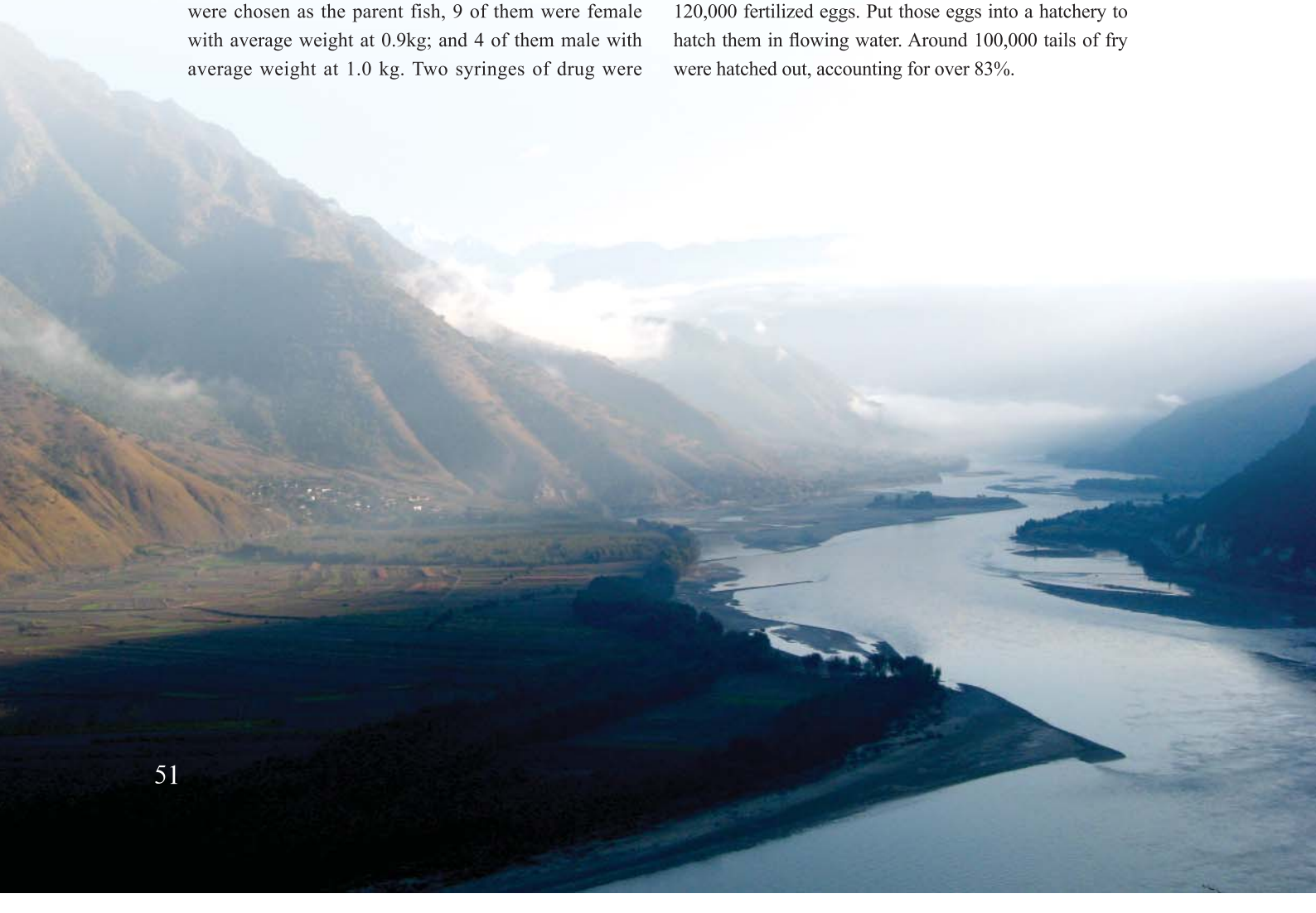
In 2007, the artificial propagation experimental targets of endemic fish species included *procypris rabaudi, Megalobrama pellegrini, Leptobotia elongata* and *Cyprinidae Bangana*. Among them, artificial propagation experiment was successful for *Procypris rabaudi* and *Megalobrama pellegrini* but failed for *Leptobotia elongata*. The accumulated experience and data had reference value to future artificial propogation experiment.

● Experiment of Artificial Propagation of Procypris Rabaudi

13 tails of 6-year-old domesticated *Procypris rabaudi* were chosen as the parent fish, 9 of them were female with average weight at 0.9kg; and 4 of them male with average weight at 1.0 kg. Two syringes of drug were applied on male fish with half dose on female fish to facilitate the reproduction. The water temperature of the experiment was 20℃. The injected fish were placed into tower-crane-shape net cage with flushing. 12 hours later, female fish began spawning with fecundation rate at 66.7%. After that, dry method was employed for artificial insemination. 14 hours later, 6 female fish finished spawning with a total of about 25000 fertilized eggs. adhered these eggs onto screen-egg board and placed them into a hatchery to hatch them in flowing water and over 80% of the eggs successfully hatched out.

● Experiment of Artificial Propagation of *Megalobrama pellegrini*

14 pairs of adult *Megalobrama pellegrini* were selected with average weight of female fish at 0.9 kg and male fish at 0.75 kg. Two syringes of drug were employed to hasten the spawning with half dose for male fish. The water temperature of the experiment was 22℃. The injected parent fish were placed into a 0.5 m2 cement pond and flushed them. At the second day, it was observed that the female fish had naturally spawned a total of about 120,000 fertilized eggs. Put those eggs into a hatchery to hatch them in flowing water. Around 100,000 tails of fry were hatched out, accounting for over 83%.



Host Organization:
Department of Reservoir Management, General Office of the State Council Three Gorges Project Construction Committee

Chief Compiling Organization:
China National Environmental Monitoring Center

Compiling Members:
Hubei Provincial Office for Assisting the Three Gorges Construction
Hubei Provincial Statistics Bureau
Chongqing Municipal Statistics Bureau
Chongqing Municipal Environmental Monitoring Center
Headquarter of Geological Hazardous Prevention and Control of the Three Gorges Reservoir Area, Ministry of Land and Resources
Environmental Protection Center of the Ministry of Communications
Water Conservation Committee of the Yangtze River
Office of the Fishery Resources Management Committee of the Yangtze River
Agriculture Ecological and Environmental Protection Station of Hubei Province
Institute of the Aquatic Resources of the Yangtze River, the Ministry of Agriculture
Chinese Center for Disease Control and Prevention
Ecological and Environmental Monitoring Center of the State Forestry Administration
Institute of Hydrobiology, Chinese Academy of Sciences
Institute of Soil Sciences (Nanjing), Chinese Academy of Sciences
Institute of Oceanology, Chinese Academy of Sciences
Institute of Geodesy and Geophysics, Chinese Academy of Sciences
Institute of Mountain Hazards and Environment, Chinese Academy of Sciences
Institute of Botany, Chinese Academy of Sciences
National Climate Center, China Meteorological Bureau
Institute of Earthquake Science, China Seismological Bureau
Department of Financial Planning, General Office of the State Council Three Gorges Project Construction Committee
China Three Gorges Project Corporation

Technical Guidance Organization:
Ecological and Environmental Monitoring Center of the Three Gorges Project
Information Management Center of the Ecological and Environmental Monitoring System of the Three Gorges Project

Approval Institutions:
Ministry of Environmental Protection of the People's Republic of China
General Office of the State Council Three Gorges Project Construction Committee

Release Organization:
Ministry of Environmental Protection of the People's Republic of China

Translation:
Department of International Cooperation, Ministry of Environmental Protection