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

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Content

Summary

In 2008, all construction projects in the primary design completed except the ship lifting facility project in the principal project of the Three Gorges. It is expected that all the construction projects in the primary design will be finished according to the schedule with further benefits in flood prevention, power generation and navigation. The construction of urban infrastructure in the project administrative region of the Three Gorges water control project enjoyed further improvement with large-scale implementation of such projects as water & soil conservation, afforestation and ecological restoration.

In 2008, the Three Gorges Project areas enjoyed steady rapid social and economic growth with GDP rise by 15% compared with that of 2007 based on the comparable price. The industrial structure of the reservoir areas was on continuous optimization with the growth of the output in each industry. The living standard rose continuously with good public health.

In 2008, the average air temperature of the Three Gorges Reservoir areas was slightly higher than the historical average. However, it experienced the low-temperature snow & freeze weather in winter with the frequency of once in 20 years. The annual precipitation was close to the historical average but with precipitation intensity once in every 50 years during mid & late autumn. There was some increase of earthquake frequency with the rise of impoundment water level. Monitoring and early-warning of earthquake disaster had obtained smooth progress with achievements in the pollution prevention and control for emergency response.

In 2008, the total cultivated area and total forest area of the Three Gorges Reservoir areas went up but with reduction in total sown area and

multiple crop index. Agricultural production was still dominated by grain crops. Both the total application amount and unit-application amount of fertilizers went down with the imbalance of fertilizer application. There was some increase of both the fry run-off of the "four major home fishes" of the Yangtze River and the resources of tapertail anchovy, eel fry and Chinese turtle crabs in the estuary area at different degrees.

In 2008, total discharged amount of industrial effluent in the Three Gorges Reservoir areas reached 558 million t, up by 17.7%. Among them, the amount of COD was 77000 t, up by 2.9%; the amount of ammonia nitrogen was 5700 t, down by 14.9%. The discharged amount of urban & town sewage was 593 million t, up by 24.1%. Among them, the amount of COD was 86,600 t, down by 6.5%; the amount of ammonia nitrogen was 9300 t, same as in 2007. The amount of ship-oil waste water was 412,000 t with treatment rate at 94.8%. The amount of domestic sewage was 4.046 million t.

In 2008, the water of the mainstream of the Three Gorges Reservoir met Grade II~IV national surface water quality standard. The waters of tributaries met Grade II~ IV national surface water quality standard, slightly inferior to that of the last year. Some tributaries still had water bloom. The overall environmental quality of the construction area of the Three Gorges Reservoir and resettlement areas was good.

In 2008, targeting on the existing and anticipated eco environment issues, the authority has taken effective prevention, protection or treatment measures to promote the development of eco environment and trial work on ecological conservation according to the policy of "prevention first, combining prevention with treatment". The Office of the Three Gorges Project Construction Commission of the State Council organized relevant departments and technical institutions to formulate the *Special Program for Trial Work on the Development and Conservation of Eco Environment of*

the Three Gorges Project(2007-2010). On the base of scientific analysis of current situation and existing problems of eco environment of the Three Gorges Reservoir areas, this Special Program describes the necessity and urgency of demonstration work, makes clear the guiding policy, principle and objectives of trial and demonstration work, identifies the main task and implementation measures for trial and demonstration work. These trial and demonstration work would be carried out in water-level-fluctuating zones in the following seven areas such as environment control, emergency response to and long-term prevention and control of water bloom in tributaries, pollution interception and control in rural areas (prevention and control of non-point pollution), pollution interception in cities and towns (prevention and control of point pollution), guarantee the safety of tributary drinking water sources, development of ecological shelter along reservoir bank, and conservation of biodiversity. At the same time, the project on the assessment & improvement of the performance of eco environment monitoring system will be carried out mainly aiming at exploring new path, summarizing experience and studying policies, which will lay a solid foundation for comprehensive development and protection of the eco environment of the Three Gorges Reservoir areas in follow-up activities.

Chapter 1 Progress of the Three Gorges Project

In 2008, all construction projects in the primary design completed except the ship lifting facility project in the principal project of the Three Gorges. It is expected that all the construction projects in the primary design will finish according to the schedule with showcasing of further benefits in flood prevention, power generation and navigation.

In 2008, the targets on the control of main link of the Three Gorges water control project finished according to or ahead of schedule. In February, the concrete pouring of the floor of ship chamber of the ship-lifting facilities was finished. In March, the excavation of the bed of the generating sets in the main body of underground power station was finished, so did the supporting work for the water well and corridor of generating sets. In June, such works as reforming the tentative ship gate into sand-washing gate and energy dissipating structure, the knocking down of the soil and rock cofferdam in the downstream of Phase III construction project and restoration of the pier of surface holes. Up to October 30, all five generating sets in the right-bank power station were put into operation, two months ahead of schedule. In 2008, the engineering work completed in the Three Gorges Project was: digging of 103,400 million m^3 of earth and stones; concrete pouring of 152,900 m^3; 3813.6 tons of metal structure and electronic machine buried and installed, and 20900 tons of generator sets installed. The construction of the project had zero quality accident with all subprojects meeting quality standard and 95.0% with good quality.

In 2008, the water level of the Three Gorges Reservoir was within the planned range with average water level at 145.61 m during flood season. Trial impoundment was carried out after wet season. The comprehensive

benefits of the Three Gorges Reservoir—Gezhou Dam water control project enjoyed further improvement with total generated power at 97.86 billion kW•h, up by 26.8% compared with that of 2007. Navigation water dispatch was conducted during the dry period (December of 2008 to Februay of 2009) with water replenishment of 2.25 billion m^3.

In 2008, the people's government of Yichang, Hubei Province approved the Plan for the Protection & Development of the Administrative Region of the Three Gorges Water Control Project. The construction of urban infrastructure in the project administrative region of the Three Gorges water control project enjoyed further improvement with large-scale implementation of such projects as water & soil conservation, afforestation and ecological restoration.

Chapter 2 Economic and Social Development

2.1 Population, Society and Economy

In 2008, the total registered population of the Three Gorges Project area was 20.6802 million, up by 0.6% than that of 2007. Among them, 13.8567 million lived in rural areas, down by 0.5% compared with that of 2007. 6.8235 million lived in cities and towns, up by 3.0%. Urban population accounted for 33.0% of the total, up by 0.8 percentage point than in 2007.

In 2008, local GDP of the Three Gorges Project area was 382.134 billion yuan, up by 15.0% compared with that of 2007 based on comparable price. Among them, 360.598 billion yuan came from Chongqing region, up by 14.8%; 21.536 billion yuan came from the reservoir area of Hubei Province, up by 18.9%. The increased value of the primary, secondary and tertiary industries in the Three Gorges Project area was 35.063 billion yuan, 185.728 billion yuan and 161.343 billion yuan, up by 8.1%, 18.8% and 13.5% respectively compared with that of 2007. Among them, the increased value of industry reached 158.335 billion yuan, up by 21.6%. The ratio of increased value of the primary, secondary and tertiary industries was 9.2:48.6:42.2. Based on the amount of permanent residents, GDP per capita of the Three Gorges Project area in 2008 was 20063 yuan, up by 24.6% compared with that of 2007.

Table 2-1 Major Statistical Indicators of Economic and Social Development of the Reservoir Area in 2008

Indicator	Indicator value (billion)	Increase over 2007 (%)
Local GDP	382.134	15.0
Primary industry	35.063	8.1
Secondary industry	185.728	18.8

# Industry	158.335	21.6
Tertiary industry	161.343	13.5
Fixed assets investment of the whole society	304.119	24.5
Total retail value of social consumer goods	162.958	25.3
Local financial revenue	27.476	36.3
Local financial expenditure	57.750	32.4
Savings of urban and rural residents	303.565	25.5

In 2008, the total grain output was 6.3923 million t, up by 5.2% compared with that of 2007; total oil plant output was 213,100 t, up by 11.5%; total meat output was 1.0268 million t, up by 9.1%; the total wholesale amount of consumer goods was 162.958 billion yuan, up by 25.3%; the social investment in fixed assets of the Three Gorges Project area was 304.119 billion yuan, up by 24.5%; Local financial revenue was 27.476 billion yuan, up by 36.3%. Local financial expenditure was 57.750 billion yuan, up by 32.4%.

In 2008, per capita urban disposable income was 14,306 yuan, up by 14.3% than in 2007. Per capita net income of rural farmers reached 4132 yuan, up by 18.1%. Per capita savings was 14726 yuan, up by 2892 yuan compared with that of 2007.

Up to the end of 2008, the collection of books in public libraries reached 8.5232 million, up by 9.6%. Every 10,000 middle school and primary school student had 546 full-time teachers, up by 11 people than in 2007. TV coverage reached 97.33%, up by 0.30 percentage point compared with that of the last year.

2.2 Migration Settlement

In 2008, a total of 59,442 people had resettled (including past year resettlement task). The resettlement of the residents living under 175 m impoundment level and clear up of reservoir bed had been finished. Up to

the end of 2008, a total of 1.2565 million people had finished resettlement, 1.205 million of them would be provided with houses specified in the plan. A total of 49.23 million m^2 various kinds of buildings had been constructed. Among them, 42.60 million m^2 were the floorage that should compensate to migrant people. A total of 1629 factories and mining companies had been shut down or resettled. The key building project for the resettled residents under the 175 m impoundment level enjoyed good progress. The water control projects and special project compensating resettled residents had finished construction one after another with the quality of 16,500 projects meeting relevant standard. The principal body of 4 key relic projects such as Baiheliang had basically been finished and passed national chaeck & acceptance of the stage IV resettlement project. The resettlement progress of migrant farmers in the Three Gorges Project areas met the schedule, which provided a good condition for trial impoundment after wet season.

- **Countryside**

A total of 26,484 rural residents had been resettled. 27,947 farmers had been resettled with job opportunities. A total of 1205 water pools with capacity of 25,900 m^3 and two canals with total length of 1680 m had been built for resettled migrants. 70 rural roads with total length of 203.62 km were built in 2008; 12 of them (55.95 km) were the road surrounding the reservoir. A total of 793,100 m^2 houses were constructed in rural areas, 776,300 m^2 of them were for migrants and 16,800 m^2 of them were other kind of house. 722,100 m^2 of buildings were built to compensate the migrants, 707,200 m^2 of them were houses.

- **Cities & Towns**

A total of 32,958 people living in cities and towns had been resettled,

and a total of 40,000 m^2 of urban land finished greening work. 1.154 million m^2 of houses finished construction in cities and towns, 586,900 m^2 of house were constructed in cities, 567,100 m^2 of them were houses in towns; and 865,700 m^2 were compensated houses.

● **Special Facilities**

The reconstruction of special facilities had finished the construction of two big and medium sized bridges with length of 758.31 m, 3 wharfs, 1 port, 1 water pumping stations, and 3 hydropower stations. A total of 23 places of cultural relics in the Three Gorges Reservoir area finished excavation and conservation work, 12 of them on the ground and 11 underground. The total exploration and excavation area reached 20,000 m^2.

● **Assistance from Other Provinces & Municipalities**

In 2008, the assistance from other provinces & municipalities had introduced a total of 11.224 billion yuan. Among them, 339 million yuan were for various public welfare projects (332 million yuan assistance and 7 million for the Hope Project), 10.885 billion yuan for economic development projects. A total of 23,003 person•time of migrant labor, 2637 person•time of training and 119 person•time of official exchange had been arranged, showcasing stronger efforts in assisting the Three Gorges Reservoir area.

Up to the end of 2008, the accumulated assistant fund from other provinces & municipalities reached 53.349 billion yuan. Among them, 3.205 billion yuan were for various public welfare projects (including 2.996 billion yuan assistance and 209 million for the Hope Project); 50.144 billion yuan for 2926 economic development projects. The assistant projects had resettled 26692 people and arranged 80,102 person•time of migrant labor, 36751 person•time of training and 691 person•time of official exchange.

Chapter 3 State of the Natural Ecological Environment

3.1 Climate

In 2008, the average air temperature of the Three Gorges Reserboir area was slightly higher than the historical average with annual precipitation similar to the historical average. To be specific, the temperature in winter was lower than that of normal years with the occurrance of snow & freezing weather once in every 20 years. In the spring, the air temperature rose rapidly and was higher than the historical average with the temperature in local area reaching the historical high. The temperature in summer was not as high as the historical average with frequent storms. The temperature in early autumn was abnormally higher than the historical average. The mid and late autumn experienced strong precipitation and rainy days with the average precipitation intensity at once in every 50 years. The annual average wind speed, relative humidity and evaporation were basically the same as the historical average or slightly less. There was a clear reduction of foggy days in the year. On the whole, acid rain was lighter than that of the last year. There were meteorological disasters such as snow & freezing weather in winter, strong storms in the spring and summer, floods in summer, continuous rainy days in autumn as well as thunder, lightning and heavy fogs. There was slight drought.

Table 3-1 Monitoring results of meteorological elements of each region in the Three Gorges Reserboir areas in 2008

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	18.5	962.7	1154.0	82	1.3	703.8	17	23
Changshou	17.9	1019.8	898.2	74	1.1	1188.4	43	25
Fuling	18.2	1126.9	1213.7	78	0.7	1164.3	50	37
Fengdu	18.4	1002.7	1028.4	80	1.2	1504.3	36	40
Zhongxian	17.8	1219.7	1167.6	79	1.1	1127.4	60	36

Wanzhou	18.4	1018.3	1346.1	82	0.8	1221.4	11	31
Yunyang	18.2	1125.7	1317.5	74	1.1	1340.9	11	33
Fengjie	18.2	1102.7	1347.6	77	1.5	1488.8	13	30
Wushan	18.6	1223.5	1325.2	67	0.4	1485.1	6	28
Badong	17.3	1242.3	1566.5	73	1.7	1315.6	56	40
Zigui	16.4	1164.0	1120.6	81	1.1	1453.8	3	41
Bahekou	16.8	1372.7	1259.2	74	1.5	1085.8	4	29
Yichang	17.3	1344.1	1405.4	71	1.3	1156.9	15	46

The average precipitation of the reservoir areas was 1129.4mm, similar to the historical average. There was a big difference in spatial distribution of precipitation showing more precipitation in the eastern part but less in the western region. The maximum precipitation occurred in Bahekou at 1372.7 mm and minimum in Chongqing at 962.7 mm. Compared with the historical average, Wushan, Badong, Zigui and Yichang had 15.8% ~ 18.1% more precipitation with Yichang having the biggest increase. Wanzhou, Changshou and Chongqing had 12.8% ~ 17.2% less with Wanzhou having the biggest reduction. Other regions basically had similar amount of precipitation. Precipitation time distribution showed 564.2 mm in the summer, up by15.8% than the historical average; 51.2 mm in winter (December of 2007 ~ February of 2008), 268.2 mm in the spring and 244.9 mm in autumn, down by 9.9%, 10.5% and 12.2% respectively than that of the normal years. The precipitation of March, August and October went up by 36.1%~88.0% compared with the same month of normal years. However, the precipitation of May, June, September and December went down by 24.5%~51.0% than that of the same month of normal years. The precipitation of other months was the same as the historical average.

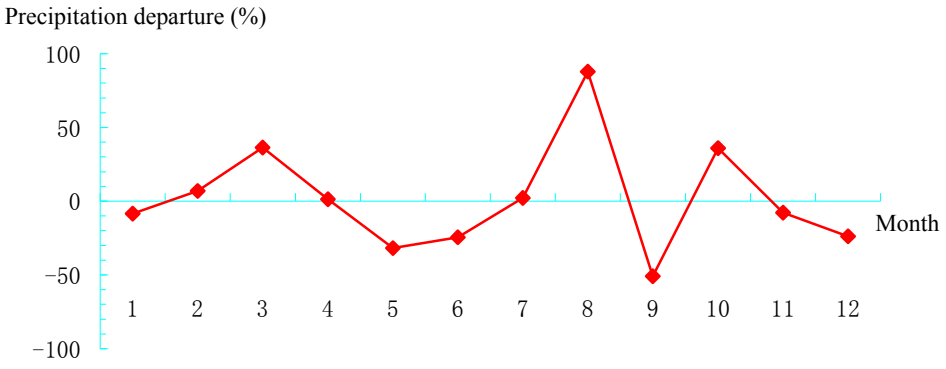


Figure 3-1 Change of the departure percent of monthly average precipitation of the Three Gorges Reservoir area in 2008

The average air temperature of the Three Gorges Reservoir areas was 17.9℃ with 0.2℃ higher than the historical average. The air temperature of each weather station was higher or similar to the historical average. In spatial distribution, the average air temperature of the western part was higher than the historical average with the biggest rise of 0.5℃ in Changshou. The air temperature in central part was lower than that of normal years with the biggest drop of 0.7℃ in Yunyang. The average air temperature of the eastern part was higher or similar to the historical average with 0.4℃ rise in Fengjie, Wushan and Yichang, There is the and similar value in Badong and Zigui to the historical average air temperature. Temperature time distribution showed that the air temperature of the reservoir areas was higher than the historical average in spring and autumn but lower in winter and summer. Among them, the average temperature of the winter reached 7.3℃, 0.6℃ lower than the same season of normal years; the average temperature of the spring was 18.8℃, 1.2℃ higher than the same season of normal years; the average temperature of the summer reached 26.7℃, down by 0.4℃; the average temperature of the autumn reached 19.1℃, up by 0.7℃. The average temperature was the lowest in January at 5.1℃ and highest in July at 28.1℃. The air temperature went

down by 1.7℃ in January, 1.3℃ in February and 1.9℃ in August compared with the same month of normal years. The average air temperature of March, May and September was more than 1.0℃ higher than the historical average, while the average air temperature of the other months was higher or similar to the historical average.

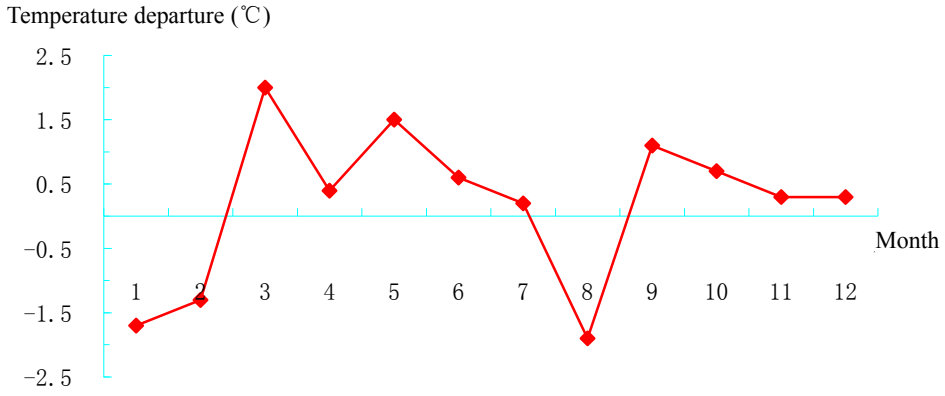


Figure 3-2 Change of the departure of monthly average temperature of the Three Gorges Reservoir area in 2008

The wind of the reservoir areas was mild with average speed of 1.1m/s, down by 0.2m/s compared with that of normal years. The maximum monthly average wind speed was 1.3m/s in January and minimum at 0.9m/s in October. Among all monitoring stations, the annual average wind speed was 0.5m/s in Wushan, 0.7m/s in Fuling, 0.8m/s in Wanzhou, and over 1.0m/s in other stations with the highest at 1.7m/s in Fengjie.

The average foggy days in the reservoir areas was 27, down by 11 days compared with that of the normal years. It was the 7 consecutive year of less foggy days since 2002, consistant with the change trend of foggy days in the entire Southwest China. The spatial distribution of foggy days showed that western part of the Three Gorges Reservoir areas had clearly more foggy days than that of the eastern part with the most in Zhongxian at 60 days and the least in Wushan & Zigui at 6 days. Compared with that of last year, there was big local change but small overall change of foggy days with increase in the east but decrease in the west. In central part, there were

3～5 more foggy days in some stations but 7~42 less foggy days in other monitoring stations with the biggest drop in Wanzhou at 41.6 days. There were 8.3 foggy days in the winter, 7.2 foggy days in the spring, 5.8 foggy days in autumn, and 5.4 foggy days in the summer. The amount of foggy days in the winter, summer and autumn was less than the historical average, while it was similar in the spring.

The average relative humidity of the reservoir areas was 76%, 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 maximum relative humidity was 81% in the spring and 75% to 76% in the summer, autumn and winter. The annual average of relative humidity of the reservoir areas had no big change compared with that of last year with slight rise in the spring and autumn. The relative humidity had slight drop in the western part with 8% reduction in Changshou but some rise in eastern part with 10% increase in Zigui.

The average evaporation of the reservoir area was 1220.8 mm, slightly less than that of normal years with more in the east but less in the west. Among them, the annual evaporation was less than 1200 mm in all areas west to Wanzhou except Fuling at 1213.7 mm. The annual evaporation was 1300~1500 mm in all areas east to Wanzhou including Wanzhou. There was big seasonal change of evaporation with 455 mm (the highest) in the summer, 344 mm in the spring, 228 mm in autumn and 123 mm in winter. The evaporation in the winter went up compared with that of the same season of 2007, while it was slightly less in the spring, summer and autumn.

The annual average pH value of the precipitation of the 6 monitoring

stations of the reservoir areas was 4.85, falling into the range of acid rain, but less acidity than that of the last year. Winter was the season with the heaviest acid rain and summer the slightest in the year. Among them, Yichang was the area with relatively heavy acid rain. Chongqing, Fuling, Wanzhou, Fengjie and Badong were the areas with ordinary acid rain. Compared with the last year, the acidity of acid rain in Wanzhou, Fengjie and Badong had some reduction, while it went up a little in Chongqing, Fuling, and Yichang.

In 2008, there were frequent meteorological disasters in the Three Gorges reservoir area and neighbouring areas. The major events include the snow and freeze attack in the winter, frequent storms in the summer and continuous rainy days in the autumn as well as other meteorological disasters like gale, hail, thunder and heavy fog.

Low-temperature Rain, Snow and Freeze: About 20 provinces (autonomous regions and municipalities) were subject to low-temperature rain, snow and freeze attack in the winter of 2008. The long and continuous low-temperature weather with the frequency of once in every 20 years occurred in the Three Gorges Reservoir areas beginning from January 11 with dramastic temperature drop, large scale of rain, snow and freeze and adverse impacts. The Three Gorges Reservoir area and its surrounding areas were subject to the disaster at different degree. A total of 32 districts (counties) of Chongqing suffered from the disaster with 9.041 million people affected, 2 deaths, 2.268 million people having difficulty in access to drinking water, 297,000 ha cropland affected, 75,000 livestock dead, about 20,000 houses damaged or destructed with 1.746 billion yuan direct economic loss. The economic loss in agriculture reached 593 million yuan. In Hubei Province, a total of 22.798 million people were affected with 13 deaths, 23,000 infected with diseases, 217,000 people evacuated from

damaged houses, 3.202 million people having difficulty in access to drinking water, 263,000 people strandede in railway and highways, 1.629 ha cropland affected (including 216,000 ha with no yield), 61,000 houses collapse and 169,000 houses damaged. The direct economic loss reached 11.4 billion yuan, 8.18 billion yuan of them were the loss in agriculture.

Storms and Floods and Geological Disasters Triggered by Floods: During the summer of 2008, there were frequent strong precipitation in the reservoir and its neighboring areas with huge rainfall, leading to serious storm and flood disasters. They were mainly concentrated during April 7~8, April 18~20, May 26~30, July 1~5, July 17~18, July 20~23, August 14～16, August 28~30 and September 18～22 leading to collapse or flood of rural houses, destruction of cropland, heavy loss of livestock and fowl farms and damage of urban and rural roads. The secondary disasters like collapse and floods as well as geological disasters like landslide triggered by storms seriously threatened life and production. About 34 districts (counties) in Chongqing Municipality suffered from the secondary geological disasters like collapse, landslide and rock & mud flow with 11,300 people affected, 1180 people evacuated in emergency response, 10 deaths, 19 wounded, 2470 houses damaged, 1456 houses collapsed, 5850 ha cropland affected (880 ha of them having no yield). The direct economic loss reached 51.92 million yuan, 12.05 million yuan of them were the loss in Agriculture.

Continuous Rainy Days in Autumn: Most areas of South China suffered from continuous precipitation during mid October ~ early November of 2008 with the highest intensity since 1951, long-lasting time and wide affected areas. Among them, the precipitation of the southeastern part of Southwest China was 100~200 mm. Chongqing Municipality was under continuous overcast and rainy days with average precipitation at

109.7 mm, the frequency of once in every 50 years, more than twice of the historical average, reaching the historical high. Hubei Province experienced the strong precipitation once in every 20 years. The continuous overcast & rainy days imposed adverse impacts on agriculture, water resource control, transportation, tourism, routine life and public health. During overcast days, less or no sunlight was not good for crop growth and later sprout of winter wheat. In rain days, slippery road and low visibility resulting from morning fog lead to frequent scratch and slight collision of vehicles. In addition, there was big increase of in-house patients due to cold, most of them are children and the old. The inconvenience in traveling affected the tourism industry.

Gale and Hail： In 2008, 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 serious damage. The gale and hail weather mainly focused on April 7~8, May 2~3, May 11~12, May 17~18, May 25~27, July 10~11, July 14~16, July 26~29, July 31~August 2, and August 10. Chengguan of Dangyang, Yichnag City recorded the gale at 28.3 m/s (Grade X) on April 8, the highest value in the history (the former highest value is 24.2 m/s). Wuxi and Wushan in Chongqing and Xiangyang, Zaoyang, Yicheng, Xiangcheng, Fancheng, Jiangshan, Zhongxiang, Shayang, Xiantao and Changyang in Hubei Province were subject to gale and hail attack during May 11~12 with 45,000 people affected and 22.536 million yuan direct economic loss in Chongqing; 905,000 people affected, 139 people evacuated, 85,000 ha cropland affected (31,000 ha having no yields), 116 houses collapsed, 11,091 houses damaged and direct economic loss at 530 million yuan.

Thunder Strike： There were several local thunder strikes in the reservoir area and its neighboring areas during the spring and summer of

2008, leading to death and injury but less overall loss compared with that of last year. Among them, there was one death in Group 11 of Xiaoyan Village, Tiancheng Town, Wanzhou District, one death in Group 6 of Hongxing Village, Gaofeng Town, Dianjiang County, Group 8 of Quanli Village of Guoliang Town, Dazu County, one death in Renhe Town of Yunyang County, one death in Wanzu Town of Pengshui County in Chongqing Municipality due to tunder attack. There were 10 deaths in Hubei Province due to thunder strikes.

Dense Fog： There were relatively early dense fogs in autumn in the reservoir areas, affecting the traffic of highways, railway, flight and navigation at different degrees. The first dense fog in Hubei Province in autumn occurred in the early morning of October 5. Areas including Yichang City were covered by the fog and the Hnakou—Yichnag Expressway was closed for 3 hours due to the fog. On November 3, three expressways (Chongqing—Yichang, Chongqing—Suiyang and Chongqing—Wuhai) in Chongqing Municipality were tentatively closed due to dense fog with traffic jam in some sections of the expressway. Six busy navigation courses were shut one after another. Chongqing Marine Affairs Bureau issued Grade III yellow warning for dense fog. On December 15, a dense fog attacked 24 counties and cities in Hubei Province, 8 counties and cities had dense fog with visibility less than 100 m. Because of less than 100 management visibility in Tianhe Airport, 30 flights were delayed causing over 1000 passengers detained in the airport. A number of airplanes had to land on other airports near Wuhan. Nine expressways in the province had to be closed for several hours.

3.2 Terrestrial Plants

The forest coverage of the Three Gorges Reservoir area was 37% with

more forests in the eastern part than that of the western part. Among all urban districts and counties, Xingshan County had 72.1% coverage ranking No.1, Yiling District, Zigui County and Badong County had 52.9%, 52.5% and 52.3% respectively, ranking No.2, 3 and 4. Wuxi County had the largest forest area at 273,200 ha; while Yiling District had 246,800 ha and Badong County 232,200 ha, ranking No.2 and No.3 respectively.

Table 3-2 Forest area and coverage of the Three Gorges Reservoir areas

Region	Forest area (10,000 ha)	Forest coverage (%)	Region	Forest area (10,000 ha)	Forest coverage (%)
Xingshan County	17.48	72.10	Fengdu County	12.26	30.53
Yiling District	24.68	52.90	Yunyang County	12.86	30.48
Zigui County	16.58	52.50	Wushan County	17.69	29.25
Badong County	23.22	52.30	Wanzhou District	10.58	24.67
Wuxi County	27.32	39.76	Jiangjin City	9.98	24.21
Shizhu County	17.65	39.68	Zhongxian County	4.93	21.56
Fuling District	11.14	32.37	Kaixian County	13.34	19.72
Wulong County	17.25	30.66	Chongqing City	11.02	18.43
Fengjie County	20.65	30.62	Changshou	2.35	15.01

3.3 Terrestrial Animals

In 2008, the findings of the investigation on winter water birds in the Three Gorges Reservoir area showed obvious change of the distribution of overwinter water birds compared with that of last year. This is reflected by more water birds (duck family) in waters of the mainstream of the Yangtze River upstream of the tailwater point and less in the downstream waters.

The investigation in tributaries found 31 mandarin ducks in the Daning River (Wushan—Wuxi), 23 of them were in rivers upstream the dam. The population of common coot (*Fulica atra*) (having habitat in waters with prosperous aquatic plants like *Ceratophyllum demersum*, duckweed and *Azolla imbricate (Roxb.) Nakai* and hard to see before the 156m impoundment period) in Xiaojiang River (Yunyang—Kaixian County) was 3.6 times of the same period of last year. There was evident

rise of the population of cormorant exceeded 2500, which was good at catching fish in deep waters.

The large-scale snow in the winter did not cause obvious impacts on the population of most animal species in the Three Gorges Reservoir areas. However, there was evident reduction of the population of *Chrysolophus pictus* (golden pheasant). And there was death only occurred in hoofed animal—muntjac. The investigation found 35.11% reduction of male golden pheasant population. For the entire Three Gorges Reservoir areas, it is expected that it will take 4-5 years to resume golden pheasant population to the orginal level (calculated with annual growth at 25% ~ 30%). The restoration of the golden pheasant population may take 2-3 years in regions with relatively good habitat conditions (deciduous broad-leaf + coniferous and broad-leaf forests, e.g. Longmen River in Xingshan and Wulipo in Wushan), 4-6 years in regions with intermediate living conditions (deciduous and evergreen broad-leaf mixed forests, e.g. Dazhiping in Badong County and Shennufeng in Wushan) and 10-12 years in regions with poorest living conditions (Japan deciduous pine forest, e.g. Liziping in Wushan) if there is no immigration from surrounding habitats.

3.4 Fishery Resources and Environment

3.4.1 Fishery Resources

In 2008, the total catch of natural fish in the Three Gorges reservoir, downstream section of the Three Gorges dam, the Dongting Lake, Poyang Lake and estuary area was 58300 t, up by 3.4% compared with that of the last year. The fry run-off of the four major native fishes at Jianli monitoring section downstream the Dam went up compared with that of the last year, and the fry fishing season was clear. The population of tapertail anchovy (*Coilia mystus*), Chinese turtle crab (parent crab) and eel fry in the estuary

area went up at different degree.

● **Reservoir Area**

In 2008, the total catch of natural fish in the reservoir area was 2669 t，up by 10.7% compared with that of the last year. The composition of the catch was 614 t of bronze gudgeon (*Coreius heterodon*), 414 t of catfish, 232 t of silver carp, 110 t of yellow catfish (*Pelteobagus fulvidraco*), 106 t of grass carp, 60 t of largemouth bronze gudgeon (*Coreius guichenoti*) and 560 t of common carp.

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 2008, the total catch of natural fish in the downstream section of the Three Gorges Dam reached 1317 t, down by 6.1% compared with that of the last year. Based on the composition of the catch, it was estimated that there was 390 t of catfish, 358 t of carp, 184 t of bronze gudgeon, 64 t of yellow catfish, and 97 t of the “four major home fish species”.

Among the catch, bronze gudgeon, catfish, carp and yellow catfish accounted for 83.0% of the total and were main commercial fishes in downstream section of the Three Gorges Dam.

● **Spawning Site of the “Four Major Home Fishes”**

During May ~ July of 2008, the fry run-off of the “four major home fishes” at Sanzhou monitoring section in Jianli County downstream the Dam was obvious at 181.5 million, up by 103.9% compared with that of last year, only 7.2% of the average amount before the impoundment (1997～2002).

The “four major home fishes” was still dominated by silver carp,

taking up 53.6%; followed by grass carp，taking up 45.7%; black carp ranked the third, taking up 0.6% and variegated carp taking up 0.1%.

● **Dongting Lake**

In 2008, the total catch of natural fish in the Dongting Lake was 20800 t, down by 2.8% compared with that of last year. Among them, the catch was 10600 t in the east Dongting Lake, 5900 t in south Dongting Lake and 4300 t in west Dongting Lake, accounting for 50.9%, 28.4% and 20.7% respectively of the total catch.

The catch was dominated by local fish species like carp, crucian carp, catfish, bream and the “four major home fishes”. They took up 75.0% of the total catch.

● **Poyang Lake**

In 2008，the total catch of natural fish in the Poyang Lake was 33300t, up by 7.4% compared with that of 2007.

The dominating species were local fishes like carp, crucian carp, yellow catfish, mandarin fish, catfish and the “four major home fishes”. They took up 86.1% of the total catch and were main economic fish species of the lake.

● **Estuary Area**

In 2008, the amount of issued tapertail anchovy catch license for the operation in this area was similar to that of 2007. However, the amount of issued catch license for eel fry went down by 12.8%, but that for parent crab went up by 172.7%. The catch season for tapertail anchovy began on May 3 and ended on June 19 with total catch per ship at 228 t, up by 0.9% compared with the same period of last year. The catch season for parent crabs began on November 15 and ended on December 22 with total catch per ship at 10950 kg, up by 168.2%. The catch time for eel fry in estuary area began on January 3 and ended on April 16 with total catch per ship at

4061.4 t, up by 32.2% compared with that of 2007.

3.4.2 Fishery Environment

In 2008, the water quality of important fishery waters including the mainstream of the Yangtze River, Dongting Lake, and Poyang Lake was monitored. The assessment of water quality complies with Fishery Water Quality Standard (GB11607-89). The unmentioned items would be assessed according to corresponding water function class specified in the Water 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 2008, basically meet the requirement for fish growth and spawning. However, some waters were under certain degree pollution with major pollutants being copper and total nitrogen (TN).

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 national Fishery Water Quality Standard. The petroleum concentration of 66.7% water samples failed to meet national water quality standard during fish spawning period. In Wanzhou fishery waters, all monitoring data met national water quality standard.

The overall 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 ammonia nitrogen of 100% sample and lead concentration of 16.7% water samples exceeded national water quality standard during fish growth. 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. In Hukou waters, the copper concentration of 100% samples failed

to meet water quality standard during fish growth period and winter; lead concentration of 66.7% samples failed to meet water quality standard during fish growth and reproduction periods. Total phosphorus (TP) and ammonia concentration of 100% samples failed to meet water quality standard during fish growth period.

At the Chinese sturgeon (*Acipenser sinensis*) spawning site in Yichang, the TN concentration of 100% sample and lead concentration of 9.1% samples failed to meet surface water quality standard during the reproduction period of Chinese sturgeon. In the spawning sites of the "four major home fishes", Zhicheng, Jingzhou and Jianli monitoring section, all monitoring data met national water quality standard during the reproduction period of the "four major home fishes".

TN concentration of fishing waters of 77.8%, 44.4% and 100% samples of the Dongting Lake exceeded water quality standard in the reproduction period, fish growth period and overwinter period respectively. The permanganate value of 11.1% samples during the overwinter period and 22.2% sample during fish growth period failed to meet water quality standard. Arsenic concentration of 11.1% samples and copper concentration of 22.2% samples failed to meet water quality standard during fish reproduction period. The zinc concentration of 33.3% water samples failed to meet water quality standard during fish growth period.

In Poyang Lake, the copper concentration of 66.7% samples in overwinter period, 66.7% samples in fish reproduction period and 100% samples in fish growth period of the Lianzi Lake water (the central part of Poyang Lake) failed to meet national water quality standard. TN concentration of 100% samples during fish reproduction and growth period went beyond national water quality standard. The non-ion ammonia concentration of 100% samples during fish reproduction period and 33.3% sample during fish growth period went beyond national water quality

standard. Lead concentration of 100% samples during fish reproduction period and TP concentration of 100% samples during fish reproduction & growth periods failed to meet national water quality standard. In Duchang waters south of the Poyang Lake, ammonia nitrogen concentration of 33.3% samples during winter and copper concentration of 66.7% samples during fish reproduction period and 100% samples during fish growth period failed to meet national water quality standard. Lead concentration of 66.7% sample in fish reproduction period, TN concentration of 100% samples during fish reproduction & growth periods and TP concentration of 100% samples during winter and fish growth period went beyond national water quality standard. In Ruihong waters of Poyang Lake, the off-standard rate of copper was 33.3% during fish reproduction period and 100% during fish growth period. The off-standard rate of TP was 33.3% during winter and 100% during fish reproduction & growth period. The off-standard rate of TN was 100% during fish reproduction period and 66.7% during growth period. The off-standard rate of lead was 66.7% and off-standard rate of Cr^{+6} was 33.3% during fish reproduction period. The off-standard rate of non-ion ammonia was 66.7% during fish growth period.

In the fishing waters of the Yangtze River estuary, the off-standard rate of petroleum was 8.3% for eel fry catch period and 33.3% for tapertail anchovy catch period. The off-standard rate of TN was 100.0% during the catch seasons of eel fry, tapertail anchovy and parent crabs.

3.5 Peculiar Fish Species and Rare Aquatic Animals

3.5.1 Peculiar fish Species in the Upper Reaches of the Yangtze River

In 2008, a total of 118 fish species were collected in fish resource monitoring activities conducted in Panzhihua and Yibin section downstream of the Jinsha River; Hejiang, Mudong and Wanzhou section in the upper reaches of the Yangtze River and Yichang section in the mid

reach of the Yangtze River. Among them, there were 25 peculiar fish species in the upper reaches of the Yangtze River, same as that of last year. The amount of sampled species was 78 at Hejiang section, 65 at Wanzhou section, 53 at Mudong section, 46 at Panzhihua section, 44 at Yichnag section and 41 at Yibin section. The percent of peculiar fish species was 26.8% at Yibin section, 23.1% at Hejiang section, 21.7% at Panzhihua section, 17.0% at Mudong section, 11.4% at Yichnag section and 10.8% at Wanzhou section.

Among the catch, the weight of peculiar fish species took up 22.0% of the total weight, 11.2% of total amount, accounting for 70.9% and 48.4% of that of the last year. After the impoundment, it was found that Wanzhou waters became still water, no longer suitable for peculiar species. As a result, they migrated to the upper sections of the river. According to the investigation findings of 1997—2008, the population of peculiar fish species in the Yangtze River was under gradual decline. This is mainly reflected by obvious reductions in its percent in total catch, relative dominance and daily average catch per ship compared with that of pre-impoundment period. The main reason is the obvious reduction of the sprawning site and habitats of these peculiar fish species, causing smaller room for survival. In addition, excessive development of fish resources is another reason for the drop of resources of peculiar fish species.

3.5.2 Rare Fish Species

Based on the analysis of fish detector data, Chinese sturgeon was mainly appeared in such river sections as Gezhouba—Miaozui section, Yiling Bridge section and Yinshou Dam in 2008. Based on the ratio of water volume of waters of different river section to the detected water body volume, it was estimated that there were about 216 tails of Chinese sturgeon before spawning and 119 tails after spawning, which was 106.4%

and 116.7% of that of the last year.

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, there was only one sprawning during the year, the spawning site of Chinese sturgeon was located in the Gezhouba──Miaozui section. The spawning location was at the section from Yichang Ship Yard to Sanxia Pharmaceutical Manufacturer, and no Chinese sturgeon was found spawning at river sections downstream Miaozui. Chinese sturgeons laid their eggs from the afternoon of November 26 to early morning of November 27 with water temperature at 18.2℃, slight rise in water flow speed but no change in river flow and water level. It was observed that egg-hunting fish species ate the eggs of Chinese sturgeon lasting from November 27 to December 3.

In 2008, there was accidental catch of one tail of yong Chinese sturgeon, 10 tails of adult Chinese sturgeons and 3 tails of Chinese sucker (*Myxocyprinus asiaticus*) in Yichang section. Six tails of less-than-one-year old *Myxocyprinus asiaticus* were accidentally caught at Wanzhou river section. The analysis of the information about accidental catch during 1997 ~ 2008 found a stable population of *Myxocyprinus asiaticus* in the Yangtze River. There was certain amount of Chinese sturgeon with declining population. There was few record of accidental caught of *Psephuyrus gladius* and *Acipenser dabryanus*, indicating very small population of the two precious fish species.

The monitoring in the downstream of the Yangtze River did not find any Chinese river dolphin. There was still certain scale population of *Neophocaena phocaenoides asiaeorientalis Pilleri and Gihr* with the trend of fragmented distribution. The population of *Neophocaena phocaenoides asiaeorientalis Pilleri and Gihr* in the Dongting Lake remained at about 200. Leishi and Lujiao were still the places with most frequent activities of

Neophocaena phocaenoides asiaeorientalis Pilleri and Gihr. This species was observed 10 times at the Xinluo Chinese river dolphin national reserves in the Yangtze River section in Hubei Province. A total of 11 *Neophocaena phocaenoides asiaeorientalis Pilleri and Gihr* were observed in the Poyang Lake. There were some activities of such fish species in Hukou area.

3.6 Agricultural Ecology

3.6.1 Ecological Environment of Agricultural Fields

In 2008, the total of arable land area and crop sown area of the Three Gorges Reservoir area went up. The orchard area and tea garden area increased while the area of other cash crop declined. The total sown area went down with reduction of multiple crop index. Agricultural production was still dominated by grain crops but with smaller percent compared with that of the last year.

In 2008, total arable land of the Three Gorges Reservoir area was 195,588 ha, 0.050 ha per person, up by 2916 (1.5%) ha and 0.002 ha (4.2%) respectively compared with that of 2007. Among the arable land, the area of paddy field was 86617 ha and that of dry land was 108971 ha, accounting for 44.3% and 55.7% respectively. The proportion of paddy field went up by 1.4 percentage points compared with that of the last year. Paddy field was dominated by double cropping, taking up 56.1%, one cropping by 33.5% and triple cropping by 10.4%. Whereas 58.6% of dry land practiced triple cropping, 33.7% practiced double cropping and 7.7 one cropping.

In 2008, the multiple crop index of arable land in the Three Gorges Reservoir area was 239.02%, down by 36.84 percentage points compared with that of the last year. Total sown area was 467495 ha, down by 11.1%.

Among them, 351396 ha were sown area for grain crops, 126421 ha were sown area for cash crops. The proportion of grain crops went down compared with that of the last year.

In the Three Gorges Reservoir area in 2008, A total of 24021.64 ha of cropland were resumed to forest or grassland, and 8800.20 ha of slope were transformed into terraced fields, both going down compared with that of last year. In the arable land mix, the percent of arable land with less than 10^{o} and ranging from 10^{o} to 15^{o} was 21.9% and 30.1% respectively, up by 0.2 and 0.3 percentage point. The percent of arable land with slope of $15\sim 25^{o}$ and more than 25^{o} was 31.6% and 16.4%, down by 0.2 and 1.3 percentage points respectively compared with that of last year.

3.6.2 Rural Energy

In 2008, energy mix in rural areas of the Three Gorges Reservoir area was dominated by firewood and straw. The annual output of was 6.658 million t for firewood, 2.8278 million t for straw, 291.9822 million kW for hydropower (from small hydro stations) and 10.019 million t for coal, up by 1.2%, 2.4%, 5.7% and 17.5% respectively compared with that of the last year. The output of biogas was 70.3570 million m^3, down by 4.5%.

In 2008, the biogas enjoyed good development in the Three Gorges Reservoir area. There were 135080 biogas pits, 11.29 pits per 100 households on the average, up by 24.6% and 4.5% respectively compared with that of the last year.

3.6.3 Crop Disease and Insect Pests

There was obvious effect of the prevention and control of plant disease and insect pests in the Three Gorges Reservoir area in 2008 with less area of cropland subject to plant disease and insect pests and less

damage. A total of 307911 ha•times were subject to plant disease and 208299 ha•times were subject to insect pests, down by 5.8% and 4.1% respectively compared with that of the last year.

A total of 276841 ha•times were under the prevention and control of plant disease and 185380 ha•times under the prevention and control of insect pests, accounting for 89.9% and 93.6% respectively of the total. Actual grain loss was 37621 t, down by 2930 t compared with that of the last year; a total of 132823 t of grain loss was saved.

Table 3-3 Major crop disease and insect pests of the Three Gorges Reservoir area in 2008

Type of crop disease and insect pests	Area affected (ha•times)	Area controlled (ha•times)	Loss saved (t)	Actual loss (t)
Rice borer	97826.7	87806.7	23350	5938
Rice blast	27566.7	24466.7	11350	2932
Corn leaf blight & spot	12720.0	10826.7	1420	487
Potato late disease	20333.3	14206.7	7600	3536
Corn banded sclerotial blight	32446.7	23346.7	4964	1469
Damage by rats	94813.3	56733.3	20222	19940

3.7 Geological Disasters

3.7.1 Earthquake

In 2008, there were a total of 2121 earthquakes with $M_L \geq 0.0$ from the head to the central part of the Three Gorges Reservoir areas (East longitude 108°20'～112°00', north latitude 29°55'～31°45'). Among them, 1112 quakes were at $0.0 \leq M_L \leq 0.9$, up by 561 event; 889 at $1.0 \leq M_L \leq 1.9$, up by 138 times; 105 at $2.0 \leq M_L \leq 2.9$, up by 9 events; 14 at $3.0 \leq M_L \leq 3.9$ Richter scale, up by 10 events; 1 at $4.0 \leq M_L \leq 4.9$ Richter scale, up by 1 event compared with that of 2007. The strongest earthquake measuring $M_L=4.6$ occurred in Zigui of Hubei Province at 16:01 of November 22 of 2008.

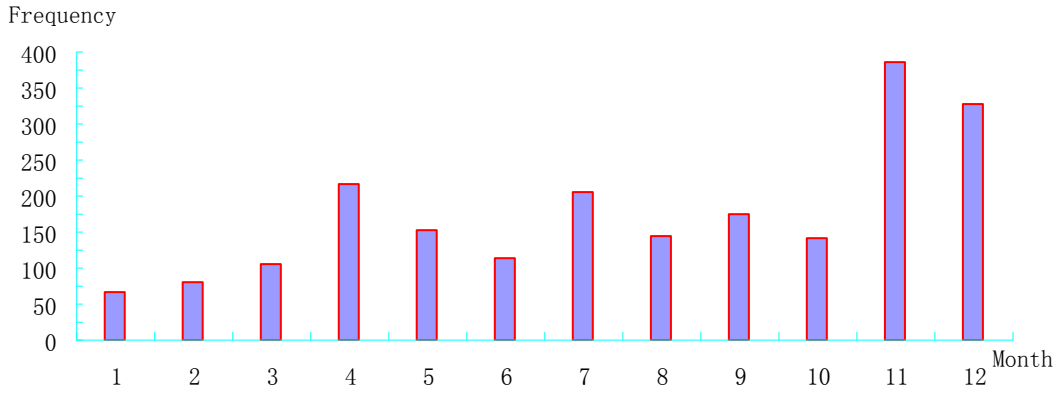


Figure 3-3 Frequency of earthquakes in the head to the central part of Three Gorges Reservior area in 2008

There was evident increase of mild earthquakes with gradual rise of impoundment of the Three Gorges Reservoir, which were mainly concentrated on Wushan-Badong-Zigui region. During the trial impoundment in 2008, there used to have obvious rise of the frequency of minor and very slight quakes with the epicenter at Badong-Zigui region. With the operation of high impoundment level of the Three Gorges Reservoir, it is expected that the frequency and intensity of earthquakes in the region will remain at relatively high level apart from the secondary geological disasters such as the cave, collapse of coal lode and reshape of reservoir bank.

3.7.2 Collapse, Landslide and Mud-rock Flow

- **Control of geological disasters and resettlement**

Up to the end of 2008, 339 sites had finished the consolidation of collapsed slope and landslide remedy in the Three Gorges Reservoir area with a total of 175 km bank subject to the prevention and control measures. According to plan, 69965 people from 646 vulnerable sites will be resellted to avoid potential geological disaster. A total of 26253 people (taking up 37.5%) of 285 vulnerable sites had finished the resettlement.

● Monitoring and Early Warning Projects

In 2008, a total of 3113 vulnerable sites in 224 towns & townships of 26 districts (counties) in the Three Gorges Reservoir area involving 577,000 people were under collapse, landslide and mud-rock flow monitoring and early warning program. All these monitoring and early warning activities involved well-organized public and community efforts. Professional monitoring was focused on 255 important places and places subject to serious damage of collapse, landslide and mud-rock flow. A total of 3653 people were engaged in monitoring and early warning program with 26,900 times of professional GPS monitoring, 1.27 times of borehole monitoring, 3778 times inspection at 251 vulnerable places and submission of 2400 various kinds of monitoring reports. The authority has sent over 100 expert groups to investigate the disaster, carry out emergency monitoring and early warning work and guide anti-disaster work.

In 2008, the prevention and control of geological disasters of the Three Gorges Reservoir area rode out the wide-spread snow & freeze in South China and the trial impoundment, effectively ensured the safety of migrant cities and towns and relevant facilities, guaranteed normal operation of the Three Gorges Project, improved the living environment in the region with remarkable social and economic benefits. A total of 75 sites (or deforming bodies) subject to collapses, landslides and bank sections in the Three Gorges Project area under professional monitoring program had clear deformation since the trial impoundment. Among them, 3 sites (Woshaxi landslip and Ni'erwan landslip in Zigui County of Hubei Province; and Zhulinwan landslide in Fengjie County of Chongqing Municipality) reached the warning grade (orange). Among the monitoring sites subject to mass monitoring & control program, 54 potential landslide sites had obvious deformation. Other sites under mass monitoring &

control program were under stable condition. A total of 894 people (720 people in Hubei Province and 174 in Chongqing) were subject to the risks of collapses. However, there was no death or damage due to evacuation and resettlement in time, which were organized by local government.

Chapter 4 Discharge of Pollution Sources

4.1 Discharge of Industrial Effluent

Environmental statistics of 2008 showed that the discharge of waste water from industrial sources in the Three Gorges Reservoir area was 558 million t, up by 17.7%; Among them, 536 million t of them were in reservoir areas in Chongqing and 22 million t in reservoir areas of Hubei Province, accounting for 96.1% and 3.9% of the total respectively. In the discharged industrial effluent, COD was 77000 t (up by 2.9%) and ammonia nitrogen 5700 t (down by 14.9%).

Table 4-1 Discharge of waste water from industrial pollution sources of the Three Gorges Reservoir area in 2008

Area		Waste water (100 million t)	COD (10,000 t)	Ammonia nitrogen (10,000 t)
TGPA in Hubei		0.22	0.05	……
TGPA in Chongqing		5.36	7.65	0.57
TGPA		5.58	7.70	0.57
Among them	Chongqing City	3.35	4.50	0.24
	Changshou District	0.64	1.09	0.04
	Fuling District	0.46	1.25	0.17
	Wanzhou District	0.30	0.16	0.06

4.2 Discharge of Urban Sewage

4.2.1 Statistics of the discharge of urban sewage

The environmental statistic data in 2008 showed that the total discharge of sewage from cities and towns of the Three Gorges Reservoir area was 593 million t, up by 24.1% compared with that of the last year. Among them, 577 million of them were in Chongqing and 16 million t in Hubei Province, taking up 96.8% and 3.2% respectively. In the discharged domestic sewage, the amount of COD was 86600 t, down by 6.5%; and ammonia nitrogen 9300 t, same as that of the last year.

There were 56 sewage treatment plants in cities and towns of the Three Gorges Project area with daily capacity at 1.9165 million t. A total of 515 million t waste water was treated, 505 million t of them were sewage, accounting for 85.2% of the total amount of sewage.

Table 4-2 Discharge of urban sewage of the Three Gorges Reservoir area in 2008

Area		Waste water (100 million t)	COD (10,000 t)	Ammonia nitrogen (10,000 t)
TGPA in Hubei		0.16	0.15	0.02
TGPA in Chongqing		5.77	8.51	0.90
TGPA		5.93	8.66	0.93
Among them	Chongqing City	4.19	5.53	0.51
	Changshou District	0.14	0.24	0.04
	Fuling District	0.28	0.27	0.05
	Wanzhou District	0.34	1.19	0.12

Table 4-3 Urban sewage treatment plant of the Three Gorges Reservoir area in 2008

Area	Amount of sewage treatment plant	Design capacity (10,000 t/d)	Annual treatment amount (100 million t)
TGPA in Hubei	8	6.2	0.13
TGPA in Chongqing	48	185.5	5.02
TGPA	56	191.6	5.15

4.2.2 Investigation on Urban Garbage

In 2008, there were 2.2 million t of domestic garbage in cities and towns of the Three Gorges Reservoir area, 1.8356 million t of them were disposed, taking up 80.0%. Another 458900 t were discharged in a non-concentrated way, accounting for 20.0%. 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, which utilized incineration technology. On the average, 78.0% of urban garbage was collected.

Table 4-4 Urban domestic garbage of the Three Gorges Reservoir area in 2008

District (County)	Urban permanent population (10000 people)	Domestic garbage (10000 t)	Disposed amount (10000 t)	Scattered discharge (10000 t/y)
Jiangjin	22.35	8.16	6.53	1.63
Banan	17.25	6.30	5.04	1.26
Six districts	358.44	130.83	104.66	26.17
Yubei (Luoqi)	2.70	0.99	0.79	0.20
Changshou	17.71	6.46	5.17	1.29
Fuling	42.66	15.57	12.46	3.11
Fengdu	9.12	6.86	5.49	1.37
Zhongxian	19.52	7.12	5.70	1.42
Wanzhou	57.89	21.13	16.90	4.23
Yunyang	19.24	7.02	5.62	1.40
Fengjie	18.51	6.76	5.40	1.35
Wushan	13.18	4.81	3.85	0.96
Badong	8.09	2.95	2.36	0.59
Zigui	12.30	4.49	3.59	0.90
Total	618.96	229.45	183.56	45.89

Note: Six districts include Dadukou District, Shapingba District, Jiulongpo District, Yuzhong District, Nan'an District and Jiangbei District.

4.3 Pesticides and Fertilizers

In 2008, both the total applied amount of fertilizer and pesticides and per-unit-application of fertilizer in 19 districts (counties) of the Three Gorges Reservoir area went down. But there was still the imbalanced application of fertilizers and pesticides.

4.3.1 Fertilizers

In 2008, a total of 140,700 t of fertilizer (pure) were applied in the Three Gorges Reservoir area, down by 15.2% compared with that of 2007. Among them, 101,400 t were nitrogenous fertilizer, 30900 t were phosphorus fertilizer, and 8400 t potash fertilizer, accounting for 72.1%, 22.0% and 6.0% of the total respectively. The application ratio of nitrogenous, phosphorus and potash fertilizers in the Three Gorges

Reservoir area was 1∶0.30∶0.08, still with imbalance in the application. The fertilizer application amount per hectare was 0.72 t, down by 16.3% compared with that of 2007. The biggest user of fertilizers (pure) was Yunyang County, followed by Wushan and Kaixian County.

Total drain of fertilizers in the Three Gorges Reservoir area was 12544 t, down by 9.4% compared with that of 2007. Among them, the drain of nitrogenous fertilizer was 10196 t, phosphorus fertilizer was 1783 t and that of potash fertilizer 566 t, taking up 81.3%, 14.2% and 4.5% respectively of the total. Among all districts and counties, Yunyang County had the biggest drain of fertilizers.

4.3.2 Pesticides

In 2008, 532.1 t of pesticides (pure equivalent) were applied in the Three Gorges Reservoir area, down by 18.7% than in 2007. Among them, 291.3 t were organophosphorus pesticides, 105.3 t were organic nitrogen pesticides, 45.4 t were pyrethroids, 42.2 t were herbicides, 47.9 t were other kinds of pesticides; accounting for 54.7%，19.8%, 8.5%, 7.9% and 9.0% respectively of the total, showing 0.9%, 4.8%, 60.0%, 33.2% and 34.7% reduction compared with that of 2007. That is, there was obvious drop of the application amount of pyrethroids, herbicides and other kinds of pesticides, but there was still wide application of high-toxicity pesticides including organophosphorus pesticides. The application amount of pesticides per hectare was 2.72 kg, down by 20.0% compared with that of last year.

The total drain of pesticides in the Three Gorges Reservoir area was 35.0 t, down by 15.2% compared with that of 2007. Among them, the drain of organophosphorus was 22.6 t, organonitrogenous pesticide 5.4 t, pyrethroids 2.3 t，herbicides 2.1 t and other pesticides 2.5 t; accounting for 64.6%, 15.5%, 6.6%, 6.0%, 6.0% and 7.1% respectively of the total, down

by 3.8%, 2.0%, 59.1%, 33.0% and 29.4% respectively compared with that of last year. Among all districts and counties, Zigui had the most drain of pesticides.

4.4 Monitoring on Mobile Pollution Sources

In 2008, there were near 8000 registered ships in the reservoir areas, slightly less than that of 2007 with increase of total tonnage. 6428 of them were motorboats with no obvious change of the amount. Ships in use continuously became more standardized, bigger and in series, which optimized the transportation structure and increased the safety. There was further rise of the automation on the monitoring and management of these ships.

4.4.1 Ship Transportation

In 2008, the passenger transport volume of the permanent ship lock of the Three Gorges Dam reached 8830 ship•times with 857,200 people•times, similar to that of 2007. A total of 54.635 million t of cargo passed the lock, up by 16.6% than in 2007. The total annual port cargo capacity of main ports with certain scale in the Three Gorges Reservoir area was 61.96 million t, up by 20.2% compared with that of last year. The passenger transport volume of navigation in ports of Chongqing Municipality was 4.44 million people•times, down by 19.1%, mainly because of significant decrease of migrant workers, travllers and other people using ship as a means of transportation due to the operation of expressway in the region.

4.4.2 Oil-containing Waste Water from Ships

In 2008, inspectors checked water pollution of 437 ships caused by oil-containing waste water from engine room and found that 325 of them (74.4%) met national pollution discharge standard in terms of waste water,

up by 1 percentage point compared with that last year. Among all types of ships, the discharge of oil-containing waste water of 92.9% towboat, 83.3% of tourist ships, 81.5% of other ships, 79.7% of passengaer ships and 70.5% cargo ships met national standard for the discharge of waste water. The up-to-the-standard rate of tourist ship and passengaer ship went down and that of towboat & other ships went up compared with that of last year. But the up-to-the-standard rate of cargo ship was still the lowest. Judging from the power of all kind of ships, the up-to-the-standard rate of the ship with power ⩾200kW was about 20% higher than that of the ship with power <200kW.

In 2008, there were about 6428 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 412000 t; 390600 t of them were under treatment, accounting for 94.8%. After the treatment, 339,600 t of waste water met the national pollution discharge standard with the up-to-the-standard rate at 86.9%. Compared with that of last year, the generated amount of oil-containing waste water went down by 97300 t with little change of treatment rate but 3 percentage points up in the up-to-the-standard rate. The rank of generating amount of oil-containing waste water from various ships had some difference compared with that of the last year: 194800 t from cargo ships, 165800 t from passenger ships, 30400 t from other ships, 10600 t from towboat, and 5000 t from tourist ships; accounting for 47.3%, 40.2%, 7.4%, 3.9% and 1.2% respectively of the total.

Among the discharged oil-containing waste water, the discharge of petroleum was 37.87 t, down by 4.2% than that of 2007. Among various

ships, petroleum discharge was 21.58 t for passenger ships, 14.71 t for cargo ships, 1.30 t for other ships, 0.17 t for towboats, and 0.11 t for tourist ships; accounting for 57.1%, 38.8%, 3.4%, 0.4% and 0.3% respectively of the total.

Table 4-5 Discharge of oil-containing waste water from ships in the Three Gorges Reservoir area in 2008

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	58	0.50	1.2	0.50	100.0	0.42	84.0	0.11	0.3
Passenger ship	2288	16.58	40.2	15.42	93.0	14.14	91.7	21.58	57.1
Cargo ship	2887	19.48	47.3	18.50	95.0	15.17	82.0	14.71	38.8
Towboat	206	1.60	3.9	1.60	100.0	1.49	93.1	0.17	0.4
Other ships	989	3.04	7.4	3.04	100.0	2.74	90.1	1.30	3.4
Total	6428	41.20	100.0	39.06	94.8	33.96	86.9	37.87	100.0

4.4.3 Ship Sewage

In 2008, 40 ships in the Three Gorges Project waters were investigated on the discharge of domestic sewage. Among them, the sewage of 16 ships did not discharge until it was treated and the concentration of suspended substances met national pollutant discharge standard. Among the pollutants, the total suspended particles, BOD_5, COD and E-coli met the discharge standards, while only 2 ships met national standard for the discharge of TP and 4 ships met TN discharge standard. The sewage of 24 ships was discharged without any treatment. Only 14 ships met COD discharge standard. The monitoring data of other ships failed to meet national standard for pollution discharge.

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 2008 was about 3.046 million t, up by 13% than that of the last year. Among them, the amount of sewage from passenger and tourist ships was 3.177 million (2.668 million from passenger ships and 509000 t from tourist ships), accounting for 78.5% of the total sewage, up by 10 percentage points than that of 2007. The sewage amount from non-passenger ships was 869,000 t, taking up 21.5%.

In the discharged sewage, the total weight of various pollutants was amount 2136.1 t, down by 9.2% compared with that of the last year. Among them, suspended substance 719.3 t, COD was 719.3 t, TN 342.7 t, BOD 303.1 t, and TP 51.7 t; accounting for 33.7%, 33.7%, 17.4%, 16.0%, 14.2% and 2.4% respectively of the total.

4.4.4 Ship Garbage

In 2008, inspectors boarded 74 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 29000 t in the year, down by 19.4%. There were still 6 ship collecting the garbage from the ships of the waters of the Three Gorges Reservoir area, 14 organizations received the pollutants, down by 2 organizations compared with that of the last year. A total of 8584 t ship garbage were collected, accounting for 29.6%, up by 10.6% percentage points compared with that of 2007.

4.4.5 Ship Accidents

In 2008, there were 8 ship traffic accidents in the reservoir waters, all falling into the catogery of normal traffic accidents, leading to 4 sunken

ships, 4 ships capsized, 23 people falling into the water, 18 of them saved, 4 lost, and 5 deaths with economic loss of about 5 million yuan. Most ship accidents were due to artificial factors including improper operation, navigation against regulations under overload or overheight conditions.

Chapter 5 Status of Water Environment Quality

In 2008, 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 2008, a total of 13 water quality monitoring sections were established at both mainstream and tributaries of the Yangtze River in the reservoir areas. 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 2008, Among the 6 sections at the mainstream, Guandukou section

met Grade Ⅱ national surface water quality standard; Qingxichang section and Tuokou section Grade Ⅲ surface water quality standarand; while Zhutuo section, Tongguanyi section and Cuntan section only met Grade Ⅳ standard due to the impact of TP concentration. Among them, water quality of Tuokou section went down to Grade III from Grade II; water quality of Zhutuo section, Tongguanyi section and Cuntan section deteriorated from Grade Ⅲ to Grade Ⅳ. The quality of the remaining 2 sections kept stable.Compare with last year, water quality of the mainstream became poor,Mainly because of the increased sand in the water which caused by the especially big autumn flood in this year(once in a hundred years),it lead to the TP concentration increased.

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

Table 5-1 Water quality of the mainstream of the Yangtze River in the Three Gorges Project area in 2008

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

Table 5-2 Percentage of graded water quality at mainstream sections of the Yangtze River of Three Gorges Reservoir area in 2008 (%)

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

5.1.2 Water Quality of Tributaries

In 2008, among the seven sections at tributaries of the reservoir area, water quality of Beibei section met Grade II standard, Linjiangmen section and Wulong section was of Grade III standard and Pengxi River mouth section, Daning River mouth section and Xiangxi River mouth section met Grade IV standard due to pollution of total phosphorus. Affected by total phosphorus, Yulin River mouth section met Grade V water quality standard. Among them, water quality of Yulin River mouth section turned into Grade V from Grade IV standard. Compared with that of 2007, overall water quality of tributaries remained stable and was prone to worsening.

Water quality was the poorest in April with all sections failing to meet Grade III standard. At least 2 sections were worse than Grade III in each of the other months. Percentage of sections with water quality at or better than Grade III standard ranged from 42.9% to 71.4%.

Table 5-3 Type of water quality of the sections of primary tributaries of the Yangtze River in the Three Gorges Reservior area in 2008

Section name	River name	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Whole year
Beibei	Jialing River	Ⅱ	Ⅱ	Ⅲ	Ⅳ	Ⅱ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅱ	Ⅲ	Ⅱ	Ⅱ
Linjiangmen	Jialing River	Ⅱ	Ⅳ	Ⅲ	Ⅳ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅲ	Ⅳ	Ⅲ	Ⅲ	Ⅲ
Wulong	Wujiang	Ⅲ	Ⅲ	Ⅲ	Ⅳ	Ⅲ	Ⅲ	Ⅲ	＞Ⅴ	Ⅲ	Ⅲ	Ⅲ	Ⅳ	Ⅲ
Mouth of Yulin River	Yulin River	Ⅳ	Ⅲ	Ⅳ	Ⅳ	Ⅳ	Ⅴ	Ⅳ	＞Ⅴ	Ⅴ	Ⅳ	Ⅳ	Ⅲ	Ⅴ

Mouth of Pengxi River	Pengxi River	Ⅳ	Ⅳ	Ⅳ	Ⅳ	Ⅳ	Ⅳ	Ⅳ	Ⅲ	Ⅲ	Ⅳ	Ⅳ	Ⅳ	Ⅳ
Mouth of Daning River	Daning River	Ⅳ	Ⅳ	Ⅲ	Ⅳ	Ⅴ	Ⅴ	＞Ⅴ	Ⅲ	Ⅲ	Ⅳ	Ⅳ	Ⅳ	Ⅳ
Mouth of Xiangxi River	Xiangxi River	Ⅳ	Ⅳ	Ⅴ	Ⅴ	Ⅳ	Ⅳ	Ⅲ	Ⅳ	Ⅳ	Ⅲ	Ⅲ	Ⅲ	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 Percentage of graded water quality at sections of primary tributaries of the Yangtze River of Three Gorges Reservior area in 2008

Water quality	Jan.	Feb.	Mar.	Apr.	May	June	July	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	28.6	14.3	0.0	0.0	14.3	0.0	0.0	0.0	0.0	14.3	0.0	14.3	14.3
Ⅲ	14.3	28.6	57.1	0.0	28.6	42.9	57.1	57.1	71.4	28.6	57.1	42.9	28.6
Ⅳ	57.1	57.1	28.6	85.7	42.9	28.6	28.6	14.3	14.3	57.1	42.9	42.9	42.9
Ⅴ	0.0	0.0	14.3	14.3	14.3	28.6	0.0	0.0	14.3	0.0	0.0	0.0	14.3
＞Ⅴ	0.0	0.0	0.0	0.0	0.0	0.0	14.3	28.6	0.0	0.0	0.0	0.0	0.0
Ⅰ～Ⅲ	42.9	42.9	57.1	0.0	42.9	42.9	57.1	57.1	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

From March to October of 2008, 82 mointoring sections were established for early warning against water bloom at primary tributaries of the Yangtze River affected by impoundment and 5 indicators were employed to assess comprehensive nutrition status of water bodies including chlorophyll a, TP, TN, permanganate value and turbidity.

The findings showed that 14.6%-28.1% of the sections along primary tributaries were subject to eutrophication between March and October with monthly average being 20.1%, up 4.2 percentage points against the previous year. 1.2%-7.3% of the sections were under oligotrophic condition and 69.5%- 81.7% of the sections were under mesotrophic condition with monthly average at 2.6% and 77.3% respectively. Due to the impact of impoundment, backwater reaches of the reservoir area showed evidently

higher level of eutrophication than non-backwater reaches. Around 20.9%-37.6% of sections were eutrophic with monthly average of 27.4%, 17.1 percentage points higher than that in non-backwater reaches.

Table 5-5 Nutrition status of primary tributary waters of the Yangtze River in the Three Gorges Reservoir area during March~October of 2008

Nutrition status	Percentage of sections under different nutrition conditions (%)								
	March	April	May	June	July	Aug.	Sep.	Oct.	Average
Oligotrophic	7.3	3.7	3.7	0.0	1.2	2.4	1.2	1.2	2.6
Mesotrophic	76.8	81.7	70.7	80.5	80.5	69.5	80.5	78.1	77.3
Slight eutrophication	12.2	11.0	20.7	11.0	14.6	22.0	15.9	18.3	15.7
Intermediate eutrophication	1.2	1.2	3.7	6.1	1.2	3.7	2.4	2.4	2.7
Heavy eutrophication	2.4	2.4	1.2	2.4	2.4	2.4	0.0	0.0	1.7
Total	15.8	14.6	25.6	19.5	18.2	28.1	18.3	20.7	20.1

5.2.2 Site Monitoring of Water Bloom

In 2008, the reservoir area saw 13 occurrances of water bloom at 11 tributaries including Xiangxi River, Shennong River, Daning River, Meixi River, Modao River, Pengxi River, Zhuxi River, Rangdu River, Ruxi River, Huangjin River and Quxi River. The dominant algae species were *Cyclotella* of *Bacillariophyta*, *Peridinaceae* of *Pyrrophyta*, *Chlamydomonas* and *Pandorina* of *Chlorophyta*, and *Microcystis* of *Cyanophyta*.

Seasonal change in dominant species of water bloom was notable. In spring *Cyclotella* of *Bacillariophyta* and *Peridinaceae* of *Pyrrophyta* were the dominant species while *Chlamydomonas* of *Chlorophyta* and *Microcystis* of *Cyanophyta* were prevalent in summer, which showed a trend from river type (*Cyclotella* and *Peridinaceae*) into lake type (*Chlorophyta* and *Cyanophyta*).

Chapter 6 Environment Quality in Construction Areas

6.1 Hydrology and Meteorology

6.1.1 Hydrological Characteristics

In 2008, the statistic 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 13200 m^3/s with the maximum flow at 38700 m^3/s on August 16 and the minimum at 4160 m^3/s on January 8. Annual sand transportation rate was 1.02 t/s with average sand concentration of 0.077 kg/ m^3. The maximum sand concentration at sections averaged 0.599 kg/ m^3 on August 17 while the minimum content was 0.001 kg/ m^3 at Feb. 21. Compared with the previous year the construction area of the Three Gorges Project featured slight increase in river flow and dramatic reduction in annual average sand transportation rate and sand concentration.

Table 6-1 Monthly river flow of Huanglingmiao Hydrological Stations in 2008

Unit: m^3/s

Time	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Whole year
Avg.	4390	4370	5020	9270	11100	15400	23000	28000	26200	11700	14300	5750	13200
Max.	5020	4630	6720	16700	15300	22300	36800	38700	36500	19400	28300	8930	38700
Min.	4160	4230	4230	5590	8500	9870	15000	19500	18700	5220	7730	4570	4160

Table 6-2 Sand concentration of Huanglingmiao Hydrological Stations in each month of 2008

Unit：kg/m^3

Time	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Whole year
Avg.	0.004	0.002	0.002	0.005	0.005	0.014	0.081	0.232	0.120	0.016	0.006	0.003	0.077
Max.	0.005	0.004	0.002	0.009	0.007	0.038	0.171	0.599	0.219	0.033	0.010	0.004	0.599
Min.	0.003	0.001	0.001	0.002	0.003	0.004	0.020	0.058	0.033	0.005	0.003	0.003	0.001

6.1.2 Climate Characteristics

In 2008 the climate characteristics of the Three Gorges Reservoir area was mild and rainy. The average temperature was lower than that of normal years while precipitation remained the same level as that of 2007.

● **Precipitation**

The annual precipitation of the construction area was 1372.7 mm, just 5.1 mm more than that of 2007. Distribution of precipitation in each month was especially uneven, for most precipitation was seen in April-August and October. The maximum daily precipataion totaled 92.6 mm on Aug. 15. The longest period of continous rain throughout the year lasted 6 days, from July 1 till July 6 whereas the longest non-precipitation period in the year numbered 25 days from Dec. 5 to 29. July saw the most precipitation which amounted to 345 mm.

● **Temperature**

The temperature of the construction area averaged 16.8℃, 0.4℃ lower than historical averages. The highest temperature in 2008 was 36.9℃, occurring on Aug. 21 and the lowest was -4.1℃ on Jan. 29.

● **Wind Speed**

Wind speed in the construction area averaged 1.5 m/s with the maximum at 22.3 m/s on August 26. Wind direction was volatile with NNW in dominance at the frequency of 20%.

Table 6-3 Meteorological indicators of the Three Gorges Project area in 2008

Time		Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Whole year
T	Temperature (℃)	2.6	5.9	13.5	16.9	22.8	25.0	26.5	26.1	23.3	18.1	12.8	8.2	16.8
	Departure (℃)	-3.1	-2.0	1.7	-0.9	1.0	-0.3	-1.1	-0.7	0.0	0.3	0.0	0.4	-0.4
P	Precipitation (mm)	25.0	5.8	72.3	178.0	87.1	161.1	345.1	298.1	32.3	135.7	30.5	1.7	1372.7

	Departure (%)	5.8	-84.1	44.3	110.7	-40.5	9.3	73.6	51.2	-69.6	54.6	-30.0	-91.1	20.2
Wind Speed	Average wind speed (m/s)	1.5	2.0	1.3	1.3	1.4	1.4	1.1	1.1	1.1	1.5	1.7	2.0	1.5
	Max.(m/s)	5.9	7.5	8.2	7.7	9.1	7.2	10.1	7.7	6.4	5.8	9.0	7.6	10.1
	Extreme (m/s)	11.3	13.3	14.6	13.1	18.5	13.2	22.3	14.3	10.8	9.1	17.6	13.9	22.3

6.2 Air Quality

Assessment of ambient air quality of construction area (office & residential areas and construction area) is subject to *Ambient Air Quality Standard* (GB3095-1996).

In 2008, the average SO_2 concentration in construction area was 0.017 mg/ m^3, meeting Grade I national air quality standard. The level was lower than that of 2007 by 0.006 mg/ m^3. Daily average concentration has all met Grade I or Grade II national air quality standard which made up 95.7% and 4.3% of total days respectively.

Annual NO_2 concentration averaged 0.025 mg/ m^3, up to Grade I national air quality standard and was 0.001 mg/ m^3 lower than that of 2007. Daily average concentrations have all met Grade I standard. The annual level of total suspended particulates (TSP) was 0.154 mg/ m^3 on average which was in line with Grade II national air quality standard. Daily concentrations of TSP in office and residential areas meeting Grade I, II and III air quality standard took up 41.0%, 56.2% and 2.8% respectively while in construction area the proportion stood at 32.7%, 58.3% and 9.0%.

Compared with the previous year ambient air quality in the construction area turned better with annual average concentrations of SO_2 and NO2 reducing by 29.0% and 3.8% respectively. TSP level was always at or above Grade III national air quality standard.

6.3 Water Quality

13 indicators were chosen for assessment of water quality in construction area according to *Environmental Quality Standard for Surface Water* (GB3838-2002) which includes 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 to evaluate near-bank water quality.

In 2008, water quality at sections of the construction area at the trunk of the Yangtze River and near-bank waters was excellent, meeting Grade I surface water quality standard throughout the year. Compared with that of 2007, annual water quality at Taipingxi section and Letianxi section of the trunk of the Yangtze River improved from Grade II to Grade I surface water quality standard. The averages of suspended substance, iron and e-coli have shown notable decrease. Water quality of the three sites at the upper approach channel, lower approach channel and auxiliary dam of the near-bank waters remained at Grade I water quality standard. Annual averages of e-coli at the upper approach channel and auxiliary dam dropped remarkably. The concentrations of other pollutants under monitoring kept stable with no evident changes 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 2008

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

Table 6-5 Water quality of near-bank waters of the Yangtze River in the construction area in 2008

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

6.4 Noise

In 2008, the average daytime and nighttime noise of the office and residential area of the construction areas was 56.1dB and 51.0dB respectively. The daytime value met Grade II of *Environmental Noise Standard of Urban Area* (GB3096-2008), down 2.4dB against 2007 while the nighttime value met Grade III standard, down 1.9dB. The equivalent sound level of environmental noise at construction operation area was 53.8dB in the daytime and 48.5dB at night, both of which met the required limits for workshops and operation sites set in national *Specifications for the Design of Noise Control System in Industrial Enterprises* (GBJ87-85). The average daytime noise increased by 1.7dB, and night noise dropped by 1.8 dB compared with that of the previous year. The annual traffic noise averaged 68.2dB, up 1.1dB against 2007. Noise level of sensitive boundary sites was compliant with *Noise Limits for Construction Site* (GB12523-90).

Chapter 7　Status of Public Health

7.1 Basic Situation

In 2008, the Three Gorges Reservoir area had the same distribution of monitoring sites for public health as in 2007, which included Chongqing Municipality (including Fengjie County), Fengdu County and Wanzhou District of Chongqing Municipalitiy and Yichang City of Hubei Province. Total population under monitoring was 595408, 21806 fewer than that of 2007. Among them 303153 were male and 292255 were female with male/female ratio of 1.04：1. Urban population numbered 229125 and rural population was 366293.

There were 329 medical institutions at all levels within the monitoring region, 4 fewer than that of 2007. There were 3425 hospital beds in all these institutions, reducing by 1061 compared with that of 2007. Altogether 4553 medical staff served in these insitutions, or 1000 more over the previous year, which was mainly caused by the adjustment of medical institutions in the Three Gorges Reservoir area.

7.2 Life Statistics

7.2.1 Birth and Death

4139 babies were born in 2008 in the monitoring region including 2136 male and 2003 female with male/female ratio at 1.07:1. The birthrate was 6.95‰, down 5.83% compared to that of 2007. There were 3431 death in the monitoring area with the death rate of 5.76‰, down 3.19% against 2007. Among the death, 2062 were male and 1369 were female with a

death rate of 6.80‰ and 4.69‰ respectively.

The birth rate of Chongqing, Fengdu, Wanzhou and Yichang was 6.27‰, 10.41‰, 5.64‰ and 6.85‰ respectively, while the death rate was respectively 5.32‰, 6.76‰, 5.30‰ and 6.34‰. Compared with 2007, birth rate of Yichang rose by 22.76% whereas Fengdu, Chongqing and Wanzhou all saw declining trend by 19.80%, 8.60% and 1.05% respectively. Death rate of Wanzhou and Fengdu increased by 6.43% and 1.81%, while that of Chongqing and Yichang fell by 16.35% and 8.91% respectively.

A total of 35 infant deaths were reported in the monitoring area including 20 baby boys and 15 baby girls. The infant death rate was 8.46‰, down 8.34% against that of 2007.

7.2.2 Analysis of Death Cause

According to the ICD-10 Disease Classification Standard, the top five death causes of the Three Gorges Reservoir area in 2008 were circulatory system diseases (208.76/100,000), malignant tumors (147.29/100,000), respiratory system diseases (78.27/100,000), injury & poisoning (55.76/100,000) and digestive system diseases (18.64/100,000). The percent of death resulting from the above five major disease against the total was 36.23%, 25.56%, 13.58%, 9.68% and 3.24% , totaling 88.29%.

Compared with 2007, the order of the top five killer diseases remained unchanged and there was little change in death cause structure. Among them, death rate caused by digestive system diseases and circulatory system diseases increased by 12.76% and 2.34% respectively while mortality of injury & poisoning, malignant tumors and respiratory system diseases dropped by 20.89%, 13.01% and 3.19%. The rank of the top five death

casues for both male and female was the same as that of the general population with higher mortality of male than female. In regional dimension, the rank of death causes differed from one another. The top three killer diseases in Chongqing, Fengdu and Wanzhou was the same as that of the general population, while in Yichang, the top two death causes was the same as the general population and injury & poinsoning came the third.

7.3 Monitoring of Diseases

7.3.1 Monitoring of Infectious Diseases

In 2008, a total of 3952 cases of infectious diseases were reported among all the monitoring sites with a morbidity of 663.75/100000, down by 4.28% against the previous year. There were 5 deaths with mortality at 0.84/100000, down by 25.66% against that of 2007. There was no report of rat plague and cholera under Category A and no outbreak of epidemics. Morbidity ranked from high to low was as the follows: 1122.72/100000 in Fengdu, 737.80/100000 in Chongqing, 555.98/100000 in Yichang and 418.42/100000 in Wanzhou. Compared with 2007, morbidity in Yichang and Chongqing went up by 10.55% and 6.63% respectively while that in Wanzhou and Fengdu was down by 8.88% and 15.94%. All moinitoring sites reported infectious diseases each month, among which occurance of infectious diseases under Category B was high in January and low in December and there was litte fluctuations in other months. The number of Category C cases swelled between May and July, particularly in hand foot mouth disease, measles and parotitis.

The monitoring sites reported 15 types of Category B infectious

diseases (excluding HIV). The total number of cases was 2627, with morbidity at 441.21/100000, down by 4.81% against 2007. The morbidity of Category B infectious diseases among all monitoring sites was ranked as 694.50/100000 in Fengdu, 509.53/100000 in Chongqing, 416.99/100000 in Yichang and 273.13/100000 in Wanzhou. Compared with 2007, morbidity in Yichang and Chongqing rose by 23.33% and 12.22% while that in Wanzhou and Fengdu fell by 20.67% and 15.77% respectively. The top five diseases in terms of morbidity were tuberculosis (174.84/100000), virus hepatitis (173.33/100000), measles (30.74/100000), diarrhea (26.37/100000) and gonorrhea & syphilis (17.13/100000). Compared with 2007, AIDs, whooping cough and leptosprirosis were added to Category B infectious diseases and malaria was removed from the list. Morbidity of some diseases declined inclduding virus hepatitis, diarrhea, gonorrhea, measles, rabies and tuberculosis, while that of other kinds had some increases such as scarlet fever, which increased by 2.42 times. Occurance of water-borne infectious diseases due to impoundment like hepatitis A (4.53/100000), diarrhea (26.37/100000) and typhoid (0.84/100000) was still maintained at a low level. Natural focus diseases related to insects as media were also at a low level of prevalence with only small increase in leptosprirosis (1 case), type B meningitis (5 cases) and epidemic hemorrhagic fever (2 cases).

Six types of Category C infectious diseases were reported across all the monitoring sites totaling 1325 cases. The morbidity was 222.54/100000, down by 3.20% against that of 2007. The morbidity of Fengdu, Chongqing, Wanzhou and Yichang was 428.22/100000, 228.27/100000, 145.29/100000 and 139.00/100000 respectively. Compared with the previous year, hand foot mouth disease was newly added to this Category. The morbidity in

Yichang and Chongqing increased by 10.55% and 6.63%, while that in Wanzhou and Fengdu dropped by 8.88% and 15.94% respectively.

7.3.2 Monitoring of Endemic Diseases

Monitoring of iodine deficiency was conducted in Chongqing, Wanzhou, Fengdu and Yichang in 2008. Palpation method was employed to investigate the disease among 660 sampled children aged 8-12. Among them, 80 were found to have I degree thyromegaly, accounting for 12.12%. Despite a little increase in morbidity, the disease was still in the range of slight epidemic. Thyromegaly rate in Wanzhou, Fengdu and Chongqing was respectively 15.00%, 10.63% and 3.00%. Compared with 2007, thyromegaly rate in Fengdu increased by 0.63 percentage points while that in Chongqing dropped by 5.81 percentage points. Wanzhou did not see any changes in morbidity. 1808 households were sampled for the test of edible salt, among which 1783 households took iodine added salt, taking up 98.62%, up by 0.51 percentage points against the previous year. 94.84% of the iodine added salt was qualified, down by 2.12 percentage points. The application rate of qualified iodine-added salt was 93.53%, up 0.21 percentage points. Although access of iodine added salt and its application rate have increased somewhat, the qualification rate went down a bit, especially in Fengdu where all the three indicators showed evident decline. This has something to do with inconsistent implementation of effective preventive measures against iodine deficiency, unsatisfied promotion and distribution of iodine added salt as well as changes in processing procedures and testing method of iodine added salt.

Fluorine endemic disease was monitored in Fengjie. 280 people were sampled and 132 cases were found with positive rate at 47.17%, down by

3.36 percentage points compared with that of the previous year.

7.4 Monitoring of Biological Media

7.4.1 Monitoring of Rats

In 2008, indoor rat density of all the monitoring sites was 3.27%, slightly higher than that of 2007 while outdoor rat density was 2.59%, a little bit lower than that of the previous year, but both were lower than the 5-year (1999-2003) average indoor and outdoor rat density (3.94% and 4.22%) before 135 m impoundment. The density in spring was higher than that in autumn, which was different from the previous year. In spring, indoor and outdoor rat density was respectively 3.61% and 2.87%, which conformed to that of 2007. And the density in autumn was respectively 2.78% and 2.15%. Indoor rat density at all monitoring sites was sequenced from high to low as 5.51% in Yichang, 4.47% in Fengdu, 4.05% in Wanzhou and 1.91% in Chongqing; while that for outdoor rat density was 6.61% in Fengdu, 5.39% in Wanzhou, 3.18% in Chongqing and 0.97% in Yichang.

Rattus flavipectus was dominant indoor rat species, taking up 41.42% in place of the traditional brown rat. Mus musculus ranked the second, accounting for 30.18%, down 1.68 percentage points against 2007 and brown rat came the third. In the field, the small insectivore (mostly short-tail shrew) was the dominating species, followed by black strip rat (*Apodemusagrarius*), accounting for 54.50% and 18.50% respectively. The proportion went up by 6.03 and 0.10 percentage points respectively. As the animal host of epidemic hemorrhagic fever and leptospiral pathogens, *Apodemusagrarius* has become the 2nd dominant species.

Lung and kidney samples of rat animals were collected at all the monitoring sites to test epidemic hemorrhagic fever and leptospiral pathogens. The detection rate of epidemic hemorrhagic fever virus was 3.64% in Chongqing, 9.59% in Fengdu and 6.58% in Wanzhou. There was no report case in Yichang. For the test of leptospiral pathogen, the testing results of all monitoring sites were negative except two samples from Yichang being positive.

7.4.2 Monitoring of Mosquitoes

In 2008, the overall density of adult mosquitoes in livestock pens and human dwellings was respectively 135.58/ pen • artificial hour and 35.22/ room • artificial hour, both of which were lower than the level of 2007 and the 5-year averages (198.57/ pen • artificial hour for the former and 63.97/ room • artificial hour for the latter) before 135 m impoundment. The indoor adult mosquitoe density was ranked (from high to low) as Wanzhou (51.08/ room • artificial hour), Fengdu (41.12/room • artificial hour), Chongqing (33.54/room • artificial hour) and Yichang (14.88/room • artificial hour). The order for adult mosquitoe density in livestock pens was Wanzhou (227.80/ room • artificial hour), Yichang (154.93/room • artificial hour), Fengdu (142.00/room • artificial hour) and Chongqing (87.06/room • artificial hour). Compared with that of 2007, mosquitoe density in livestock pens rose in Chongqing and Yichang and fell in Wanzhou and Fengdu. For indoor mosquitoe density Fengdu and Yichang saw slight increase while Chongqing and Wanzhou had lower density than that of 2007.

10-day change trend of indoor adult mosquito density during May to September was similar to that of the adult mosquito density in livestock pens. Fengdu was the first to see the peak of indoor adult mosquito density

in late May, while Chongqing was the last where the density was the highest in early July. The peak density arrived in late June in Yichang and Wanzhou. For adult mosquito density in livestock pens, the peak came first in Fengdu in late May and last in Chongqing in late September. Wanzhou and Yichang saw peak density in late June and early August respectively.

The composition of mosquito species showed that *Armigeres subbalbeatus* was the dominating mosquito species in both human dwellings and livestock pens, accounting for 73.85% and 70.11% of the total. *Culex pipiens fatigans* ranked No.2 as indoor mosquito species, taking up 10.54%. *Anopheles sinensis*, *Culex pipiens pallens* and *Culex tritaeniorhynchus* ranked the third, fourth and fifth respectively. Among the livestock pen mosquito species, *Anopheles sinensis* ranked No.2 and took up 11.42%. *Culex pipiens fatigans*, *Culex pipiens pallens* and *Culex tritaeniorhynchus* ranked No.3, 4 and 5 respectively. Compared with that of 2007, the percentages of all the mosquitoe species in human dwellings have increased except *Armigeres subbalbeatus* and *Culex pipiens pallens* while for livestock pens, only *Armigeres subbalbeatus* and *Culex pipiens fatigans* saw declining proportion amid the rise of other species.

Chapter 8 Environmental Quality of Resettlement Areas

In 2008, environmental monitoring was carried out in 15 districts (counties) within Chongqing resettlement area of the Three Gorges Reservoir area including Wushan County, Wuxi County, Fengjie County, Yunyang County, Wanzhou County, Kaixian County, Zhongxian County, Shizhu County, Fengdu County, Wulong County, Fuling District, Changshou District, Banan District, Yubei District and Jiangjin District. Monitoring focused on quality of water environment, ambient air and acoustic environment. Remote sensing monitoroing of ecological environment was also carried out in 20 resettlement dirsticts (counties).

8.1 Monitoring of Water Quality

Water quality monitoring in the resettlement area targeted surface water quality, water quality of sensitive backwater zones and water quality in 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

128 sections were set up along 52 tributaries in 15 districts (counties), up by 6 compared with that of 2007. Assessment of water quality included 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 2008, surface water quality of the resettlement areas remained stable. The overall status was good with 113 sections meeting or superior to Grade III national water quality standard, accounting for 88.3% of the total, up by 2.2 percentage points. 7 sections met Grade Ⅳ standard, 2 sections met Grade Ⅴ standard and 6 sections failed to meet Grade Ⅴ standard, accounting for 5.5%, 1.6% and 4.7% respectively of the total. The major pollutants were fecal coliforms, ammonia nitrogen, petroleumn and total phosphor.

The proportion of sections meeting or superior to Grade III quality standard in low, level and high flow periods was 87.6%, 83.4% and 87.6%, down by 1.5 percentage points, 0.2 percentage points and 2.4 percentage points respectively compared with that of the same period of 2007. River sections failing to meet Grade Ⅲ standard were mainly in Banan District and Wanzhou District.

8.1.2 Water Quality of Sensitive Backwater Zones

57 sections were set up along 35 tributaries running across 15 districts (counties). The 11 monitoring items included 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 2008, the overall water quality in sensitive backwater areas of the resettlement region was good with 54 sections meeting or superior to Grade III national water quality standard, accounting for 94.7% of the total, up by

6.7 percentage points against that of 2007. One section was measured at Grade IV standard and two failed to meet Grade V standard, taking up 1.8% and 3.5% of the total respectively. The major pollutants were BOD_5, TP and ammonia nitrogen.

The proportion of monitoring sections in backwater sensitive zones meeting or superior to Grade Ⅲ standard during March, April and May was 92.9%, 94.8% and 86.0% respectively. Compared with the same period of 2007, the percentage in May fell by 5.1 percentage points and that of March and April jumped by 9.5 and 2.2 percentage points respectively. Sections failing to meet Grade III standard were mainly in Wanzhou 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.

The trophic state index ranged from 36.51 to 70.54 in 2008. 15 river sections of the backwater sensitive zone of the resettlement area were under eutrophication, accounting for 26.3% of the total. Among them, 12 sections were under slight eutrophication, 2 sections intermediate eutrophication, and 1 seriou eutrophication, accounting for 21.0%, 3.5% and 1.8% respectively. 42 sections were under mesotrophic conditions, taking up 73.7%.

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, the same as in 2007. Water quality assessment covered 22 items

(excluding TN and fecal coliforms) as provided in *Environmental Quality Standard for Surface Water* (GB3838-2002), sulfate, chloride and nitrate (calculated by nitrogen).

In 2008, water quality of centralized drinking water sources in county cities and Class I towns of the resettlement region was good. 99.0% of the source areas met water quality requirement, up by 2.1 percentage points against the previous year.

8.2 Environmental Air Quality Monitoring

In 2008, monitoring work of environmental air quality of the resettlement area mainly included the monitoring of urban air quality and precipitation quality.

8.2.1 Environmental Air Quality

A total of 25 ambient air quality monitoring sites were established in the 15 districts (counties) with 31 dust monitoring sites. Monitoring work targeted SO2, NO2, inhalable particles and dust. The *Ambient Air Quality Standard* (GB3095-1996) was applied in the assessment of the environmental air quality.

Urban air quality of the resettlement area improved a little in 2008 as compared with that of 2007 with the drop of comprehensive air pollution index by 3.8%.

The annual average SO_2 concentration was 0.035 mg/m^3, meeting Grade II national air quality standard. The daily average SO_2 concentration was 0.001～0.272 mg/m^3, with 0.59% of the total failing to meet national air quality standard. The highest daily average was 0.81 time of the limit. Among the 15 districts (counties), the annual average SO_2 concentration of

14 districts (counties) met Grade II national air quality standard, accounting for 93.3%, up by 6.6 percentage points compared with that of 2007.

The annual average NO_2 concentration was 0.026mg/m^3, meeting Grade II national air quality standard. The daily average NO_2 concentration was 0.001～0.104 mg/m^3. All the annual average NO_2 concentrations of 15 districts (counties) met Grade II national air quality standard, the same as in 2007.

The annual average concentration of inhalable particulates was 0.084 mg/m^3, meeting Grade II national air quality standard. The daily average particulates concentration ranged from 0.008 to 0.354 mg/m^3 with 4.1% of the 365 days exceeding daily limit. The highest daily average exceeded the limit by 1.36 times. Among the 15 districts or counties, the annual average particulate level of 13 met Grade II standard, taking up 86.7%, down by 6.6 percentage points against 2007.

The annual average amount of dustfall was 5.54 t/km^2 • month, 0.48 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 dustfall amount of 10 districts (counties) was lower than the reference standard, accounting for 66.7%, up by 40 percentage points compared with that of the previous year.

8.2.2 Precipitation Quality

In 2008, 19 precipitation monitoring sites were established in 15 districts (counties) with 783 rain samples collected, 436 of which were acid rain samples. The acid rain frequency was 55.7% and amount of acid rain took up by 62.3% of total precipitation, down by 1.3 and 0.8 percentage points compared with that of the previous year. The monitored pH value of

the precipitation ranged from 3.44 to 8.31, with the average at 4.73. Among the 15 districts or counties, the annual average pH of the precipitation of 11 districts or counties was less than 5.60, taking up 73.3%, up by 13.3 percentage points compared with that of 2007.

8.3 Monitoring of Acoustic Environment Quality

In 2008, the monitoring of acoustic environmental quality in the resettlement areas included monitoring of regional environmental noise, traffic noise and functional area noise. The evaluation work complied with the *Standard of Acoustic Environment Quality* (GB3096-2008).

8.3.1 Regional Environmental Noise

A total of 1429 monitoring grids of regional environmental noise were established in cities and towns of the 15 districts (counties), covering 173.02 sq. km. built-up area. 2-4 times monitoring was carried in 2008.

In 2008, the overall regional acoustic environment of the resettlement area was good with the equivalent sound level at 53.6 dB. Among them, Fengjie County had the highest equivalent sound level at 57.6 dB, 0.8 dB lower than that of 2007. Changshou District posted the lowest level at 49.4 dB. The noise source was dominated by domestic noises, taking up 60.6% followed by traffic noise that took up 22.9%. Among the 1429 noise monitoring grids, 1347 met national noise standard, accounting for 94.3%, up by 5.8 percentage points compared with that of 2007. The percent of monitoring grids meeting Class I, II, III and IV function areas was 78.7%, 95.4%, 100% and 98.9% respectively. Compared with that of the previous year, the meet-the-standard rate went up by 40.2 percentage points in Class I function area and by 4.8 percentage points in Class II function area. That

of Class III and Class IV function area remained unchanged. Among the 15 districts (counties), 8 had good or fairly good regional acoustic environment quality, taking up 53.3%, up by 26.7 percentage points against 2007.

8.3.2 Traffic Noise

A total of 240 road sections in the cities (towns) of 15 districts or counties were established to monitor traffic noise with a total length of 325.72 km. The traffic noise was monitored 2-4 times.

In 2008, the overall road traffic noise of the resettlement was relatively good with average equivalent sound level at 66.5 dB. The average traffic flow was 1,082 vehicles per hour. The total length of trunk road with equivalent sound level over 70 dB was 33.68 km, accounting for 10.3% of the total monitored length. 14 districts (counties) out of the 15 had good and relatively good traffic noise level, taking up 93.3%, up by 20.0 percentage points compared with that of 2007.

8.3.3 Noise of Functional Areas

36 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 121.93 km^2. The monitoring was conducted 2～4 days, once an hour.

In 2008, the daytime and night equivalent sound level of the functional areas of the resettlement area was 55.1 dB and 45.2 dB respectively, down by 1.4 dB and 2.1 dB compared with that of 2007. The day and night sound level was 55.1 dB, down by 1.7 dB against 2007. 6.3% and 19.1% of equivalent sound level in daytime hours and night hours exceeded the limit, both of which were lower than the previous year’s

levels. Equivalent sound levels for daytime and night in all functional areas met the standard.

8.4 Remote Sensing of Ecological Environment

In 2008, multi-source satellite remote sensing was applied for moniotoring of ecological environment of resettlement area the Three Gorges Reservoir area. The time-phase was based on that of 2006.

8.4.1 Land Use and Green Coverage

There was a total of 18345 km^2 land for use and green coverage in the resettlement area. Among this there was 4448 km^2 (24%) woodland planted with coniferous forest and mixed forest. Their distribution defined distinctive geographic features, which can be seen in high altitude and steep areas. These trees grew in areas along mountain ridges. Shrub land covered 4048 km^2 (22%). Most of the shrubberies were scattered at canyon cliff on either side of the trunk of Yangtze River and its major tributaries where were bare bedrock, abrupt slopes and places trees can not grow. The shrubs also grew on hills and places largely affected by human activities with destroyed habitat. There was 2748 km^2 grassland (about 15%), which included natural meadow in high altitude, wild grass land along cliffs, places with bare bedrocks and thin soil layers as well as unused land with sparse herbaceous plant such as bare rocks and soil. Dry arable land accounted for 3695 km^2 (around 20%), dominated by dry land on slopes in low altitude and gentle slope areas. Paddy field covered 1591 km^2 (about 9%), mostly at the bed of river valley, flatland and gentle terrace. Paddy field concentrated in areas west of Wanzhou. There was 395 km^2 (about 2%) cash plantation, of which citrus was the mainstay for tree plantation located on the riverbanks below 600-meter altitude while tea gardens were

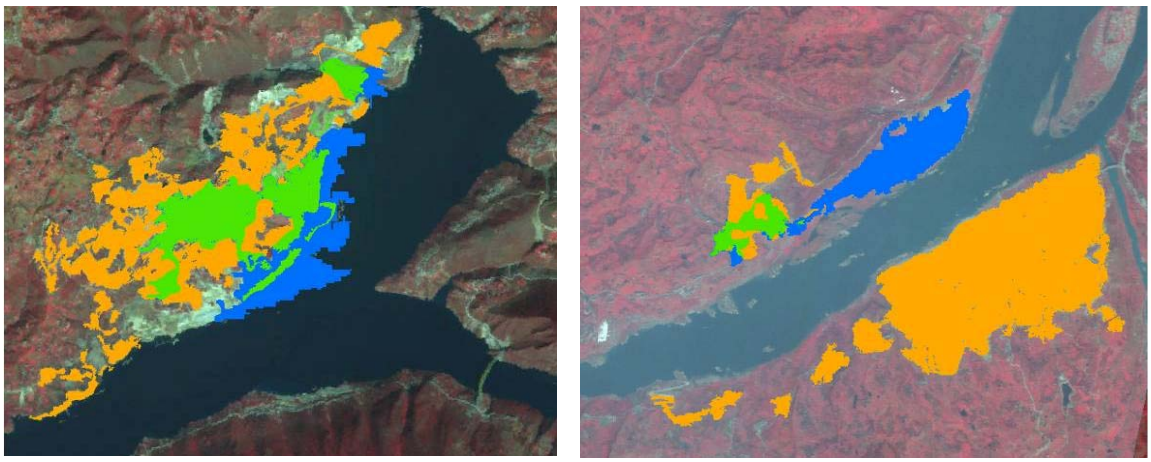
dominant in shrub plantation, whose distribution followed strong geographic rules due to the limit of natural conditions. In addition, waters covered 874 km^2 (about 5%) and dwelling areas & road occupied 476 km^2 (about 3%) in the resettlement area.

8.4.2 Changes of the Built-up Area of the Resettlement Areas

Great changes have taken place in the area, space structure and distribution of cities & towns after receiving the relocated population. County-level districts experienced the biggest change with total area of 2006 increased by 73% against that of 1992. Different types of relocation brought about distinct differences in terms of spatial strcture and urban area.

Districts relocated to and built up in other places saw area increase by 186% on average compared with that of 1992. These urban districts mainly included Fengdu County, Kaixian County, Yunyang County, Fengjie County, Badong County, Xingshan County, Zigui County and dam areas. With complete and well-distributed infrastructure and service systems, the newly built cities enjoy better service functions and ecological landscape. However, the urban expansion was at the cost of quality farmland in flat areas, lead to higher tension between man and land resources. The area of semi-submerged urban districts increased by 58% compared with that of 1992 on the average, mainly including the main districts of Chongqing Downtown area, Banan District, Changshou District, Fuling Distrcit, Wulong County, Zhongxian County, Wanzhou District and Wushan County. These areas embraced both new and old towns. Rebuilding old towns and adjusting city functions has promoted the upgrading and further development of cities.

With a large population and limited land resources in the Three Gorges Reservoir area, urban relocation was largely restricted by landform, particularly several counties in the east. In general, the relocated cities or towns not only expanded their erea, but also enjoyed better landform (from mountainous area to flat ground). According to slope classification of 0-7°, 7-15° and 15° beyond, the proportion of urban areas falling into the three grades in 2006 was 43%, 35% and 22% respectively. Compared with that of 1992, the area falling into 0-7° grade went up by 10%, while the urban area falling into 7-15° and 15° grades dropped by 3% and 10% respectively. However, the gradient of Yunyang County, Zigui County and Badong County increased after their relocation due to the limit of landform.



1) Semi-submerged county (Wushan County) 2) Relocation in other places (Fengdu County)

(Note: blue refers to submerged area, green unchanged area and yellow added area)

Figure 8-1 Change of urban area due to relocation in the Three Gorges Reservoir areas during 1992-2006

Chapter 9 Monitoring and Studies on Ecological Environment

9.1 Monitoring on Eco-Environment of Wanzhou Model Zone

Standard run-off comparison trial for the study and monitoring of eco-environment of Wanzhou model zone continued in 2008 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 has been developed for 7 years till 2008 with evident improvement in soil water retention capacity. Findings of dynamic monitoring of water content at different soil layers (0-15cm, 15-30cm, >30cm) carried out 2 days, 4 days and 8 days respectively after raining showed that on the same day of monitoring, compound farming of grain crops, cash crops and fruit trees on ridges of slope farmland (Pattern I) had the most soil moisture, followed by compound farming of grain crops, cash crops and fruit trees on non-ridge farmland (Pattern II) and flat cultivation of grain crops and cash crops along the slope (Pattern III as the control pattern). Compared with the control pattern, Pattern I demonstrated the best water retention capacity with soil moisture increasing by 17.20% on average two days after raining; and that of Pattern II increased by 6.6%. The same rule applied for soil moisture at different layers under the same cultivation pattern according to monitoring results in two days and four days after raining day. Surface layer enjoyed the most water content, then the middle layer followed by the lower layer. The soil water content after rainfall had the maximum change in Pattern III (control group), followed

by Pattern II and Pattern I.

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 Pattern II, Pattern I had fewer soil particles with diameter between 2 and 0.02mm and more particles with diameter between 0.02-0.002mm and below 0.002mm.

Pattern I also had more soil nutrition than Pattern II and the Control Pattern. The concentrations of various nutrients in the soil of Pattern I farmland were obviously higher than that of Control Pattern except the content of total potassium (increasing demand of potassium by fruit trees led to lower potassium content year on year). On the whole, the concentration of soil nutrients under different land use patterns applied the general rule of more nutrients in the soil of Pattern I, followed by Pattern II and the Control Pattern.

Disregard the amount of rainfall-runoff, Pattern I demonstrated the best result in reducing soil erosion and runoff under different land use patterns on the same monitoring day. Water retention capacity of Pattern II ranked the second, followed by the Control Pattern. Pattern I excelled Pattern II and the Control Pattern in terms of level of nutrients in soil such as organic matter, TN, TP, Kjeldahl nitrogen, quick-acting phosphorus and quick-acting potassium. Nevertheless, the level of total potassium was the highest in the Control Pattern, followed by Pattern II and Pattern I. The concentration of soil particles with diameter below 0.002mm among eroded soil tended to get lower and lower from the Control Pattern to Pattern II and Pattern I. This proved that Pattern I was most effective in conserving water.

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

Monitoring of water content was carried out respectively on the 2nd day, 4th day and 8th day after raining day. The results of dynamic monitoring of water content at different soil layers (0-15cm, 15-30cm, >30cm) revealed that on the same monitoring day shaddock-king grass hedgerows (Fence Pattern) had more moisture than flat cultivation of pure grain crops along the slope (Pure Grain Crops Pattern). There was no regularity in water content of different soil layers (surface layer, middle layer and lower layer) under the same land use pattern. Under the Fence Pattern, soil in the hedgerows was the richest in water and there was little change after rainfall. Water content in the upstream and downstream soil of fences was similar, but there was relatively big change in it after rainfall.

The soil bulk density in the hedgerows and layers between fences of the Fence Pattern increased by 26.5% and 0.7% respectively, while the porosity reduced by 32.8% and 17.8% compared with that of the Pure Grain Crops Pattern (control pattern). The percent of clay particles with diameter ＜0.002 mm went down by 4.2% and there were more particles with diameter between 0.02 and 0.002 mm. This proved the biological fence could enhance soil fertility.

The concentrations of nutrients in all layers of soil of the Fence Pattern such as organic matter, TN and Kjeldahl nitrogen increased by 27.3%, 46.2% and 31.5% respectively compared with the control pattern. TP content in the hedgerows and 0-30 cm soil layers between grew by 33.5% on average. The average reduction of TP was 3.3% and quick-acting potassium in hedgerows and layers between fences fell by 27.4%.

The trial showed that Fence Pattern could effectively reduce soil erosion in slope farmland. Among the 10 rainfalls monitored, 3 rainfalls failed to generate runoff under the Fence Pattern. Levels of nutrients such as organic matter, TN, TP, Kjeldahl nitrogen, quick-acting phosphor and quick-acting potassium were all higher than that of the control pattern. Only TK concentration was lower than that of the control pattern.

9.2 Monitoring on Ecological Environment of Zigui Model Zone

In 2008, 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 2008, a total of 31 precipitation with ≥10 mm were observed across the year; 16 of them generating obvious run-off and soil erosion. Runoff, soil erosion and loss of nitrogen and phosphorus on slope land in the navel orange orchard were more serious than slope farming land.

The run-off coefficient, run-off sediment and N-P loss of the slope of the plots of naked navel orange orchard were 1.1, 2.6, 2.7 and 2.0 times respectively of that of wheat-groundnut plots. Although vegetation cover of navel orange orchard was 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 amount was 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 bigger than that of slope cultivated cropland. The navel orange orchards of the Three Gorges Reservoir 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 should attach more importance to the prevention and control of water and soil erosion and N-P loss.

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 3.5% and 3.8% respectively, soil loss went down by 70-80%; slope nitrogen loss dropped by 27.4% and 37.5%; phosphorus loss dropped by 83.6% and 86.6% respectively. Run-off coefficient of navel orange plot interplanted with day lily fence remained at a low level. The soil loss, nitrogen loss and phosphorus loss of navel orange plot interplanted with day lily fence went down by 72.4%, 49.5% and 55.9% respectively in the same period of 2008 compared with that of navel orange plot without any cover (control plot).

Navel orange orchard with straw mulching 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 soil loss of the navel orange plots interplanted with white flower clover or with straw mulching went down by 73.0% and 61.5% respectively. The total N-P loss of navel orange orchard plot interplanted with perennial white flower clover dropped by 24.7% and 61.9% respectively. The total N-P loss of navel orange plots with straw mulch coverage fell by 27.4% and 58.3%.

During the fruiting period, different land use pattern of the navel orange orchard had certain effect on the slope runoff coefficient. Compared with nornmal navel orange plots, navel orange orchard plot interplanted with groundnut-wheat saw evident increase in runoff coefficient whereas that of navel orange orchard plot interplanted with day lily always remained at a low level. Interplanted white flower clover or straw mulching had certain control effect on slope runoff, but the result was unstable. This might have something to do with straw coverage range and seasonal change in rainfall distribution.

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 2008.

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 5m-7 m.

The monitoring results showed that the annual average groundwater level of all observation boreholes ranged from 21.56 m to 22.49 m with annual maximum of 22.14～23.33 m and minimum of 20.63～21.70 m. The annual fluctuation was 0.90～2.11 m. The phreatic surface changed from 20.90～23.16 m and the water table of confined groundwater varied from 20.63 m to 23.33 m with maximum change at 2.26 m and 2.70 m respectively. The water table of confined groundwater in borehole B and D was slightly higher than that of the previous two years and that of A, C and E was similar to the year 2007. Water table changes of phreatic surface boreholes were similar to that of confined groundwater. Water table in most boreholes was close to that of 2007 with only slightly lower water table in borehole C.

The monthly average of the phreatic surface of all phreatic surface boreholes was 21.08-22.86 m and the water table of all observation boreholes for confined groundwater ranged from 20.86 m to 23.09 m. Monthly average water table peaked from June to September with borehole A and B having highest water table in July and C, D and E in August. The lowest water table appeared in January and February, mostly concentrating in January. High water table period occurred during May-November 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 December. Changes of water table showed that there were double peaks this year. The peak of flood season was not evident and the water table reached its high in October. This might be connected with autumn flood and reservoir operation.

Table 9-1 Groundwater table of each observation borehole from Shimatou to Xiaogang Farm of the Honghu Lake in 2008

Unit: m

Boreholes	Confined water table					Phreatic surface				
	A	B	C	D	E	A	B	C	D	E
Annual average	22.49	21.64	21.76	21.56	21.92	22.13	22.43	22.15	21.98	21.93
Maximum	23.33	22.59	22.58	22.14	22.51	23.01	23.16	22.65	22.38	22.50
Minimum	21.57	20.96	21.05	20.63	21.48	20.90	21.70	21.57	21.48	21.49
Change	1.76	1.63	1.53	1.52	1.04	2.11	1.46	1.08	0.90	1.01

9.3.2 Monitoring on Indicators of Soil Gleization

In 2008, 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. The monitoring was conducted once in the winter and once in summer.

Monitoring results showed that the total amount of reduction materials was 0.25～14.16 cm•mol/kg with the average at 3.54 cm•mol/kg. The concentration of active reduction materials was 0.098～12.48 cm•mol/kg with the average at 2.85 cm•mol/kg. The ferrous concentration was 0.026～0.762 cm•mol/kg with average at 0.357 cm•mol/kg. Compared with that in 2007, there was evident increase of the total concentration of reduction materials and active reduction materials and slight increase of ferrous

concentration. The level of total amount of reduction materials and active reduction materials in summer was 2.22 times and 2.47 times respectively of that in winter, but both margins were smaller than that of the previous years, indicating worsening of soil gleization in winter.

9.4 Monitoring on Terrestrial Plant Communities

From March to October of 2008, investigations were conducted on the plant communities in 145～156 m water-level-fluctuating zone of the Three Gorges Reservoir area. Monitoring sites were set up in typical water-level-fluctuating zone at Shibaozhai, Zhongxian County, Chongqing Municipality, which was to the northern bank of the mainstream of the Yangtze River. 40 types of waterlogging resistant plants were planted in the water-level-fluctuating zone for the observation of plant waterlogging resistance.

A total of 61 types of plant communities were found within 145～156m water-level-fluctuating zone, most were annual herbage dominated by *Poaceae*, *Asteraceae*, *Amaranthaceae* and *Cyperaceae* families which rapidly reproduce by seeds and develop into dominating communities.

The fast growth and community formation of annual herbage plants helped to conserve water and greening land during reservoir recession, thus it might serve as auxiliary means to ecological rehabilitation of the water-level-fluctuating zone. Perennial herbage communities are the most important type for vegetation rehabilitation of reservoir water-level-fluctuating zone. These communities were made up of herbage plants with strong resistance to waterlogging and reproductive capacity, such as *Cynodon dactylon*, *Paspalum distichum L.*, *Hemarthria altissima*,

Cyperus rotundus Linn, *Equisetum ramosissimum Desf.* and *Polygonum japonicum Meisn*, etc.

Monitoring results of fixed monitoring sites suggested that within the 146～156m water-level-fluctuating zone, the higher the elevation was, the more species there were, which meant the longer plants were waterlogged, the less diversity of species was preserved. Additionally, waterlogging would undermine some plants' (eg. mulberry) photosynthetic rate and efficiency of utilizing potential water.

Trial of plant waterlogging resistance and the two-year monitoring investigations of natural rehabilitation of plants within the water-level-fluctuating zone helped to identify 60 plus species of plants for vegetation rehabilitation including 20 more species of woody plant with strong waterlogging resistance and over 40 species of annual herbage that produce large amount of seeds and are able to use seed bank stored in soil for rapid reproduction even after waterlogging.

9.5 Comprehensive Monitoring of Ecological Environment of the Estuary of the Yangtze River

In 2008, 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 2008, 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. Yinyang Section near the river mouth recorded higher salinity. Monitoring results of Daxing Section and Xinglongsha Section were close and lower than that of Yinyang Section.

● **Water Conductivity of the Yangtze River**

The dynamic change patterns of water conductivity of Yinyang Section, Daxing Section and Xinglongsha Section were similar with gradual drop of conductivity in the first half of the year and hitting the bottom in summer. The conductivity then continued to increase, reaching its annual high in September in Yinyang Section, up 47.2% compared with the same period of 2007. Conductivity of Daxing Section started to turn higher than that of the same period of 2007 since October, while at Xinglongsha Section, conductivity was lower than that of 2007 in the first 6 months and higher than the same period during 2003 ~ 2007.

● **Groundwater Table**

In 2008, the dynamic change pattern of the groundwater table of all sections in the estuary area was basically the same, relatively low in the autumn, but high in the summer. Groundwater depth was lower at Yinyang Section in the winter and spring compared to the same period of 2007 and higher in the summer and autumn. Groundwater depth of both Daxing Section and Xinglongsha Section was higher than that of the previous year, and reached their annual highs in May and April respectively.

● **Groundwater Conductivity**

Conductivity of Yinyang Section gradually rose from June to August,

reaching the maximum in August, and then fell step by step. This trend was different from that of the previous years. Conductivity of Daxing Section and Xinglongsha Section gradually climbed in the spring and peaked in May and July respectively. Their change patterns were similar to that of Yinyang Section. In the first half of 2008, groundwater conductivity of Daxing Section was lower than that of the same period of 2007 and in the second half of the year the conductivity increased by 26.6% compared to that of 2007. Monthly average conductivity of groundwater at Xinglongsha Section was higher than that of the same period of 2007.

● **Conductivity of Inland River**

The change pattern of inland river conductivity at all sections in the estuary area conformed to that of the Yangtze River, but the change lagged a little. Inland river conductivity declined gradually in the spring, hovering at its annual low from June to September and then started to rise in autumn and winter. Inland river conductivity of Yinyang Section was higher in the spring and autumn compared to that of the same period in 2007, but that of Daxing Section was lower compared that of the previous year. The annual average conductivity at Xinglongsha Section was slightly higher than the historical average since 2003.

● **Soil Conductivity**

The change of soil conductivity was susceptible to groundwatear (including groundwater conductivity and table) and meteorologic factors (including precipitation and evaporation). Recent years have seen increasingly high concentration of salt in topsoil at Yinyang Section. Its soil conductivity changed a little in the first half of 2008 and gradually rose in the second half. At Daxing Section, soil conductivity in the first 6 months

was higher than that of the same period in 2007 and in the second 6 months it was close to that of 2007. No much fluctuation was found in the soil conductivity of Xinglongsha Section, which was higher than historical values in the first half of 2008 and close to that of 2007 in the second half of 2008. Soil conductivity was higher at monitoring sites close to the bank of Yangtze River.

9.6 Study on Unique Fish Species

In 2008, Institute of Hydrobiology, Chinese Academy of Sciences chose five unique fish species for artificial propagation experiment including *Hemiculter leucisculus*, *Ancherythroculter nigrocauda*, *Megalobrama pellegrini*, *Cyprinidae Bangana* and *Procypris rabaudi*. The experiment successfully produced 77,000 fries of *Hemiculter leucisculus*, 68,000 fries of *Ancherythroculter nigrocauda*, 1,993,000 fries of *Megalobrama pellegrini*, 23 fries of *Cyprinidae Bangana* and 4,000 fries of *Procypris rabaudi*. This accumulated experience for artificial propagation of *Coreius guichenoti* and other unique fish species in the upper reaches of the Yangtze River. Since 2001, 3.97 million fries of six unique fish species have been produced in the artifical propagation trial including *Hemiculter leucisculus*, *Leptobotia elongata*, *Ancherythroculter nigrocauda*, *Megalobrama pellegrini*, *Cyprinidae Bangana* and *Procypris rabaudi*. Now the Institute of Hydrobiology has acquired the technology for artificial propagation of the six fish species, but more effort is needed to improve the hatchability and survival rate of fries.

9.6.1 Experiment of Artificial Propagation of *Procypris Rabaudi*

From April to May, 2008, ocyodinic methods were employed five

times on 62 female *Procypris Rabaudi* with average ocytocic rate of 62.90%, fertilization rate 93.01% and hatching rate 22.30%. It took *Procypris Rabaudi* 10-13 hours to respond to ocyodinic methods. 62,000 fries were ready for cultivation at large area waters five days after birth with the survival rate in this stage being 80.52%.

9.6.2 Experiment of Artificial Propagation of *Megalobrama pellegrini*

From June to July, 2008, birth drugs were used three times on 59 female fish and 54 male fish at the *Megalobrama pellegrini* artificial propagation center at Luzhou Base. The average ocytocic rate was 93.55%, fertilization rate 93.30% and hatching rate 85.40%. 1.8315 million fries were hatched and five days after birth 700,000 fries were able to be cultivated at large area waters. The survival rate of fries was 38.20%.

On July 9, 2008, Institute of Hydrobiology, Chinese Academy of Sciences conducted artificial propagation on *Megalobrama pellegrini*. They chose 9 female fish and 2 male fish from the artificially bred F1 generation. Birth drugs were used for artificial reproduction with ocytocic rate being 100%, fertilization rate and hatching rate being 96.05% and 93.64% respectively.

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