Chapter 10
Green Development and Ecological Construction

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Ecological construction is an important part of green development which fully considers the effect and importance of ecosystem and environment. The Chinese government continued to focus on the protection and construction of ecosystem in the process of green development. During the 11th *Five-Year Plan* period, China had made important innovations and remarkable achievements on ecological policies and methods. Different scales of ecological engineering construction made the ecosystems all over China to get some degree of restoration and protection, and the area of nature reserve also increased largely. There were some new features in the ecological construction recently: first, ecological engineering construction turned from quantity increase to quality improvement; second, the connection of different ecological function regions improved the entire ecological functions; third, the economic functions of ecosystem appeared. These characteristics will be represented in the ecological construction in the 12th *Five-Year Plan*, which will bring the improvement and optimization of ecosystem quality and ecological service function to a new stage of the green development.

10.1 China's Achievements in Ecological Construction During the 11th Five-Year Plan Period

In "2011 China Green Development Index Report", six positive third class indicators were selected to measure the ecological construction in the process of China's green economic growth, namely, water resources per capita, forest area per capita, total standing stock volume per capita, forest coverage rate, the proportion of area of natural reserves in total area of a region and the proportion of area of wetlands in total area of a region. In other words, land greening, biodiversity and water conservation were important parts of China's ecological construction.

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During the past 5 years, under the guidance of correct principles and methods, a series of supporting policies and institutional arrangements were promulgated and implemented. In addition, members of the society participated in eco-environmental protection. Therefore, ecological construction had achieved great achievements during the 11th *Five-Year Plan* period.

In 2000, "*The National Programme for Ecological Environment Protection*"compiled by the State Council of China clearly stated that measures should be taken to prevent the environmental damage and degradation of ecological functions by establishing ecological function protected areas. In 2004, "Circular on Strengthening Biological Species Resources Protection and Management" compiled by General Office of the State Council demanded Ministry of Environmental Protection in conjunction with other departments concerned to develop the protection and utilization plan of national biological species resources. "The 11th *Five-Year Plan* for National Economic and Social Development of the People's Republic of China" and "*The Decision of the State Council on Implementing the Scientific Development View and Strengthening the Environmental Protection"* both pointed it out that the construction of the important ecological function protected areas should be regarded as one of most important missions contributed to the main function areas construction. In addition, the ecological function of the key ecological function protected areas should be maintained stable and the utilization of species resources should be reasonable and the prevention of its loss should be rigorous. In October, 2007, with the consent of the State Council, Ministry of Environmental Protection issued the "National Biological Species Resources Protection and Utilization Plan" (referred to as "Species Plan") and "The Outline of National Plan for Key Ecological Function Protected Areas" (referred to as "Ecological Function Protected Areas Plan") at the same time, which indicated China's major ecological principles and methods in the 11th *Five-Year Plan* period.

"Species Plan" proposed strategic thinking and tasks on protection and utilization of species resources. First, five principles on protection and utilization of species resources were determined, which were the principle of state sovereignty, scientific principle, the principle of conservation priorities, the principle of coordination between conservation and utilization and the principle of participatory. Second, propose the overall objective of national biological species resources protection and utilization in the next 15 years. Furthermore, the implementation would be divided into 3 five-year period. By 2010, the current dramatically reduction trend of biological species resources would be curbed. Furthermore, the loss of biological species resources would be controlled by 2015 and the biological species resources would be protected effectively by 2020. Third, the recent and medium-long term planning tasks covering the 12 critical areas were determined, including the traditional knowledge and exit-entry administration of animals, plants and microorganisms. Fourth, 10 priority actions and 55 priority projects were proposed during the national biological species resources protection and

utilization during the 11th *Five-Year Plan* period, thus specifying the focus direction of fiscal funds.

"The Outline of National Plan for Key Ecological Function Protected Areas" defined the guiding ideology, basic principles and main tasks of construction of the ecological function protected areas based on the characteristics of ecological function protected areas. Firstly, ecological function protected areas were delineated regions with certain areas, which special protection were undertaken and development and construction were restricted due to its important ecological regulation effects, including water conservation, soil and water conservation, regulation of floods, sand—fixing, and maintenance of the biological diversity, etc. Secondly, key ecological function protected areas belonged to the restricted zone, which should be adhered to the principles of protection priority, development restraint, duplication avoidance and complementary during its construction. Under the principle of protection priority, these areas supposed to select development directions rationally, develop special advantage industries, strengthen ecological environmental protection and restoration, increase the intensity of ecological environment monitoring and protect and regenerate the regional ecological functions. Finally, local offices of ecological function protected areas should focus on the following three aspects in their work during the 11th *Five-Year Plan* period pointed by the "Plan Ecological Function Protected Areas". The first one was improving leadership in industry development reasonably, including developing ecological agriculture, ecological forestry and eco-tourism activity; limiting the high pollution, high energy consumption and high material consumption industries, which should be eliminated in accordance with law if they got serious pollution, serious damage to the regional ecology and serious resources waste; promoting the development of biogas, wind, small hydro, solar, geothermal and other clean energy industries activity to meet the rural energy needs and reduce the destruction to natural ecosystems based on the difference in resources. Secondly, protect and restore ecological functions following the principles of first urgent, focused, protection priority, active management, actions under local circumstances and damage, in conjunction with the implemented or planned ecological management projects there. Furthermore, increase the protection and regeneration efforts of region's natural ecosystem and improve the ability of water conservation, regeneration of soil and water conservation function, sand-fixing function, flood storage capacity and regional environmental quality. Thirdly, strengthen the environment regulatory. Via strengthening laws, regulations and monitoring capacity and strengthening monitoring and scientific research, the management would raise the level of ecological and environmental monitoring, prediction and early warning. Moreover, intensifying publicity and education could enhance the public's awareness of protecting the ecological safety of region and basin consciously.[1]

[1] Ministry of Environmental Protection: "National Biological Species Resources Protection and Utilization Plan" and "The Outline of National Plan for Key Ecological Function Protected Areas". http://news.xinhuanet.com/politics/2007-12/24/content_7304472_3.htm,2011-04-13.

In short, the 11th *Five-Year Plan* period got extraordinary development in the history, especially on eco-friendly construction of China. During the past 5 years, Chinese government focused on the construction of critical ecological function areas and protection of biodiversity, and took the emission of the main pollution reduction as the binding index of economic and social development planning and made great change on ecological protection from acknowledgement to practice. During the 11th *Five-Year Plan* period, China had intensified the work on ecological construction and environmental protection to make sure the water resources had been protected effectively and afforestation had been improved and the construction of nature reserves and wetlands had been pushed forward.

10.1.1 Effective Protection of Water Resources

In the early 2008, from the strategic perspective of construction of ecological civilization, Present Hu Jintao proposed that lakes and rivers should recuperate, which became the national guiding ideology of comprehensive management of water environment and water resources. Subsequently, the State Council transmitted "The Key Water Pollution Control Planning Appraisal of the Implementation of Interim Measures". Meanwhile, the water quality evaluation system of crucial watershed based on trans-boundary section had been established.[2] By the end of 2009, the rate of completed pollution control project in planning had achieved 64.9 %. In addition, 80.1 % of water quality in the section was up to the standard. Under cooperation of three provinces, Heilongjiang, Jilin and Inner Mongolia autonomous region, Songhuajiang basin had achieved remarkable progress in comprehensive management. Water quality on 201 sections was assessed in seven hydrographic net of Hebei Province and the basin ecological compensation mechanism had been established. Jiangsu province improved the water quality of Taihu Lake by contributing to machine of appointing government officers as the leader of water resources commission. Shandong province adopted the approach of "rule, use, security" to restore the provincial key pollution controlled rivers, therefore, fishes regenerated in all rivers there. In 2009, permanganate index average concentration of the national state-controlled sections was 5.1 mg/L, decreased by 29 % compared with the year 2005. The rate of water quality which was better than Grade III of state-controlled sections in seven major river systems increased from 41 to 57 % since 2005.

In addition, during the 11th *Five-Year Plan* period, the government pushed the work of safeguarding the security of drinking water. Ministry of Environmental Protection organized governments at all levels to survey water resources area

[2] Zhou Shengxian, Rely firmly on the core of the new requirements of the theme and the main line, strive to create a new situation of environmental protection- Zhou Shengxian, Minister Speech at the 2011 National Conference on environmental protection. http://www.zhb.gov.cn/gkml/hbb/qt/201101/t20110120_200070.htm.

environment, assessed environmental conditions of 226 centralized drinking water source areas in key environmental protection cities and supervised the implementation of environmental protection requirements. "National Environmental Protection Plan of Urban Drinking Water Sources (2008–2020)" had been compiled and publicized, which proposed that the rate of national drinking water source areas with water quality standardized was no less than 90 % by 2015 and stabilized at 95 % by 2020.

10.1.2 The Constant Increase in Afforestation

On March 12, 2011, the office of the national afforestation committee released the "2010 China Land Greening Situation Bulletin". According to relevant data in the bulletin, during the 11th *Five-Year Plan* period, the afforestation increased constantly, mainly in the following areas. First, the national voluntary tree planting flourished. According to statistics, there were 590 million people participating in voluntary tree planting and 2.603 billion trees were planted in 2010. By the end of 2010, the number of people participated in voluntary tree planting reached to 12.7 billion. Meanwhile, 58.9 billion trees were planted. Second, key forestry afforestation projects got remarkable effect. Government gave priority to key forestry ecological engineering construction, taking reform of Collective Forest Right System as driving force, focusing on the mechanism innovation, vigorously carrying out afforestation in barren hills and nearby places and constructing the base of featured economic forests, carbon sink forests and energy forests. In addition, quality of native and rare species was strengthened to cultivate, consequently, completing the planting area to 5.9225 million hectares for the year 2010. Third, urban greening made steady progress. During the 11th *Five-Year Plan* period, that was, by the end of 2010, the urban greening covered an area of 1.4945 million hectares. Meanwhile, green areas reached to 1.3881 million hectares and park green area accounted for 401,600 ha. The proportion of the green coverage in the built-up region reached 38.22 % and the rate of green area arrived at 34.17 %. In addition, per capita park green area was 10.66 square. Fourth, departments carried out greening actively. Greening Committee of departments under the Party Central Committee and the direct subordinate organs of the Central State Organs carried out voluntary tree planting, garden virescence and beautification activities. In 2010, the government built over 120,000 squares new green space for the whole year and rebuilt more than 200,000 square green space. Via urban and rural areas hand in hand activities in voluntary tree planting, central government organs positively supported greening in suburbs of the capital and new rural construction. Fifth, the effect of the prairie construction was evident. During the 11th *Five-Year Plan* period, the government contributed to prairie protection and construction projects, including "Return Grazing to Grass", "Jing-Jin Sandstorm Source Control Project", grassland governance in karst mountainous area in southwest China and the Nomadic settlement projects. As a consequence, regeneration momentum of prairie vegetation was much

better in these areas and the ecological environment ameliorated significantly, for instance, the vegetation coverage, height and biomass improved evidently. By the end of 2010, the national accumulative area of grass preservation was 22.6667 million ha., while grassland fencing area was 73.3333 million hectares and grass grazing, rotational grazing grassland was 0.107 billion hectares. Sixth, protection of forests and grassland was strengthened. During the 11th *Five-Year Plan* period, the prevention and control of national forests and grassland pests had made new progress, mainly on intensifying the prevention and control of forest pests, including pine wood nematode, American white moth, rat and rabbit damage, *Mikaniamicrantha* and other pests with significant risk, besides, the number of pine wood nematode disease in county-level epidemic points showed a decrease trend for the first time and the proliferation had been primary curbed. In 2010, the occurrence area of national major forestry pests was 11.9893 million hectares and the prevention area reached 8,296,700 ha. Moreover, the area of non-pollution control reached 6.548 million hectares. The area of controlling grassland rodents was 6.6667 million hectares and that of controlling insects was 400 ha grassland, by which direct economic loss was reduced by nearly 1.6 billion Yuan. Seventh, afforestation policy mechanism continued to be improved, especially in the reform of Collective Forest Right System which got significant benefit. By the end of 2010, 18 provinces, autonomous regions and municipalities directly under the jurisdiction of the central government all over the country had completed there form tasks of property rights clarification of Collective Forest Right System and land contracted to home. 162 million hectares of forest land was declared collective, which took 88.6 % of the total area, with 134 million hectares forest area and 72.6 million farmers issued warrants. Consequently, more than 300 million farmers benefited from it directly. Reform of Collective Forest Right System allowed peasants to become the owner of forests, which stimulated the peasants' enthusiasm in afforestation.

Column 10.1 Libo, Guizhou: An Emerald on the Belt of the Earth

Libo is known as an emerald on the belt of the earth. It is a minority mountain areas in the southern part of Guizhou province, which is located in 107°37′ ∼ 108°18′E, 25.7° ∼ 25.9°N. It is next to Congjiang and Rongjiang from Northeast, Huanjiang and Nandan from Southeast, Dushan from the west and Sandu County to the North. The county covers the area of 8459 ha and has a forest cover rate of 53.96 %. 6 towns, 11 villages (5 autonomous villages included), 170 villagers' committees and 4 residence committees were under the administration of Libo. Meanwhile, it is a typical example of cone karst topography existing in the transitional belt from Guizhou Plateau to Guangxi Basin, which has been considered to be a typical representative of South China Karst. Libo is the only green land on this latitude in the world, sparsely populated and full of strong vegetation, of which the rain thermal condition is superior, like a green gem isolated itself from the outside world. Libo was also one of the poorest 90,000 mountain counties supported by the state, where the transportation was inconvenient, culture was relatively backward, productivity level was low

and peasants in rural communities and forest areas were under the line of extreme poverty for a long term. Since the national "87" poverty alleviation programme was implemented, Libo stuck to the road of "eco-development industrialization and ecological industry development" to create tourism-dominated city, with the goal of building "international professional tourist city". Libo was crowned with the World Natural Heritage title in 2007 for its fine example of Karst topography. The ecological system in Libo County has been well protected and the karst park here is now the most probable Chinese natural scenic spot that could be listed on the World Natural Heritage list. In 2008, its years of hospitality was 1.68 million, 71.1 % increased on the year; tourism direct revenue reached 19.98 million Yuan, an increase of 84.32 %; integrated tourism revenue was 0.326 billion Yuan, with an increase of 83.52 %; the county total retail sales of social consumer goods were up to 323.17 million Yuan, an increase of 26.24 %; average net income of peasants reached 2 618 Yuan, an increase of 21.27 %. "World Heritage" not only effectively promoting leap-forward development of the LIBO County Tourism, but also effectively promote the growth of services and the improvement of people's livelihood, meanwhile, Libo have markedly improved and repaired the ecological environment.

On March 1, 2011, "Libo County National Ecological County Construction Planning" (referred to as "Planning") reviewed in the meeting held by Guizhou Province Environmental Office, which clearly pointed out that : 2011–2018, Libo County would be expected to invest 1.7 billion Yuan in 5 key areas, which were ecological industry system construction, ecological environmental protection and construction, project of municipal facilities and the environmental pollution control, eco-residential construction, and integrated capacity-building, besides, 86 key projects would be under construction to reach national ecological County standard basically. It implies that Guizhou province takes a great step forward to the construction of ecological civilization with the characteristic of development, prosperity, and ecological soundness, with ecological county as a carrier.

Sources:

1. Baidu encyclopedia. http://baike.baidu.com/view/339007.htm,2011-05-12.
2. PeiYu, LIBO, road to "heritage",Guizhou ethnic minority report, 2011-03-21.
3. Reviewing on Libo County National Ecological County Construction Planning, official website of the Office of environmental protection in Guizhou province, 2011-05-13.

10.1.3 Nature Reserves and Wetland Construction Continued Promoting

China continued to promote the construction of nature reserves and wetlands, aimed at strengthening the construction of key ecological functional area and the protection of biological diversity. In 2010, China established the National

Committee for international year of biodiversity under the leadership of Chairman LiKeqiang and released "2010 International Year of Biodiversity China Action Plan". China State Council Executive meeting deliberated to set up "The Biodiversity Conservation Strategy and Action Plan of 2011–2030", then carried out activities for the international year of biodiversity.

By the end of 2010, the number of national forest nature reserves, including forest ecosystem, wetland ecosystem, desert ecosystem and wildlife protection area, was 2035, covering 124 million hectares, accounting for 12.87 % of the whole national area. These nature reserves had ready protected 90 % types of terrestrial ecosystem, 85 % of wildlife populations and 65 % higher plant communities effectively; therefore they played a pivotal role in maintenance of biodiversity. In addition, the protection and restoration of wetland ecosystem moved forward, including the implementation of "Chinese Wetland Protection Engineering Planning 2005–2010" and establishing a special central financial fund for protection of wetland. Furthermore, establish wetland parks, take its obligations seriously under the "Convention on Wetlands of International Importance Especially as Waterfowl Habitat", improve the construction of protection system of wetland continuously, and modify the ecological crisis and degradation of wetland effectively. In 2010, 45 new parks were added. At present, the total number of national wetland park reached 145, of which 37 were wetlands of international importance, covering 18.2 million hectares. Consequently, 50.3 % of the wetlands were effectively protected.

During the 11th *Five-Year Plan* period, 192 all types of nature reserves were newly established. The area of terrestrial nature reserves accounted for 14.72 % of land area and China continued to improve the work system of ecological construction demonstration zone, building up 11 national ecological counties (cities). Government released "Guidelines of the National Key Ecological Function Protected Areas Planning", "The National Ecological Function Zoning" and other important policies. Some provinces with key ecological function continued to focus on strengthening the ecological security, for instance, Tibet Autonomous Region invested over 10 billion Yuan to construct the ecological security barrier project. Yunnan province set up a foundation for biodiversity conservation and Qinghai province strengthened the ecological monitoring and protection project of three-river sources vigorously.[3]

Column 10.2 Lalu Wetland: Lung of Lhasa

Lalu wetland is located in the northern part of the capital city of Lhasa in Tibet Autonomous Region. The total area of Lalu wetland is 12.2 km^2, of which the core area is 6.6 km^2, accounting for 11.7 % of the built-up area of Lhasa and its average elevation is 3,645 m. It is a typical Qinghai—Tibet plateau wetland,

[3] National Afforestation Committee. 2010 Communiqué on China Land Afforestation Status.

belonging to the sedge peat swamp. Lalu is the highest and largest natural wetland in urban areas in the world, since it was listed as a provincial nature reserve in the late 1990 of the twentieth century. It gradually becomes home to Huang Ya, Bar-headed Goose and other migratory birds, besides, black—necked crane and other protected birds perch here, which makes Lalu a "bird's nest" in a real city. On July 23, 2005, Lalu was officially approved to be a national nature reserve by the State Council.

Lalu has more than 300 species of plants, 43 species of terrestrial wildlife, over 30 species of aquatic wild animals and 101 species of insects, making it a real "gene pool" of plateau biological species. Vegetation covers more than 50 % of its core area, of which Phragmites and Cyperaceae are the main plants. Due to the lush plant growth, transpiration is 3 times of that in grassland vegetation communities; therefore, water in Lalu wetland can be transported into air through the Meadow plants in the light continuously to increase the content of moisture in air and the humidity in Lhasa. In this sense, Lalu is a natural "humidifier". Every year around 3,000 wild migrant birds fly back for winter, which becomes an ecological harmonious image of a scene vividly.

Lalu is the main supply source of oxygen for Lhasa. Grass here grows well, which can absorb 78,800 tons of carbon dioxide and producing 53,700 tons of oxygen through photosynthesis every year. In addition, known as "the Lung of Lhasa ", Lalu is agiant air purifier and a water filter, which can absorb 5,475 tons of dust in the air each year and handle more than 10 million tons of sewage.

The Lalu wetland is acclaimed as 'the Lung of Lhasa' for its significant role in protecting Lhasa's environment. Lalu Wetland has been listed as an autonomous region-level nature reserve. A preservation scheme with an investment of over 100 million Yuan (US$12 million) has been launched. Recently as part of this input, the local environmental protection department has set up an automatic monitoring site to record temperature and humidity in the wetland.

From the beginning of the Lhasa city planning, District Government decided to give priority to ecological and environmental protection by abandoning the planning of changing the Lalu superior location and fertile soil of the area into building land and agricultural land. During the construction period of Lalu wetland nature reserve, government overcomes all kinds of difficulties. For example, close the quarries around the wetlands and other sources of pollution. At present, Lalu wetland has become a propaganda base for environmental protection education in Tibet and the window to display achievements of regional ecological environmental protection.

There are over 40 nature reserves like Lalu in Tibet, of which there are 9 national ones and 6 provincial ones. During the 11th *Five-Year Plan* period, funding for environmental protection and ecological construction of Tibet Autonomous region reached 10.1 billion, which was more than 3 times than that of Tenth Five-Year period. As data showed that by 2010, Tibet had established 47 nature reserves, which covered an area of 413,700 km^2, nearly 35 % of land area in Tibet, which was second to none in the national territory, making a significant contribution to the state work of ecosystem protection. 125 species of national protected wildlife and

39 species of national key protected wild plants are protected well. In addition, Tibet takes the lead in starting the country grassland ecological protection incentive pilot, establishing compensation system for forest ecological benefits. More than 150 million acres in all the 65 districts were included in public welfare forest compensation system. Afforestation area reached 0.11473 million hectares, sand prevention and control 42,666.6 ha, conversion of cropland to forest 39000 ha, returning cropping land to forage land 3.94 million hectares. The state key ecological functional area transfer payment work has been done.

On March 1, 2011, "Wetlands Protection Ordinance" officially christened in Tibet, thereby it made Tibet the first region that had the legal protection of wetland resources in China's history, which was significant for Tibet, especially in terms of the largest wetland in China there. Protection of wetland resources is an important part of engineering system of ecological environment protection in Tibet. Tibet treasures both of protection and development and vigorously supports the "Barrier Protection and Construction of Ecological Security in Tibet" project; therefore, the ecological environment has been improved and will be better and better.

Sources:

1. Zhaxi, Tibet constructs the ecological security screen. http://www.chinadaily.com.cn/hqgj/jryw/2011-03-20/content_2069048.html,2011-03-20.
2. Deyongjian, The exploration to highest city "bird's nest"—Lalu wetland.http://www.chinadaily.com.cn/dfpd/xizang_hjbh/2011-04-14/content_2307360.html,2011-04-14.

10.2 Regional Comparison of Ecological Construction in Green Economic Development in China's 11th Five-Year Plan Period

10.2.1 Region Comparison of Ecosystem Status

The 11th *Five-Year Plan* has been significantly modified in ecosystem conservation and restoration. In the perspective of region configuration, the restoration of ecological function regions, including natural forest protection zones and important water self-restraint zones, has been emphasized, which formed a regional ecological security patterns.

Water Ecosystem

Water pollution is one of the most important factors which affect water ecosystem function. The 11th *Five-Year Plan* focused on the water pollution control and

water source conservation, which is a difficult task, because it is varied in different geographic locations and development characteristics. The "national science and technology key projects on water pollution control and management" were launched by the Chinese government during 11th *Five-Year Plan* period (2007), which eased the situation of water pollution to some extent. Quality of water ecosystem varied in different regions, which were related to the economic development conditions.

According to the proportion of the water which is worse than grade V, water ecological conditions varied significantly in different regions of China (Fig. 10.1). The proportion of highly polluted water which is worse than grade V without ecological functions could represent the healthy condition of water ecosystem in a basin. The water pollution in Haihe River area was most seriously in different basin areas in 2009, and the proportion of grade V-plus water was more than 50 %. All the proportions of grade V-plus water were over 20 % in Liao River, Yellow river, and Huai River areas, which connected with their industry developments. South eastern River, Yangtze River, and Pearl River areas were polluted lighter relatively. Because of slow growth rates of industry, the rivers in northwestern and south western river areas were polluted lighter. The water qualities of serious polluted basins were improved compared with the conditions in 2005 in some extent, and the most obvious case was Huai River area. The similar case can be seen in Pearl River area. However, water qualities in the southeastern, northwestern and southwestern river areas became worse slightly.

Lake is special among all the water ecosystems, because it is a closed system, which always challenges restoration after pollution. Water pollution always brings a serious damage to the ecosystem, and it is difficult to eliminate and control. As the monitoring data shows in Table 10.1, water quality in Dianchi Lake was still worse than grade Vin 2009. The water quality in Chaohu Lake had already fallen down from grade IV–V to grade V-plus. The water quality in Taihu Lake fell from grade III to grade V-plus, and the water quality in Baiyangdian Lake, Nansihu Lake, Namtso Lake, Poyanghu Lake and Honghu Lake was grade V or grade IV, which were belong to polluted water. The water quality in Qinghai Lake and Fuxian Lake were better, grade II. However, nearly half of the 15 lakes in our census were suffered from eutrophication. Eutrophication reveals the unbalance of ecological community in the lake ecosystems, which may be in danger of ecosystem breakdown.

Wetland has been recognized as the "kidney of the earth", which is one of the most important ecosystem types in the world for its powerful functions. Wetland performs a crucial role in local ecosystem regulation and sustainability. 550 wetland nature reserves, 100 national parks, 120 local wetland parks and 37 international important wetlands were established in 2010. 18.2 million hectares natural wetlands were efficiently protected, which was about 50.3 % of all natural wetlands.[4] The wetland coverage was more than 50 % in Shanghai due to the

[4] State Forestry Administration. Report on Economic Performance of Forestry Industry in 2010. http://www.forestry.gov.cn/portal/main/s/304/content-458701.html.

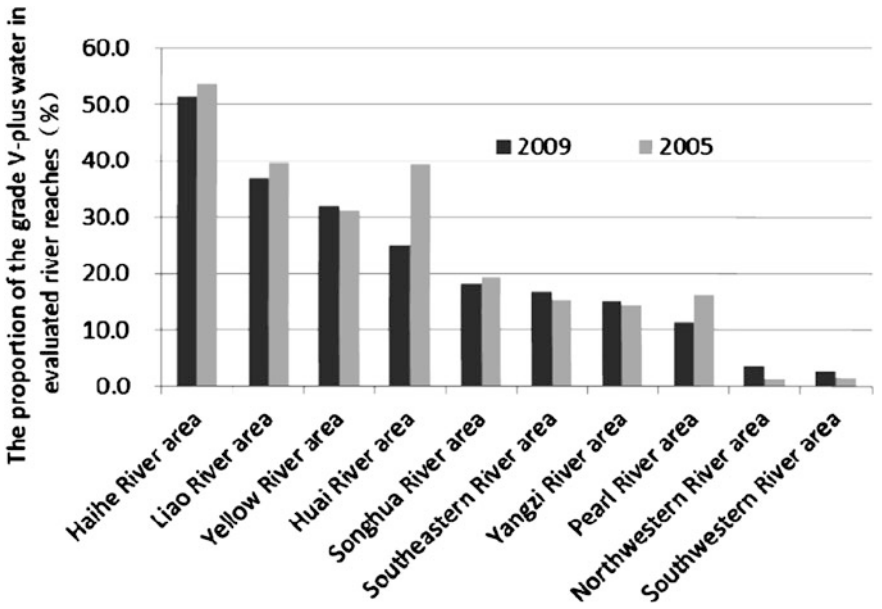

Fig. 10.1 Water qualities in different basin areas in China. (Grade V-plus water belongs to seriously polluted water which does not have ecological and environmental functions). *Sources* National Bureau of Statistics of China. China Statistical Yearbook of Environment China Statistical Yearbook of Environment 2006, China Statistical Yearbook of Environment 2010. Beijing:China Statistics Press, 2006, 2010

advantage of outfall, was more than 10 % in Jiangsu, Tianjin and Shandong, and was lowest in Guizhou, Chongqing, Yunnan, Xinjiang and Shaanxi, which located in southwest and northwest China. Considering the absolute value, the largest wetlands were in Tibet (5,232,000 ha.), Heilongjiang (4,314,800 ha.), Inner Mongolia (4,245,100 ha.), Qinghai (4,126,000 ha.) and Shandong (1,784,100 ha.); while the smallest wetlands were in Beijing (34,400 ha.), Chongqing (43,200 ha.), Guizhou (79,400 ha.), Tianjin (171,800 ha.) and Yunnan (235,300 ha.).[5] These wetland ecosystems, integrating with 201 wetland conservation and restoration projects during the 11th *Five-Year Plan* period, constructed the wetland conservation network primarily and would perform their holistic roles progressively[6] (Fig. 10.2).

[5] National Bureau of Statistics of China.China Statistical Yearbook 2010.

[6] National Bureau of Statistics of China. http://www.stats.gov.cn/tjfx/ztfx/sywcj/t20110310_402709535.htm.

Table 10.1 Water qualities of large lake ecosystems in China (2009)

Lake name	Districts	Evaluation area (km^2)	Water quality grade		Nutrition state
			2009	Contrast 2005	
Baiyangdian	Hebei	113.5	V		Moderate eutrophication
Taihu	Jiangsu, Zhejiang	2 338.0	V-plus	III	Moderate eutrophication
Hongzehu	Jiangsu	2 152.0	III		Moderate eutrophication
Luomahu	Jiangsu	625.0	III		Mild eutrophication
Chaohu	Anhui	110.0	V-plus	IV-V	Moderate eutrophication
Poyanghu	Jiangxi	2 184.0	IV		Moderatenutrients
Nansihu	Shandong	1 266.0	V		Mild eutrophication
Honghu	Hubei	395.4	IV		Mesotrophy
Dianchi	Yunnan	300.0	V-plus	V-plus	Moderate eutrophication
Fuxianhu	Yunnan	212.0	II		Mesotrophy
Erhai	Yunnan	250.0	III	II	Mesotrophy
Namtso	Tibet	1 920.0	V		Mesotrophy
Pumo Yum Tso	Tibet	284.0	III		Mesotrophy
Qinghai	Qinghai	4 247.0	II		Mild eutrophication
Bosten	Xinjiang	251.0	III	IV-V-plus	Mild eutrophication

Notes

[1] The selected lakes were large ones whose evaluation areas were more than 100 km^2 in 2009. Some data in 2005 was missing. Taihu Lake contained Wulihu in Shanghai

[2] Environmental quality standards for surface water(GB 3838–2002): Grade I, mainly for source water and national nature reserves; Grade II, mainly for Grade 1 protection areas for centralized potable water source, rare aquatic habitats, fish and shrimp production field, juvenile fish feeding ground, etc.; Grade III, mainly for Grade 2 protection areas for centralized potable water source, fishing waters for fish and shrimp wintering ground, migration pathway and aquaculture areas and swimming areas; Grade IV, mainly for general industrial water areas and entertainment water areas non-directly touched by body; Grade V, mainly for water areas for agriculture and general landscape requirement; Grade V-plus, seriously polluted water which does not have ecological and environmental functions

[3] According to the lake (reservoir) eutrophication evaluation method and classification technology regulation, lake (reservoir) eutrophication evaluation index uses chla, TP, TN, SD and CODMn as water comprehensive nutrition state evaluation index

Source National Bureau of Statistics of China. China Statistical Yearbook of Environment 2006, China Statistical Yearbook of Environment 2010. Beijing:China Statistics Press, 2006, 2010

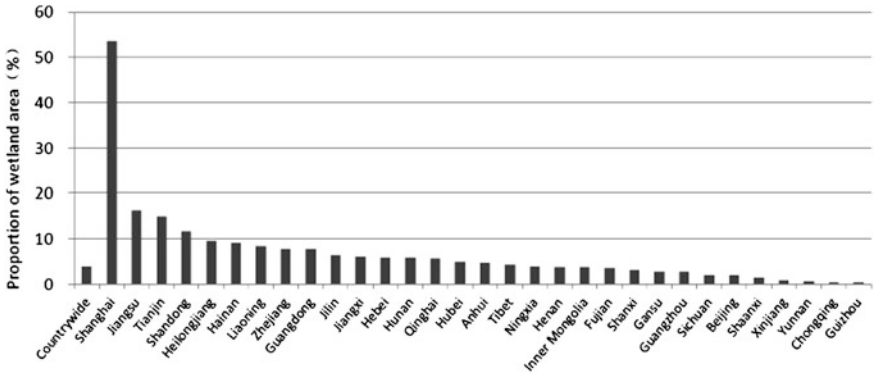

Fig. 10.2 Inter-provincial comparison of the wetland area proportion in China *Note* this chart was drawn according to China's first wetland survey (1995–2003) material, not including Taiwan, Hong Kong and Macao. Wetland area did not included paddies wetland. *Source* National Bureau of Statistics of China. China Statistical Yearbook 2010. Beijing:China Statistics Press, 2010

Forest Ecosystem

As the most important terrestrial ecosystem type, forest has significant ecological functions, including headwater and soil conservation, carbon fixating and oxygen releasing, organics accumulating, air cleansing and biodiversity conservation. As the 7th National Forest Inventory (NFI) (2004–2008) showed, the forest status during the 11th *Five-Year Plan* period were: forest coverage rate was not less than 20 % in 21 ones among all 31 provinces, was more than 50 % in only 5 provinces, including Fujian (63.10 %), Jiangxi (58.32 %), Zhejiang (57.41 %), Guangxi (52.71 %) and Hainan (51.98 %), was less than 10 % in 5 provinces, including Xinjiang (4.02 %), Qinghai (4.57 %), Tianjin (8.24 %), Shanghai (9.41 %) and Ningxia (9.84 %) (Fig. 10.3). The most regions with low forest coverage rate were located in arid region of northwest China and some circumlittoral developed regions, which illustrated that the forest distribution was affected by climate factors and economic development conditions.

The regional characters of forest ecosystem change in the 11th *Five-Year Plan* period could be realized by comparing 7th National Forest Inventory (NFI) (2004–2008) with the 6th one(1993–2004) (Fig. 10.4). The largest net growth of forest area was 23,442,600 ha of Inner Mongolia, about 10 % of national net growth. Based on the monitoring results, both desertification and sandy land areas declined in Inner Mongolia during the 11th *Five-Year Plan* period. The desertification expansion had been under control in key control areas around the 5 large deserts (Badainjaran, Tenger, Kubuqi, Ulanbuh and Bajanondor), and the desert area was relatively stable. The forest and grass coverage in all the 5 large sandy lands (Mu Us, Otindag, Horqin, Hulunbeir and Ujimqin) was increased, and the sandy area had shrunk. The ecological condition in Horqinsandy land and Mu Ussandy land reversed fortunately. 16 million hectares sandy land and 10 million

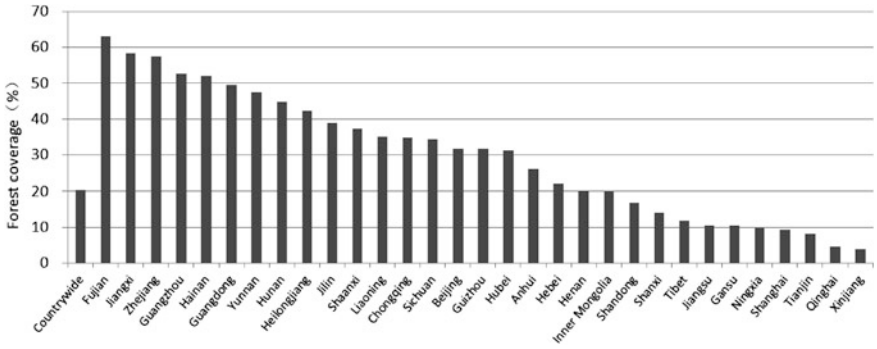

Fig. 10.3 Inter-provincial comparison of forest coverage rate in China. *Note* this data was from the 7th National Forest Inventory (NFI) (2004–2008). The countrywide count included Taiwan, Hong Kong and Macao. *Source* National Bureau of Statistics 19361212 of China. China Statistical Yearbook 2010. Beijing:China Statistics Press, 2010

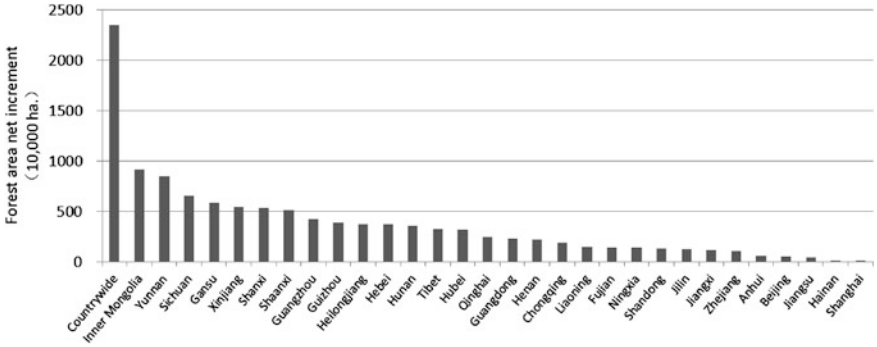

Fig. 10.4 Inter-provincial comparison of net increment of forest area between two forest resources inventories in China *Notes* this data was from the 6th (1993–2004) and 7th (2004–2008) National Forest Inventory (NFI). The countrywide count included Taiwan, Hong Kong and Macao. *Sources* National Bureau of Statistics of China. China Statistical Yearbook 2006, China Statistical Yearbook 2010. Beijing:China Statistics Press, 2006, 2010

hectares soil erosion area were under control, 4 million hectares farmland and 5.3 million hectares pasture and meadow was well protected by forest network.[7] In addition, forest coverage rate was also highly increased in the provinces where large potential area could be used to reforestation because of low vegetation coverage or serious ecosystem damage, such as Yunnan (9,160,800 ha.), Sichuan (8,473,200 ha.), Gansu (6,558,100 ha.), Xinjiang (5,825,000 ha.), Shanxi (5,463,900 ha.), Shaanxi (5,354,100 ha.) and Guangxi (5,126,200 ha.).Because of high vegetation coverage in Hainan, Zhejiang and Jiangxi and high development in Beijing, Shanghai and Tianjin, their potential forestation area was relatively limited, and the forest net growth was not obvious compared with other regions.

[7] Inner Mongolia Broadcast Net. http://www.nmrb.cn/Item/240455.aspx.

Nature Reserve

The major tasks of nature reserves included national nature reserve establishment and improvement, critically endangered species salvation and conservation, and important nature reserves (e.g. three-river-source) construction in the 11th *Five-Year Plan* period.[8] Under this guidance, the nature reserve distribution characters were formed (Fig. 10.5). The proportion of nature reserve area was 15 % in China, which already beyond the 13 % as one of the objectives in the 11th *Five-Year Plan.*[9] The two largest proportions of nature reserves in China were in Tibet (34.51 %) and Qinghai (30.28 %), which suggested that the government paid high attention to protection of the river source ecosystems. Taking three-river-source nature reserve as an example, the area of major lakes increased by 245 km^2, and desert ecosystem area decreased by 95.63 km^2 from 2004 to 2009.Vegetation coverage was increased by 23.2 % in average in grassland desertification control area, and was increased by 80 %in Heitutan control area. Vegetation coverage reached 90 % in returning cultivated land to grassland area. Three-river-source ecosystem provided 16.89 billion $m^3$of water to the downstream area every year, increased by 4.46 billion m^3 compared with the count of 12.43 billion m^3 during 1975–2004.[10] Other nature reserves located in Sichuan, Shanghai, Heilongjiang, and Xinjiang were established for protecting important ecosystems, while some were located in some fragile regions, such as Gansu, Tianjin, and Inner Mongolia. The provinces with small proportions of nature reserves were Zhejiang, Hebei, Fujian, Anhui, and Henan.

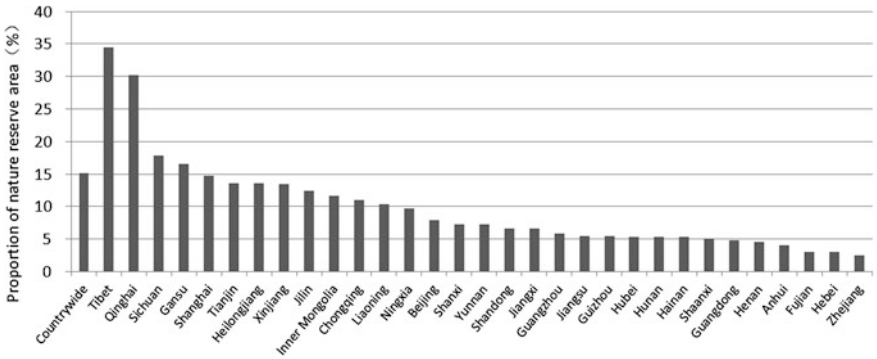

Fig. 10.5 Inter-provincial comparison of proportion of nature reserve area in China (2008). *Source* National Bureau of Statistics of China. China Statistical Yearbook 2010. Beijing: China Statistics Press, 2010

[8] The *12th Five-Year Plan* for National Economic and Social Development of the People's Republic of China.

[9] State Forestry Administration of China.11th Five-year and medium-and-long-term Plan on National Forestry Development, 2006.

[10] Qinghai News Net. http://www.qhnews.com/2010zt/system/2011/01/08/010267811.shtml.

10.2.2 Key Ecological Projects and Major Regions

Major ecological engineering projects were propelled in the 11th *Five-Year Plan* period, including Natural Forest Protection Project, Returning Farmland to Forest Project, Three-North and Yangtze River Basin Shelterbelt Project, Jing-Jin Sandstorm Source Control Project, etc. Due to the varied ecosystem characters in different regions, these projects ensured ecological functions performing well by increasing ecological resources quantity and quality. These projects obtained significant achievements, and the accumulative afforestation area was 16.87 million hectares from 2006 to 2009 (Fig. 10.6).

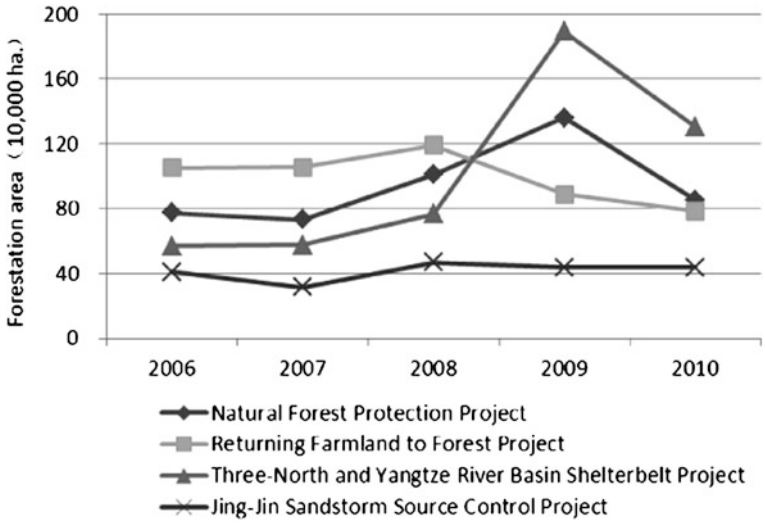

Fig. 10.6 Forestation areas of major ecological engineering projects in the 11th Five-Year Plan period. *Sources* (1) National Bureau of Statistics of China. China Statistical Yearbook 2010. Beijing:China Statistics Press, 2010. (2) National Afforestation Committee. 2010 Communiqué on China Land Afforestation Status

The purpose of Natural Forest Protection Project was to conserve and tend forest ecosystem that was one of the most important terrestrial ecosystems. The project included three aspects: stopping nature forest logging in the upstream area of Yangtze River and the middle-downstream area of Yellow river, reducing the forestry products in major state-owned forest in northeast China and Inner Mongolia, taking charge other natural forests by local governments. These tasks were further boosted in the 11th *Five-Year Plan* period. Therefore, 94.18 million hectares natural and other kinds of forests in the projects were effectively conserved, and forestation and planting grass processes were sped up in suitable barren land. Forestation area in Natural Forest Protection Project was about 4.73

million hectares cumulatively from 2006 to 2010,[11] which lead to both quantity and quality increase of important forest ecosystems in the upstream area of major rivers and important state-owned forest areas.

Column 10.3 AoHan County is Forging the Green Growth Pole to Realize the Sustainable Development

According to the requirement of circular economy development, Aohan County in Chifeng city in Inner Mongolia followed a "green growth" way to speed up the transformation of the economic development mode and to stick to the conservation of resources and environmental protection. The enterprises with small production scale and resources wasting had been closed, and the government supported the ones with large production scale and high technology, which attracted a large number of low carbon enterprises, including oil shale refining, chemical, machinery manufacturing, garment processing, wind power, etc. Due to the resource integration administration in 2011, the iron ore resources enterprises were integrated from about 80 to 20, and the gold miners were integrated from about 20 to 10 factories integration.

Aohan owned "Global 500 Roll of Honors for Environmental Achievement" award of UN with rich tourism resources. Aohan County planned tourism development as a key of the modern service industry. Insisting the government leading, departments cooperation, social participation, market operation, planning first and project support, they constructed Xinglongwa relics as a representative of the "village tour", Huangyangwa pasture as a representative of the "green tour", Aohan spa as the destination of the "spring tour", Chengzishan relics as the destination of the "heaven tour", which formed the tourism pattern in Aohan. Tourism has been becoming a special product and service as a part of the great tourism circle in Chifeng, even Lioaxi. This is a strong engine of the economic growth.

The government has been reforming the old block, developing the new block, completing the facilities and improving the livable quality. In the near future, Aohan will be a new city with complete functions, good ecosystem and environment, suitable living, prosperous industry and outstanding characteristics.

Source: Ministry of Finance of People's Republic of China: http://www.mof.gov.cn/xinwenlianbo/neimenggucaizhengxinxilianbo/201007/t20100706_325859.html.

Returning Farmland to Forest Project was a great strategic decision of China against increasingly aggravated soil erosion. According to the plan, soil erosion area in 2010 would be retained under 22.7 million hectares, wind-breaking and sand-fixing area would be under 26.7 million hectares, and average quantity of sediment flowing into Yangtze River and Yellow River would be reduced by 260

[11] China Statistical Yearbook 2010, 2010 Communiqué on China Land Afforestation Status.

million ton. The project was emphasized in the upstream area of Yangtze River, the up-middle stream area of Yellow River, Jing-Jin wind and sandstorm source area, southern key rocky desertification area, water source area in the middle route of South-to-North Water Transfer Project, western and northeastern sandy area, etc. In addition, regions with higher than 25° of slope were considered as the important section in the project. Forestation area of the Returning Farmland to Forest Project was about 4,966,900 ha cumulatively from 2006 to 2010, and 99 % area had been maintained,[12] which reduced the soil erosion and sand threat in the project area, increased forest resources and recovered and restored some important ecosystems.

The Three-North and Yangtze River Basin Shelterbelt Project covered largest area among all the shelterbelt projects in China, including the shelterbelt project in Three-North, the coastal region, Pearl River, HuaiRiver, Taihang Mountain, the plain area, Dongting Lake, Poyang Lake, and the middle-downstream of Yangtze River basin. According to the plan, forestation would be 22.7 million hectares, and 71.87 million hectares forest would be well protected. This project strengthened the administration area and vegetation restoration mode to increase forest coverage rate by artificial and aerial seeding afforestation. The major section of the shelterbelt project included West Coast, Yangtze River Delta, Pearl River Delta, Bohaibay, Hainan Island, and BeibuGulf. The shelterbelt project in these areas advanced the establishment of shelterbelt system, built up lots of trunk shelterbelts, protected and restored plenty of mangrove wetlands, and built a series of demonstration areas. Forestation area of this project was 5,106,700 hectares cumulatively from 2006 to 2010.[13] Forestation area of Three-North Shelterbelt Project was 857,900 ha in 2010, and it increased from 5.05 % (1977) to 12.4 %.The forestation area of the Costal Shelterbelt Project was 231,500 ha, and the ability of defensing storm and storm surge would keep improving.[14]

Jing-Jin Sandstorm Source Control Project is an important project for Beijing, because of its special geographic location and necessitous situation. This project aimed to solve the sandstorm problem in and around Beijing. It promoted the region administration and vegetation restoration mode, and focused on returning farmland to forest, forestation in suitable barren land, artificial afforestation, aerial seeding afforestation, closing sandy land for upbringing vegetation, grassland control, small watershed management, water facilities construction and ecological migration during the 11th *Five-Year Plan* period. Forestation area of this project was 2,065,500 ha cumulatively from 2006 to 2010. Vegetation quality in and around Beijing was greatly improved, and sandy weather had been reduced significantly.

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[12] 2010 Communiqué on China Land Afforestation Status.

[13] Source: China Statistical Yearbook 2010.

[14] 2010 Communiqué on China Land Afforestation Status.

10.3 Prospects for China's Ecological Construction in Green Economic Development During the 12th Five-Year Plan Period

10.3.1 Building the Strategic Pattern for National Ecological Security

During the 11th *Five-Year Plan* period, China's ecological construction was focused on some specific regions and remarkable achievements had been made. In the 12th *Five-Year Plan* period, the ecological construction has come to the stage of joint construction among different regions. Important ecological functional regions would be connected through scientific conservation and management measures, to form a new strategic pattern of the national ecological security and provide guarantee for *green development* nationwide.

Ecological security refers to a non-threatened condition for people's living, health, well-being, fundamental rights, life security sources, necessary resources, social orders and adaptability to environmental changes, etc., which constitutes a composite artificial ecological security system covering natural-, economic- and social-ecological security.[15] National-scale ecological security pattern is an important support for sustainable development and the proper functioning of national ecosystems. It is an interconnected and organic ecological network comprised by forests, grasslands, rivers, wetlands and other natural ecosystems, which has various important functions of conserving biodiversity, offering ecological resources, providing good environment support for economic development, and improving the quality of people's living conditions, etc. Studies have shown that the ecological security area at the lowest level of safety standard (the highest level of protection) accounts for 35.7 % of China's total land area.[16]

Key ecological functional regions are important components of ecological security pattern, which are areas of vital role in water source preservation, water and soil conservation, flood regulation, wind-break and sand-fixation, and biological diversity maintenance. Conservation and management of key ecological functional regions possess essential significance for mitigating and preventing natural disasters, coordinating watershed-and-regional ecological preservation and economic and social development, and ensuring national and local ecological security. *Plan for National Key Ecological Functional Conservation Zones* (No.165 document of SEPA in 2007) released by the former State Environmental Protection Administration of China pointed out that, major ecological functional areas in China were severely damaged, with the overall degradation or even

[15] MA Ke-Ming, FU Bo-Jie, LI Xiao-Ya, GUAN Wen-Bin.The Regional Pattern for Ecological Security (RPES): the Concept and Theoretical Basis [J]. *Acta Ecologica Sinica*, 2004, 24(4).

[16] YU Kong-Jian; LI Hai-Long; LI Di-Hua; QIAO Qing; XI Xue-Song. National-scale Ecological Security Pattern. *Acta Ecologica Sinica*, 2009, 29(10).

complete loss of ecological functions in some areas, which had become a serious threat to national and regional ecological security. The damages were mainly reflected by the following aspects: degradation of ecological functions and decline of water source preservation function in the headwater regions of major rivers threatening the ecological safety of downstream regions; vegetation deterioration and oasis shrink in some important sand-fixing regions of Northern China intensifying the threat from sand storms; shrinking of wetlands, rivers and lakes and degradation of these ecosystems reducing their functions of flood regulation; aggravated soil erosion in some areas menacing the regional sustainable development; damages to the offshore ecosystems leading to the production decline in major fishery waters; increasing degradation of natural habitats for some resource-intensive areas causing the decline of biodiversity maintenance function. These problems stem not only deep-rooted contradictions between economic development and environmental protection, but also from some historical reasons and management issues.

Thus it can be seen that, during the 12th *Five-Year Plan* period, to build a strategic pattern for national ecological security is faced with dual tasks. On one hand, the existing achievements of key ecological functional region constructions must be consolidated and developed, accompanied by strengthening ecological and environmental protection and improving management level, to ensure the proper exertion of such ecological functions like water source preservation, water and soil conservation, wind-break and sand-fixation, biodiversity conservation, etc. On the other hand, the ecological functional units need to be connected and managed integrally, which has been stated in the 12th *Five-Year Plan* as follows: constructing the ecological security strategy pattern based on Qinghai-Tibet Plateau ecological barrier, Loess Plateau-Sichuan-Yunnan ecological barrier, northeastern forest zone, northern sand-control belt, southern hilly and mountainous areas and major river systems, supported by other key ecological functional regions, and also comprised by punctate-distributional national prohibited development zones.

10.3.2 Strengthening Ecological Protection and Management

China's nature reserves experienced rapid development. The number of nature reserves of different levels nationwide reached 2541 at the end of 2009, with an increase of 192 in comparison with 2005. The area of nature reserves was altogether 147,750,000 ha in 2009, accounting for about 14.7 % of national land area.[17] Currently, there are some problems with the development of nature

[17] National Bureau of Statistics of China,*ReportSeries of Economic and Social Development Achievements during 11th Five-Year Plan period (No.14):PositiveProgresses in Environmental Protection. In* http://www.stats.gov.cn/tjfx/ztfx/sywcj/t20110310_402709535.htm*, 2011-03-10.*

reserves as follows: unreasonable construction and expansion make for wrong compartmentation and decline of management quality in some nature reserves[18]; the step of protection could not catch up with the speed of destruction; the periphery area of some reserves are severely interfered by the anthropogenic factors, which is unfavorable to their protection; reserves mostly exist in isolation, lack of necessary inter-connection hindering the migration of species and restoration of biodiversity. Therefore, during the 12th *Five-Year Plan* period, the supervision of nature reserves construction needs to be strengthened, the mechanism and daily management of reserve construction need to be standardized, and the organic links among reserves should be established to gradually form the nationwide network system of nature reserves, putting ecological protection into an overall consideration with the economic development.

Biodiversity is an important part of ecosystem quality and also a basis for sustainable economic and social development as well as a guarantee for ecological security and food security. *China Biodiversity Protection Strategy and Action Plan*(*2011–2030*) (No. 106 document of SEPA in 2010)issued by the Ministry of Environmental Protection mentioned that, the legal and policy systems of biodiversity protection are still incomplete, the monitoring and early warning system has not been established yet, the input for biodiversity protection is insufficient, the management and protection level needs to be further improved, the basic scientific research ability is weak, and the ability to deal with new issues on biodiversity conservation is scarce. In addition, biodiversity is increasingly affected by growing urbanization and accelerated industrialization, habitats of species are threatened, and the environmental releases of invasive alien species as well as genetically modified organisms (GMOs) increase the pressure on bio-security. It also set objectives to strive to effectively curb the trend of biodiversity decline in key areas by 2015, which include: strengthen in situ conservation to maintain the ratio of total land nature reserves area to total land area being around 15 % and enable 90 % of national key protected species and typical ecosystem types to be well protected; carry out reasonable ex-situ conservation to obtain effective protection for over 80 % of those threatened species to which the in situ conservation is inadequate and whose wild population is quite small; in addition, bio-security management should be reinforced, the conservation and management of biological species resources should be intensified, species resources reduction and loss should be effectively prevented, the mechanism of monitoring and access control of species should be improved, and the alien species invasion should be positively prevented.

Although the national forest coverage had increased to 20.36 % during the 11th *Five-Year Plan* period, a lot of problems still exist as follows:

1. The total forest volume was not enough. The forest coverage was only 2/3 of the world's average level, ranking the 139th.

[18] *LEI Guang-Chun. Problems and* Challenges Faced with the Nature Reserves of China [J]. *World Environment*. 2008(4).

2. The reversal trend had been growing. *The* 7th *National Forest Inventory Data* showed that, during the 5 years' inventory interval, the area of non-forest land turned from forest land reached 8.32 million hectare due to deforestation and cultivation, natural disasters and project construction, 85 % of which had been changed reversely to other agricultural use.
3. The forest quality and productivity are very low. Existing forests present several negative phenomena: artificial pure forests are more than mixed forests, single-layer forests are more than multi-layer forests, immature and young forests are more than mature and old forests. The collectively-owned forest land, which accounts for 60 % of total forest land, has low stock volume per unit area of only 53 m^3/ha.

Forest lands deteriorate significantly. Waste mountains, unreclaimed lands and bare sand lands suitable for afforestation account for about 14.5 %. Forest land deterioration was quite critical especially those of western and southern regions as well as collective forest regions.[19]

Therefore, during the 12th *Five-Year Plan* period, it's essential, on one hand, to accelerate the process of ecological restoration and afforestation and the launch of a series of key forestry projects such as natural forest protection, shelter forest networks including northeastern-northern-northwestern (known as "Three-North Shelter Forests"), Yangtze River basin and coastal region shelter forests, etc., wildlife protection and nature reserves construction, to speed up some key ecological projects such as anti-desertification, comprehensive management of Karst rocky desertification in some southern Karst regions as well as forest protection and restoration, to launch the follow-up major ecological projects, to accelerate the afforestation pace of suitable lands, and to make use of forest resources sustainably. On the other hand, it's necessary to reinforce the ecological management of the degraded forest lands in key regions, focusing on vegetation recovery and ecological restoration, to significantly improve the ecological conditions in key ecological management areas as soon as possible.

10.3.3 Establishing and Optimizing Eco-Compensation Mechanism

The attempt of eco-compensation mechanism is a major highlight of ecological construction during the 11th *Five-Year Plan* period. Depending on economic measures, the eco-compensation mechanism maximizes the protection of existing ecological resources and ensures the effective functioning of ecosystem services. China started a pilot eco-compensation from the year 2005 and nearly 400 key ecological areas benefited from eco-compensation during the subsequent 5 years.

[19] See *Program Outline of National Forest land Utilization and Conservation (2010–2020)*.

In the next 5 years, China will accelerate the establishment of eco-compensation mechanism to improve the level of ecological civilization.[20] Domestic eco-compensation can be divided into the following aspects: regional compensation (compensation from the eastern to the western region), basin compensation (compensation among basins inter-provincial or within local administrative areas), ecosystem compensation (compensation to services offered by ecosystems like forests, grasslands, wetlands, ocean, farmlands and other ecosystems), resources exploitation compensation (mineral resources exploitation, land reclamation and vegetation restoration, etc.).[21] The 12th *Five-Year Plan* clearly proposes to speed up the establishment of eco-compensation mechanism, following the principles of that those who conduct the explorations should take the responsibility of protection accordingly and those who get benefits should make corresponding compensations.

The current problems of eco-compensation can be summarized as follows: the theory of eco-compensation mechanism is far from complete to still in an exploratory stage. Eco-compensations vary widely among regions, and the standard of compensation and other aspects remains controversial, lacking of mature optional solutions; legal system of eco-compensation is incomplete which leads to subjective and arbitrary behaviors; compensation amount is generally too low to guarantee the successful implementation of eco-compensation mechanism; compensation relies excessively on transfer payments, increasing the fiscal burden while hindering the market to play its role; the relationship with economic development is not well handled, limiting the development of compensated regions to some extent.

To solve the problems stated above, two issues should be paid more attention to when carrying out eco-compensation: determine eco-compensation amounts based on the ecosystem service value theory, and introduce market mechanism into eco-compensation. For each compensation type, the range of compensation needs to be clearly set to avoid waste of money; stakeholders in the compensation mechanism should be precisely indentified to avoid social conflicts; reasonable quantitative criteria must be formulated to ensure the effective operation of compensation funds; a sound assessment system of eco-compensation efficiency needs to be set up to evaluate the effects of eco-compensation and correct arising problems in a timely manner. Moreover, for some areas in financial difficulties, it should be considered to increase financial support from the government and improve the compensation amounts. It's necessary to change the current situation of government finance payment being the sole source for eco-compensation. Enterprises and

[20] National Development and Reform Commission. *Taking Use of Economic Levers to Control Pollution Shows Full Effectiveness of the Eco-compensation Mechanism.* In http://www.sdpc.gov.cn/ajgx/t20101224_387531.htm, 2010-12-24.

[21] Li Wen-hua, Liu Mou-cheng. Several Strategic Thoughts on China's Eco-Compensation Mechanism [J]. *Resources Science*. 2010, 32(05).

individuals should be introduced to join the eco-compensation mechanism, and market mechanisms should be actively explored and encouraged. Ecosystem service should be increased through multiple ways. Eventually, the eco-compensation would be led to the track of enhancing the national ecological security.