WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature by:

- conserving the world's biological diversity
- ensuring that the use of renewable natural resources is sustainable
- promoting the reduction of pollution and wasteful consumption.

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Summary of the First-ever Yangtze River Basin Climate Change Vulnerability and Adaptation Report

November 2009

The Crying Mother

A Norwegian scientist recently captured an image of a melting icecap in the Arctic region that looked remarkably like a woman in tears.

This dramatic finding animates the planet's suffering and renders it in human terms - global warming is hurting our planet and moving it to tears!

The Yangtze River Basin (YRB) is commonly referred to as the cradle of the Chinese civilization. But is global warming damaging this important resource? Our study of the YRB shows that climate change is having an enormous impact on the river basin, likely to cause more damage than just tears.

This brochure provides an overview of the Yangtze River Basin Vulnerability and Adaptation Report by summarizing its main conclusions and focusing on the following questions:

(1) How has the climate in the YRB changed since 1950s and how will it change in the 21st century?

(2) What are the impacts of climate change on different socioeconomic sectors and ecosystems in the basin?

(3) How have the socioeconomic and ecological systems responded and adapted to climate change in the basin in the past decades?

and (4) What strategic plans and management measures should be taken for different sectors and ecosystems to adapt to climate change in the 21st century? The full report will be released in mid Nov. 2009 and it will be available on the WWF website, www.wwfchina.org.

Yangtze Basin Profile

The Yangtze River is China's longest, extending 6300 km in its main stream.

The Yangtze River Basin (YRB) covers an area of 1.8 million km^2, encompassing about one fifth of China's total territory, one third of the nation's total population, and one quarter of its total arable land.

The YRB is also a major economic zone, contributing 41.1% of GDP, 35.4% of the nation's total grain production and 31.4% of its forest area in 2007. In addition, the river basin is home to many rare and endangered species, such as the giant panda, Yangtze River Dolphin, and Yangtze Sturgeon.


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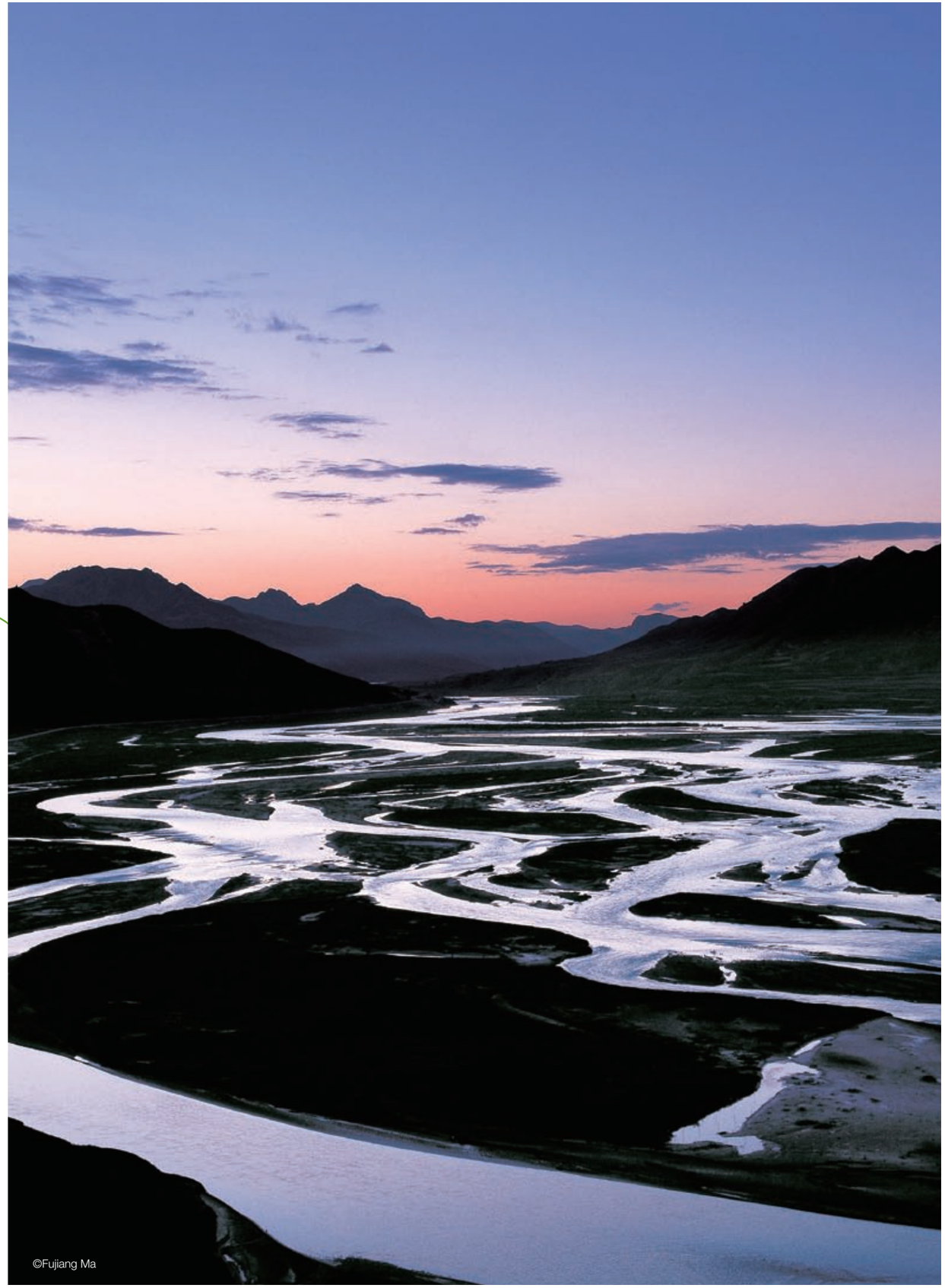
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Climate Change in the Yangtze River Basin

The YRB has experienced warmer temperatures over the past few decades.

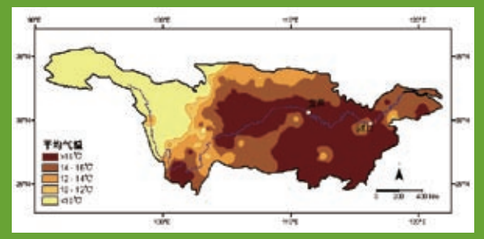

Figure 1. Spatial distribution of annual temperature in the YRB

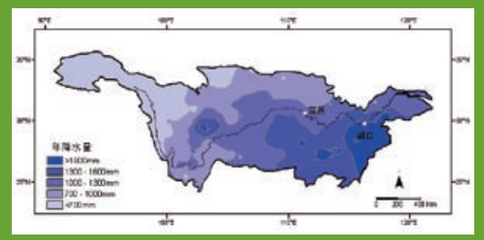

Figure 2. Spatial distribution of annual precipitation in the YRB

Air temperature increased 0.33℃ during the 1990s and 0.71℃ during the 2001-2005 period, while annual precipitation showed almost no change.

According to climate model projections, temperatures in the YRB will continue to rise during the first half of the 21st century, with precipitation staying flat.

Extreme climate events, such as flooding, drought, heat waves and disastrous snowstorms, will become more frequent in the 21st century and especially in the last two decades.

Yu shu

Vulnerability 1: Water resources

Climate change has had little effect on the total amount of water resources in the YRB over the past 50 years.

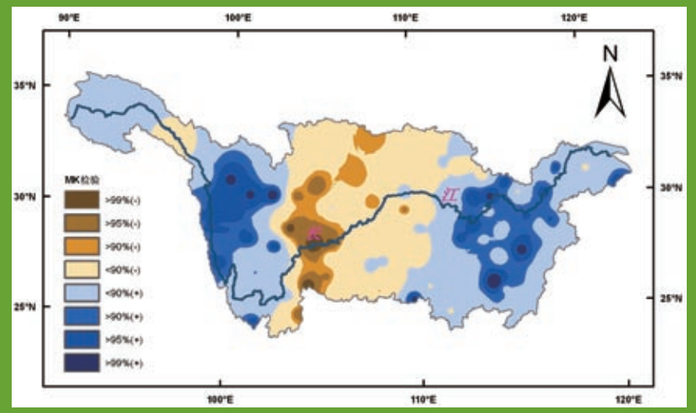

Figure 3. Drought and flooding distribution of YRB during 1961-2000

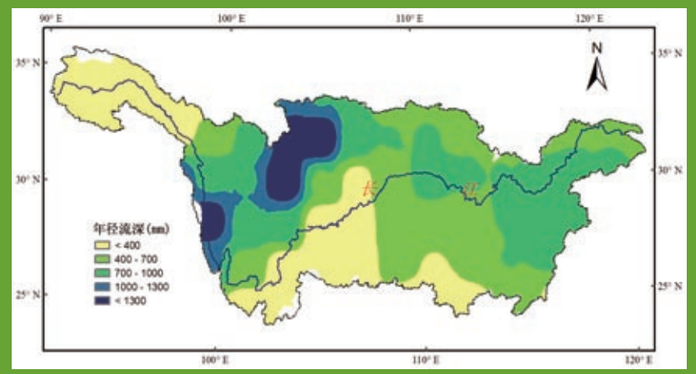

Figure 4. Spatial distribution of average annual runoff in the YRB

Ba tang

Climate and hydrological projections say this will continue in the 21st century.

However, climate change will alter the spatial distribution of water resources in the river basin according to future greenhouse gas emission scenarios:

(1) Under the IPCC SRES-A2 scenario, the headwaters region and the Central and Lower Yangtze will become wetter, but the Min and Jinsha tributary basins will become drier;

(2) Under the IPCC SRES-A1B scenario, an opposite pattern is likely to happen where the headwaters region and the Central and Lower Yangtze will become drier, while the Han and Min sub-basins become wetter;

and (3) Under the IPCC SRES-B1 scenario, the southern part of the YRB will become drier and the northern part wetter.

In addition, the future warmer climate will accelerate the melting of the glaciers and permafrost in the headwaters region of the Yangtze River, especially on the Tibetan Plateau. The glacial area will decrease 11.6% by 2060 in comparison with that in 1970, while runoff will increase 28.5% during the same period.


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Vulnerability 2: Agriculture

Climate change alone will significantly reduce grain production in the YRB.

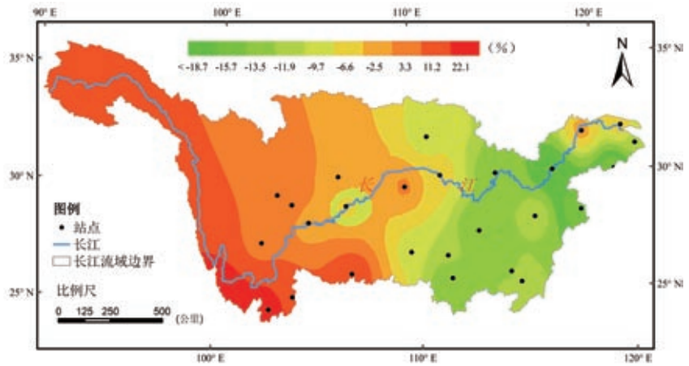

Figure 5. The rice production change of YRB under A1B climate scenario by 2050 (%) (comparing with 1980~1999)

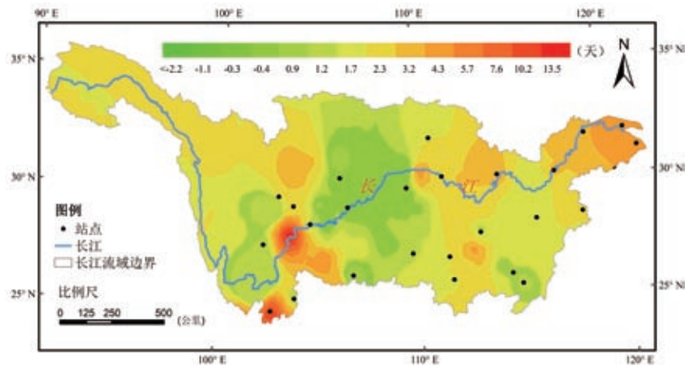

Figure 6. Annual change of rice growth duration in the YRB (days)

Li jiang

For instance, rice production in the river basin will decrease 9-41% by the end of the 21st century, while corn and winter wheat production will decline more rapidly.

However, the reduction in grain output will be lessened by the increase of CO_2 in the atmosphere (CO_2 fertilization effect), with an estimated overall reduction of 3.6% for early harvesting rice, 2.8% for the double harvesting rice, and a slight production increase for single harvesting rice.

Meanwhile, corn production will see a significant decline, especially in the Sichuan Basin, where a reduction of up to 25-50% is estimated by 2080.

Vulnerability 3: Forests

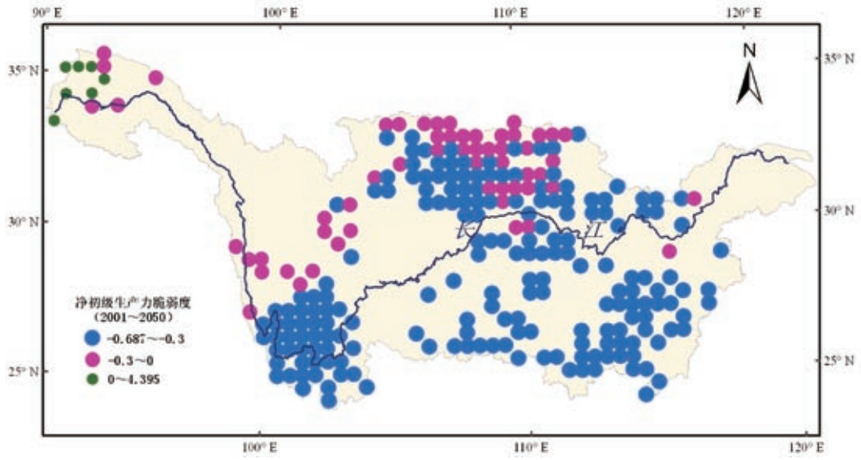

Figure 7. The vulnerability of forest system in YRB during 2001-2050

Forest cover in the YRB decreased from about 80% approximately 6,000 years ago to 16% in 1940s. Large-scale reforestation projects brought the number up to 30.5% over the past three decades.

Most YRB forests are highly productive, falling in new growth category.

Based on the analysis of the Net Primary Productivity (NPP), forests in the YRB are generally less vulnerable to climate change than those in northern and northeastern China.

However, future climate change will make most YRB forests in the YRB more vulnerable, especially in Jiangxi, Hunan and Yunnan provinces.

Xi chang

Pan zhi hua

Deciduous broadleaf forests will see the largest increase in vulnerability in the first half of the 21st century.

Geographically, the most sensitive and vulnerable forests are located in the headwaters region, especially in high altitude areas.

In addition, climate change will alter the composition of forest species, which may exacerbate the loss of biodiversity. Long-term human activities in the basin is also having a devastating impact on species movement/migration due to the increased fragmentation and isolation of forests.

Vulnerability 4: Grasslands

The headwaters of the Yangtze are dominated by grasslands, which have degraded considerably over the last 30 years.

Climate change is one of the major driving forces behind grassland degradation:


©Li Na

Yi bin

it is estimated that in alpine meadows, climate change has contributed 81% to ecosystem degradation, and human activities 18%.


©Li Na

This is because the warming climate has accelerated permafrost melt, which results in a thicker active layer, 0.5-1.2m deeper in the past 25 years.

A consequent decrease in soil moisture has driven ecosystem succession backwards to xerosere, which is quite dry, and features lower vegetation coverage, lower production, lower aboveground biomass, and more plants adapted for growth under dry conditions (xerophytic species).

In some areas grassland degradation has resulted in desertification and bare soils.

The southern part of the headwaters region is the most vulnerable to climate change, while moderately vulnerable ecosystems are located in the north and middle of the area, and the least vulnerable ecosystems are in the east and west parts of the headwaters area.

Climate change will continue to accelerate permafrost melt and exacerbate the grassland degradation in the headwaters region of the Yangtze.

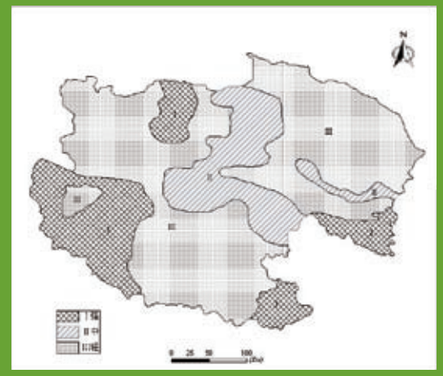

Figure 8. The vulnerability level classification of sourcing region of YRB

Figure 9. NPP change of vegetation in sourcing regions of YRB

Vulnerability 5: Wetlands

Yangtze River wetlands provide crucial habitats for many bird and fish species, as well as numerous other rare and endangered animals.

However, wetland areas have declined rapidly over the past few decades due to human activity and climate change.

Water and air temperature have increased significantly, leading to a general northward movement of winter habitats for many fish species in the Yangtze and its tributaries.

Warmer water also causes some fish species to spawn earlier, which could affect reproduction if the food supply does not meet demand. In addition, many bird species are changing their migration paths and distribution range as a result of climate change.

Increasing temperatures combined with lower water levels has reduced the number and diversity of aquatic birds in the Central and Lower Yangtze.

Chong qing

This has resulted in a higher mortality rate due to the increased migration distance.

Vulnerability 6: Coastal city (Shanghai)

Climate change will make coastal cities like Shanghai more vulnerable to sea level raises, extreme climate events, as well as natural and human-induced disasters.

Wan xian

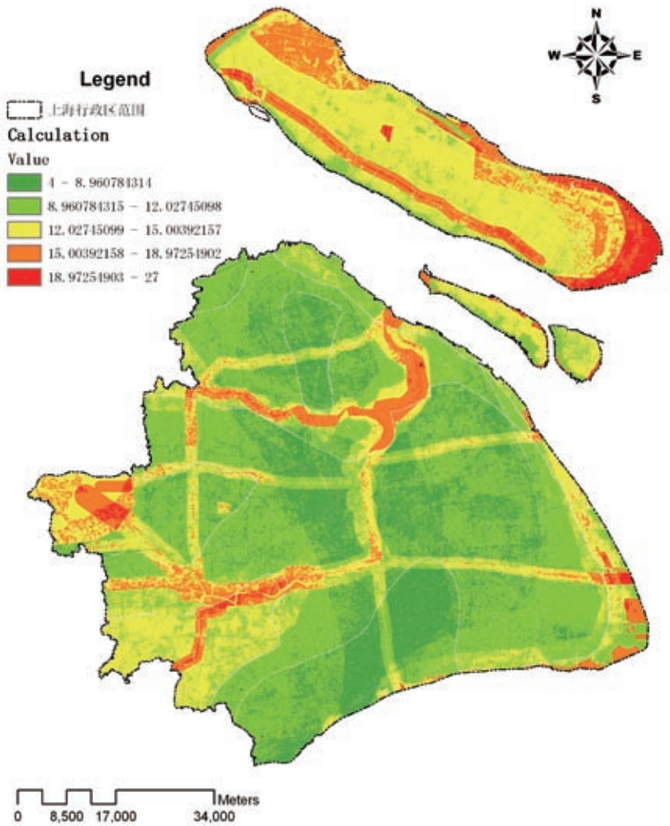

Figure 10. Vulnerability zones classification of Shanghai

Air temperature in Shanghai has increased 2.35℃ in the past 50 years, which doubles the national average warming rate and quadruples the global average during the same period.

The sea level at Shanghai has raised 11.5cm in the last 30 years, which is also greater than the national average of 9cm for the same period.

The sea level will increase by 18cm in 2050 when compared with 1990 levels. Sea level rise has resulted in flooding, loss of wetlands, and seawater intrusion, a major threat to Shanghai's water supply.

Global warming has increased the frequency of heat waves and flooding in the city over the past 50 years.

Climate change will continue to threaten Shanghai's economy and ecosystems, impacting transportation, investment and insurance, tourism and biodiversity.


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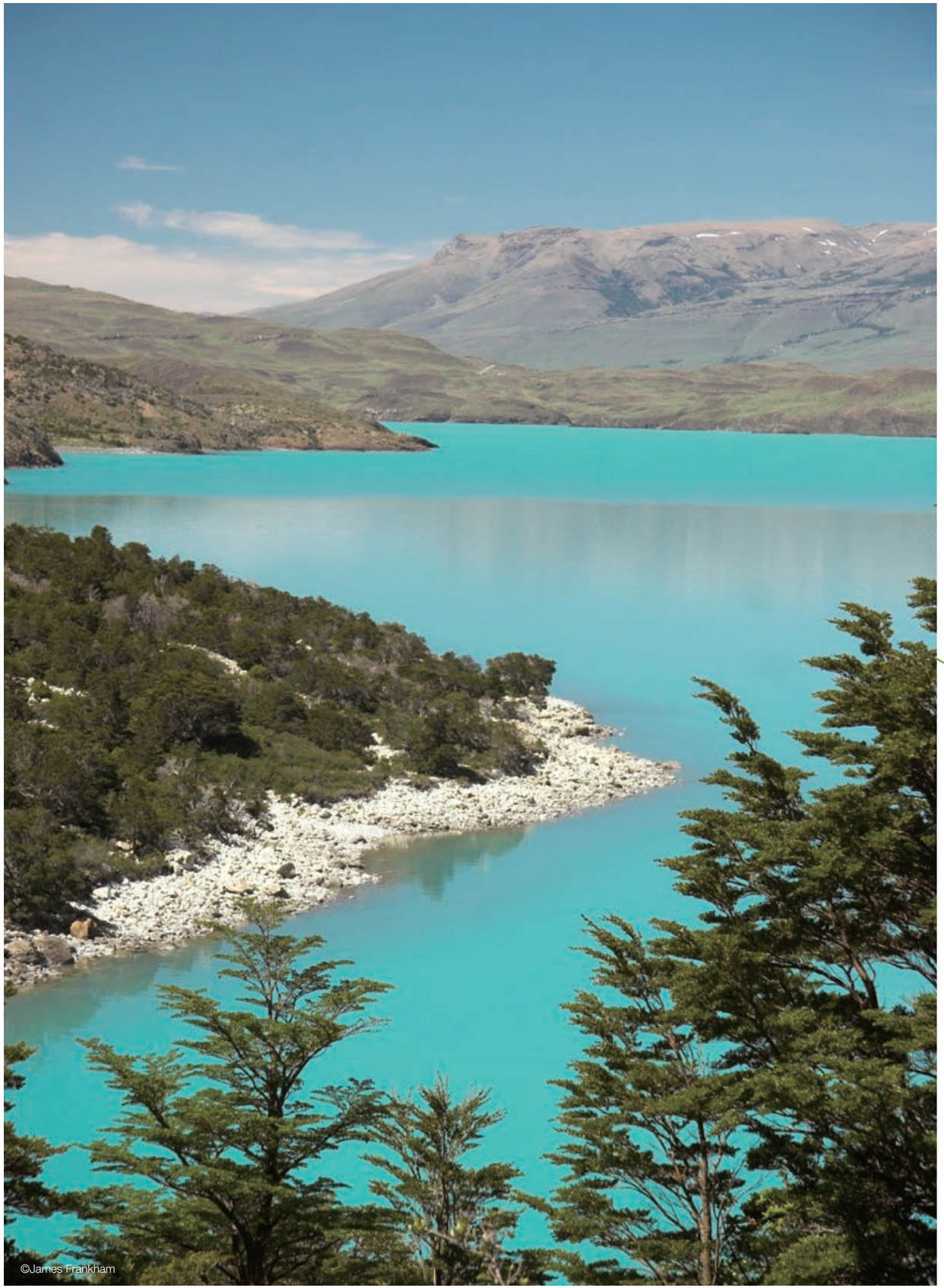

Adaptation: General strategies

Good adaptation measures and practices should consider not only climate itself, but also other specific factors, such as economy, technology, as well as social and cultural norms.

Given the complexities and uncertainties associated with climate change, adaptation should firstly consider a “no-regrets” strategy, which does not require additional cost.

Secondly, a “free-ride” strategy should be considered, where adaptation to climate change is a “by-product” of other socioeconomic activities.

Finally, synthesizing previous experiences and lessons on climate change adaptation is extremely important to the success of future actions.

Climate change adaptation is a dynamic optimization process where adjustments are necessary to accommodate advances in new knowledge and technology.

Yi chang

Adaptation: Specific measures

1.Build capacities to deal with climate change by improving economic status, living conditions and public facilities, such as energy and power supply, transportation network, river and coastal dike reinforcement, and irrigation systems.

2.Promote Integrated River Basin Management (IRBM) by systematically optimizing the management of the major hydro-engineering projects, adopting market-based water allocation strategy, and increasing environmental flows to ensure the minimum ecological water demand.

3.Adjust cropping systems, breed new strains and improve crop management practices for adapting to the new climate.

Corn is one of the most vulnerable crops to climate change in the YRB. Therefore, replacing corn with rice may reduce the vulnerability of the agriculture sector in the basin.

For boosting rice production in a warming climate, a single-rice cropping system will be replaced by a double-rice system, and double systems by a triple-rice system in transition zones where cropping systems are able to take advantage of the elongated growing season and warmer days.

In the areas where new cropping systems can't be supported, breeding new strains with longer growing periods should be adopted.

Adaptation measures taken in the past decades in the YRB have been effective in reducing the impact of climate change.

Without taking any adaptation measures, rice production per unit area in the YRB should have decreased in the past decades with climate change. In reality, rice production per unit area has increased significantly during the same period.

4.Protect natural forests from logging by establishing a new ecological compensation system in the YRB; improve the management of plantations by planting more native tree species and selecting southern provenances for new plantations; enhance the management of natural reserves for protecting biodiversity and ecosystem integrity.

Adaptation: Specific measures

5.In the headwaters area of the YRB where climate change is the dominant force driving ecosystem degradation, adaptation measures should focus on protecting the permafrost and biodiversity from human disturbances.


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In the areas where ecosystem degradation is mainly caused by human activities, integrated adaptation measures should be taken to reduce the ecosystem vulnerability.

Specifically, the measures should include controlling the stocking rate under grazing capacity, introducing and breeding new grass strains to grow in a warmer climates, establishing and improving the fodder reserve system to survive snowstorms, and improving the predicting and warning system for extreme climate events in remote high altitude areas.

6.Include wetlands in the integrated river basin management plans to improve the connections between rivers and lakes, optimize the management and operation of major hydro-engineering projects to improve environmental flows and wetland hydrological conditions, reinforce coastal defenses to protect coastal wetlands from seawater intrusion,

and enhance studies and long-term monitoring on ecosystem processes in the major wetlands in the YRB.

7.Adjust and optimize the economic structure by promoting low-carbon development in urban areas in the YRB, explore new development pathways to take both climate change mitigation and adaptation measures,

establish and improve the emergency response and warning system for disastrous climate events, elevate public education and awareness on climate change to promote environment- and climate-friendly lifestyles.


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WWF (World Wide Fund for Nature) is one of the world's largest and most respected independent organizations dedicated to the conservation of nature. Since the first office was founded in Switzerland in 1961, WWF has grown into a global network active in more than 100 countries with almost five million supporters.

WWF has been active in China since 1980, when it was invited by the Chinese government as the first international NGO to work on nature conservation. The Beijing office opened in 1996, and there are now eight additional field programme offices spread across China.

WWF has more than 100 staff working in China on a broad range of conservation programmes including species, freshwater, forest, marine, climate change and energy, the green economy and footprint.

In 2010, WWF celebrates 30 years of conservation work in China. Our major achievements over that time include the establishment of 67 giant panda nature reserves, the protection of 1.5 million hectares of wetlands through the Yangtze Basin wetland conservation network,

and the certification of more than 1 million hectares of forest as part of the Forest Stewardship Council's responsible management system.

Wu hu

An qing

Working with partners, we have introduced environmental education into school curriculums, promoted sustainable business practices and established China's first low carbon cities in Shanghai and Baoding.

Nan jing

Shang hai

WWF is grateful for HSBC's support of this research project and the report through the global HSBC Climate Partnership.

The HSBC Climate Partnership is a 5-year global partnership between HSBC, The Climate Group, Earthwatch Institute, The Smithsonian Tropical Research Institute and WWF to reduce the impacts of climate change for people, forests, water and cities.

This report is the first ever climate change vulnerability assessment on the Yangtze River Basin.

The study was carried out by the Chinese Academy of Sciences (CAS), the China Meteorological Administration (CMA) and Fudan University, in partnership with WWF-China.

It took two-dozen of scientists more than two years to finish the project. The leading contributors to the report are Dr. Ming Xu from Institute of Geographic Sciences and Natural Resources Research (IGSNRR) of the CAS and Dr. Chaode Ma from WWF's Beijing Office. Other main contributors are Drs. Guoyu Ren and Tong Jiang from CMA, Drs. Xiubo Yu, Qiang Yu, Huimin Wang and Mei Huang from IGSNRR of CAS, Dr. Silong Wang from the Institute of Applied Ecology of the CAS, Dr. Gengxu Wang from the Institute of Mountain Hazards and Environment of the CAS, and Drs. Xiangrong Wang and Zhengqiu Fan from Fudan University.

The authors gratefully acknowledge the comments and suggestions of 14 reviewers and accept all responsibility for errors or omissions.

This summary is based on the full report, which is available online at www.wwfchina.org