



INITIATIVES POUR L'AVENIR
DES GRANDS FLEUVES
INITIATIVES FOR THE FUTURE
OF GREAT RIVERS

Synopsis sheets

Rivers of the World

THE YELLOW RIVER

The Yellow River

With a total length of 5,464 km, the Yellow River (Huang He) is China's second longest river after the Yangtze and the 6th longest in the world. Its watershed is the home of more than 100 million people, the cradle of northern Chinese civilisation and the centre of the region's socioeconomic development, with close to 7% of Chinese GDP. But China's "mother river" is faced with many problems: drought, floods, pollution, demographic pressure, the degradation of ecosystems, etc. Its protection and the fate of its population depend on the good management of the river and its watershed.



China's "mother river"

Its origins

The source of the Yellow River lies in the Qinghai-Tibetan plateau, in western China (at 4,700 m above sea level). It is there that three of China's largest rivers spring: the Yellow River, the Changjiang River and the Mekong, making this region China's water tower.

It then runs through northern and central China, where the temperate continental monsoon climate is dominant. The south-eastern section of the basin has a humid climate, whereas the north-western areas are considerably drier.

The river crosses 9 provinces – Qinghai, Sichuan, Gansu, Ningxia, Inner Mongolia, Shanxi, Shaanxi, Henan and Shandong – before draining into the Bo Hai Sea.

According to the Organisation of Economic Cooperation and Development (OECD), in 2015, 113,7 million people lived in the Yellow River basin (or about 9% of China's population) and nearly 30% of the basin is urbanised. However, the population is unevenly distributed with about 70% living in the lower third of the basin.

Technical sheet

<u>Length:</u>	5,464km
<u>Watershed:</u>	795,000 km ²
<u>Average discharge :</u>	2,571m ³ /s but with considerable variations within the year
<u>Precipitation:</u>	368-670 mm/year; 60% of the annual precipitation between June and September
<u>Main cities:</u>	Lanzhou, Baotou, Luoyang, Zhengzhou, Kaifeng, Jinan
<u>Main tributaries:</u>	Fen He and Wei He

Cultural cradle

The basin of the Yellow River has played an essential role in China's economic development, and it has also participated in building the cultural identity of the Chinese people.

A large amount of archaeological information provides proof that the Yellow River was the cradle of the ancient Chinese civilisations of the Xia (2100-1600 BC) and Shang (1600-1046 BC) eras. Agriculture began on the **Loess plateau**, as the earth there is very fertile due to the silt carried by the river.

The Yellow River flows through some China's oldest cities, in particular Lanzhou, Baotou, Xi'an, Taiyuan, Luoyang, Zhengzhou, Kaifeng and Jinan. It also symbolises the "Chinese spirit", meaning the capacity to bear burdens (considerable quantities of sediment), adaptation (the changes in the course of the river) and perseverance (its continuous flow). Lastly, the Yellow River has inspired many artists, songs and poems that express the spirit of both the river and the Chinese people.

A difficult river, between flood and drought

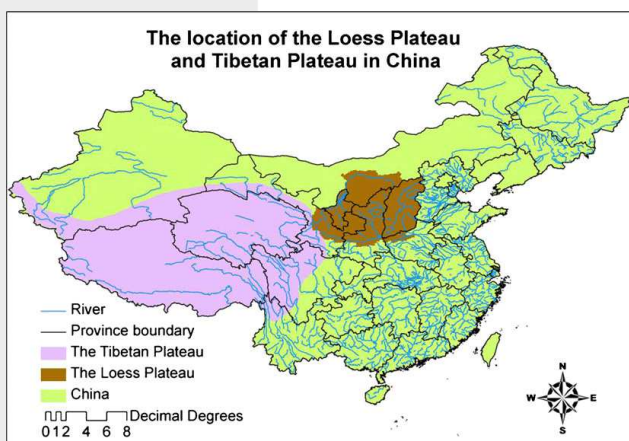
A dense concentration of sediment

The Yellow River's morphology is rather special, with the highest sediment load in the world. Moreover, its name stems from its alluvium (silt, mud, sand, etc.) freed from the erosion of soil on the extensive Loess Plateau covering 640,000 km², that gives it a muddy colour (*huang* means yellow in Mandarin).

The upper course of the river (the Tibetan Plateau), some 3,500 km long, flows through mountains and is difficult to reach. It stretches from the high Tibetan plateaus, crosses the gorges and continues to the city of Lanzhou.

From Hekou to Zhengzhou, **the middle course** borders the Loess plateau for 1,200 km and drains a basin of 345,000 km². 90% of the sediment come from the middle course of the Yellow River, and upstream of the three tributaries (the rivers Wei, Luo and Jing).

The lower course (the alluvial plain), from Zhengzhou to the sea, is located on a low-lying plain and flows for 800 km. Due to the accumulation of sediment – **1.6 billion tonnes of sediment transported on average a year and only about 25% carried to the sea!** – the riverbed lies 4 to 6 meters above the cities and farmland, thus forming the world famous "hanging river". This difference can be even more marked in certain places. **At Kaifeng city**, the river bed is 13 and 20 m higher, respectively, than the level of the surrounding land. The height of the dikes has had to be regularly increased.



While the erosion in the loess soil band is a natural phenomenon, it has increased greatly as the result of the environmental degradation caused by human activities. The Yellow River Conservancy Commission (YRCC) has made flushing out sediment its most critical environment priority.

The Yellow River is also characterised by **considerable variations in its discharges** with:

- A low discharge from March to June
- A rainy season from June to September, with 60% of annual rainfall.

Coping with floods and droughts

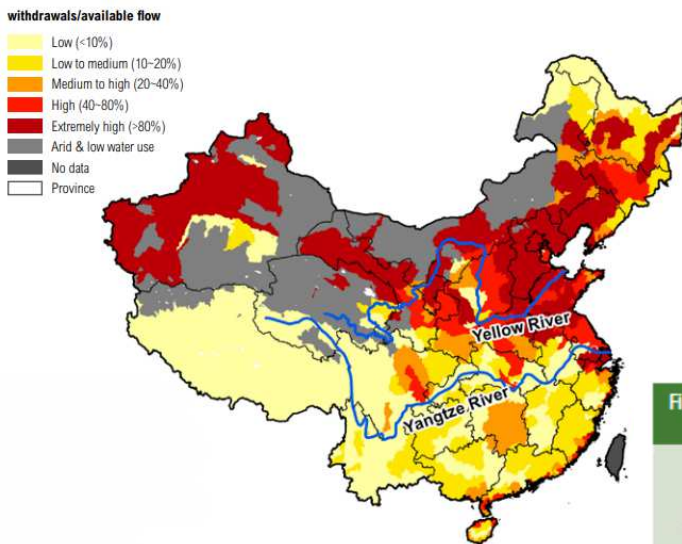
Known for its floods during which it has changed its course several times, the Yellow River is one of the most dangerous rivers in the world.

Ever since historians have kept registers, from around 602 BC, the river has changed course 26 times and caused more than 1,000 major floods – that is to say at least two major floods every three years – causing the death of millions of people. The total region where the land is lower than the riverbed covers some 120,000 km² and is home to approximately 90 million inhabitants.

The phenomenon of drought is also present during the long history of the Yellow River basin. It became more important with the increasingly larger withdrawals of water to irrigate farmland, and to supply urban areas and industry. In the 1980s-1990s, it was not rare that the lower part of the river dried up, leading to considerable loss of agricultural production and the shutdown of certain factories (especially textiles). However, the peak was reached in 1997: the river did not flow into the sea during a record period of 300 days. Its lower course was dry for 704 kilometres, i.e. 90% of its length. This drought had severe impacts on the fish fauna, with ten migrating species being unable to swim upstream to breed.

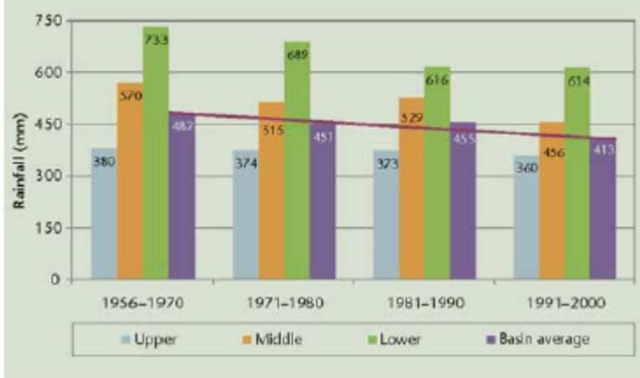
The effects of climate change on temperature and annual precipitation could also reduce the availability of the water resources. According to various models, annual average temperature in the Yellow River basin could rise by up to 3.90°C and precipitation decline by 8.67% by 2080. Managing water scarcity is now the number one priority in the Yellow River basin.

Figure 8 | Baseline Water Stress China (2010)



Source : Wang, J., L. Zhong, and Y. Long. 2016. "Baseline Water Stress: China." Technical Note. World Resources Institute, Beijing.

Figure 2.2 Rainfall in various reaches of Yellow River basin, 1956–2000



Source: YRCC, 2002.

Scarcer water resources

China only has 7% of the planet's freshwater resources, whereas its population represents 21% of the world's population and its water resources are unequally distributed. Southern China has 80% of the country's water resources for 55% of the population, whereas northern China has less than 15% of available water resources for 45% of the population. Certain northern provinces have exceeded the threshold of hydric stress, with less than 500m³ of water per inhabitant per year.

To overcome this chronic lack of water, China has decided to build infrastructures to **transfer water from the south to the north**. **The South-North Water Transfer Project**, launched in 2002, is intended to transfer water to Northern China via three huge canals.

The aim of the project is to irrigate the dry regions of the north to maintain farming activities, and ensure the supply of water to Beijing. **The first diversion in the east** uses the layout of the Grand Canal to Tianjin to convey 9 billion m³; **the second in the centre**, starts from the River Han near the Yellow River and the Beijing region, while the **third in the west** requires crossing a very mountainous region, to convey 19.5 billion m³ a year in the upper course of the Yellow River.

This titanic project required an investment of 500 billion Yuans (\$77.4 billion). The central canal was brought onstream in December 2014. From 2014 to 2017, more than 10.8 billion cubic metres of water were transferred to northern China.

In April 2019, the eastern route was tested to supply water to the province of Hebei and to the municipality of Tianjin, in the north of the country. According to the transfer plan, Hebei will receive 17 million cubic metres of water and Tianjin 20 million, thus avoiding the overexploitation of groundwater.

Regarding the western route, the works have not begun since the feasibility of this route is still at the study stage.



Source: State Council's Office of the South-to-North Water Diversion Project Commission CHINA DAILY

Despite this project, the situation could get worse. In the **the Yellow River Basin**, available water resources (estimated at 66.1 billion m³, including 17.2 billion m³ of groundwater) are burdened by urbanisation and demographic growth. Water demand in the basin increased from 10 billion m³ in 1949 to 37.5 billion m³ in 2006 and, between 2007 and 2014, withdrawals have increased by 10%. The overexploitation of groundwater resources has been a serious concern with a peak of 10.7 billion m³ reached in 2000! **At the same time, the reduction of rainfall in the basin and climate change also make water resources scarcer.**

Myriad uses

Dams and hydropower plants

In the past, the river has breached the dikes that were built to contain it. As from the 1950s, the Chinese government decided to reinforce the safety of dwellings and prevent floods. To achieve this they adopted a development plan for the Yellow River, with the construction of 46 dams on the **main course** of the river and structures to preserve the soil of the great plateau regions. Besides, a 800km long high quality standardized embankments/groynes system along the two banks of the **lower course** has been completed to improve flood safety.

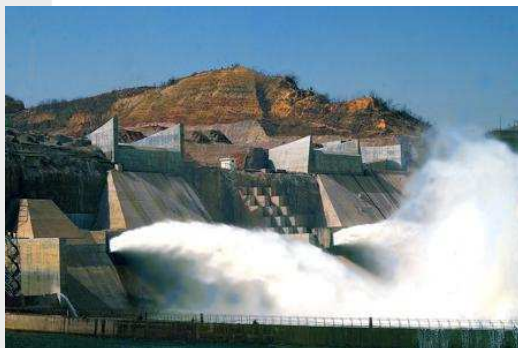
As a result of intensive water development between 1951 and 1987, many structures were built in the basin for flood control, hydropower and irrigation. In 2000, there were over **10,000 reservoirs in operation, with total storage capacity of 62 billion m³; 23 involve large dams (installed capacity of more than 10 GW). Hydropower production amounts to 40 TWh per year.**

Xiaolangdi: a multipurpose mega-dam

It is located close to Jiyuan, 40 kilometres from Luoyang, in Henan. **It's one of the largest dam in China, after that of the Three Gorges.** The project was approved in 1991, and the entire dam was completed in January 2001. The first turbine started operating in 1999. It represented an investment of \$4.2 billion, partially funded by the World Bank. It is estimated that its construction required the displacement of about 181,000 people.

This structure satisfies several objectives:

- **Managing floods and controlling the sedimentation of the Yellow River**
- **Producing hydroelectricity:** the dam is coupled with a hydropower plant with an installed capacity of 1,836 MW. This plant currently supplies the demand for energy of the province of Henan.
- **Providing water for irrigation:** the dam allows better distribution of the water so that farmland with less access to water obtains a better share. It improves the use of water for the region's agriculture. With 30% of the water available for irrigation, it supplies water for 2 million hectares, thus reducing dependence on groundwater.
- **Ensuring water supplies** for industry and the cities situated downstream.



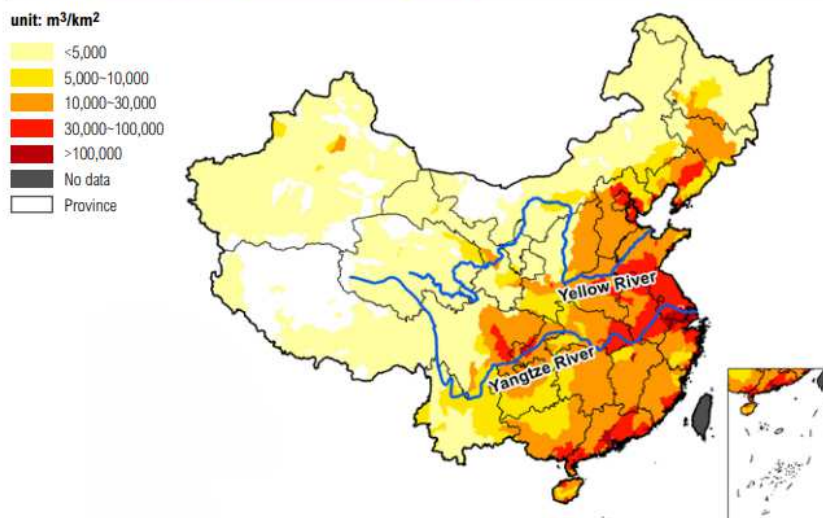
Myriad uses

Water supplies

The population in the coastal region of the Yellow River nearly tripled in the 1950s. This process of rapid urbanisation has led to heavy demand for water. **In 2009, the Yellow River supplied water to 155 million people (i.e. 12% of the population).** Some cities built reservoirs, while others withdraw water from underground aquifers.

However, the overexploitation of groundwater inevitably led to land subsidence. The plain of northern China has been severely affected by lowering land surfaces. Excessive pumping of the groundwater in Beijing caused it to sink from 6 m below the surface in 1950, to 50 metres in 1994, then to 61 metres in 1999. This phenomenon was further exacerbated by river pollution, since it encouraged the local authorities to increase the level of pumping from the aquifers to obtain water of sufficiently good quality.

Figure 4 | Domestic Water Withdrawal Intensity (2010)



Source: Wang, J., L. Zhong, and Y. Long. 2016. "Baseline Water Stress: China." Technical Note. World Resources Institute, Beijing.

Irrigation

Agriculture in China is a sector of major economic importance: **agriculture represents 15% of the country's GDP and more than 300 million people earn their living from farming.** But agriculture is also the foremost consumer of water in China, with 70% of water being withdrawn for irrigation. Since 1950, irrigation for agriculture has increased 5-fold.

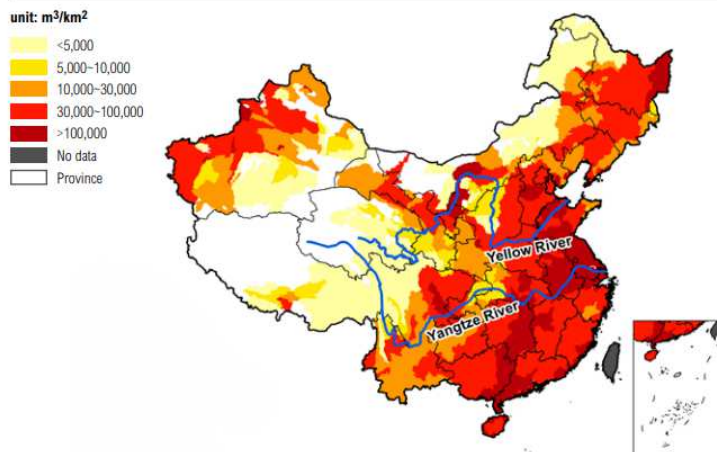
Agriculture still accounts for 84% of total water consumption in the Yellow River basin with more than 75,000 km² of irrigated area.

Myriad uses

The great plain of northern China is one of the country's largest agricultural regions. It produces about 40% of Chinese cereals (wheat, maize and sorghum). The importance of withdrawals for irrigation downstream of the river provide a partial explanation for the drying of the delta.

To avoid wastage of the resource, programmes to develop the best irrigation techniques were implemented in the 2000s. The government invested in the renovation of the irrigation canals.

Figure 2 | Agricultural Water Withdrawal Intensity (2010)

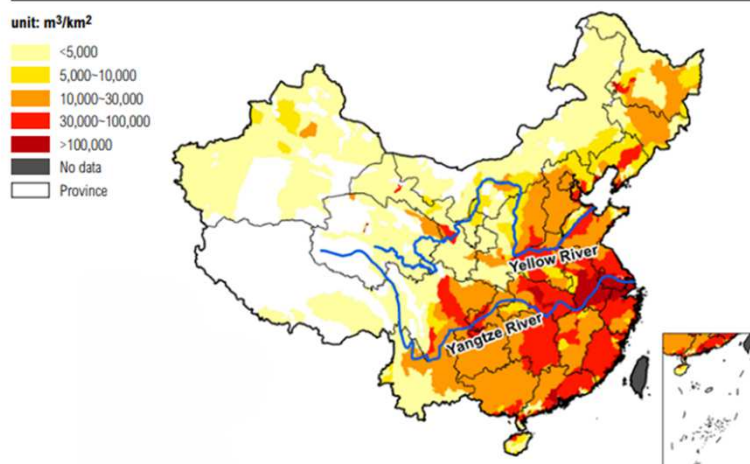


Industry

The basin of the Yellow River has developed to become an industrial region. Coal mining and chemical plants are present in the autonomous region of Mongolia, Ningxia and Xinjiang and in the province of Shanxi. **Industry accounts for 9% of total water consumption.**

Moreover, although essential to the basin's economy, these industries emit pollution. Large quantities of non- or poorly treated industrial wastewater and urban effluents are discharged into the river. The amount has doubled since the 1980s to 4.2 billion m³ per year and the river receives over 300 pollutants. Since the 2000s, a legislative framework has been established in order to better protect water quality.

Figure 3 | Industrial Water Withdrawal Intensity (2010)



Governance

Several authorities are responsible for managing water resources:

Ministry of Water Resources

The Ministry of Water is responsible for managing water resources in China (utilisation, distribution and protection), flood control and drought relief, irrigation and drainage, rural water supply, soil and water conservation, water policies, laws and regulations etc. It is also the supervisory body of **7 basin authorities**.

Ministry of Ecology and the Environment

The Ministry of Ecology and the Environment is responsible for protecting the air, water and soils of China. Its mission is to control environmental pollution, protect nature, control pollutant discharges into rivers, supervise nuclear safety and protect public health and the security of the environment. Provincial branches are responsible for implementing national regulations at the local level.

Ministry of Natural Resources

It is responsible for preserving natural resources and ecosystems, land-use planning and interactions between rivers, lakes, wetlands and the ocean.

The Yellow River Conservancy Commission

Since 1946, the Yellow River Conservancy Commission (YRCC) was officially set up to manage the Yellow River basin. Its missions are to reduce the severity of floods and **droughts**, and limit the accumulation of sediments in the river. The Yellow River Conservancy Commission also manages **water quality, resource allocation for all the uses (industrial, agricultural, environmental...) and the protection of the ecosystems. It implements sustainable resource management** (*environmental water management*).

This work is performed in an integrated manner. The aim is to invest in resource management measures that jointly improve ecological outcomes and enhance the welfare of the people who live in the Basin.

Furthermore, the Yellow River Conservancy Commission applies an adaptive model, in which the actions carried out rely on the continuous analysis of surveys and scientific monitoring. It also takes into account changes in the needs of the population.

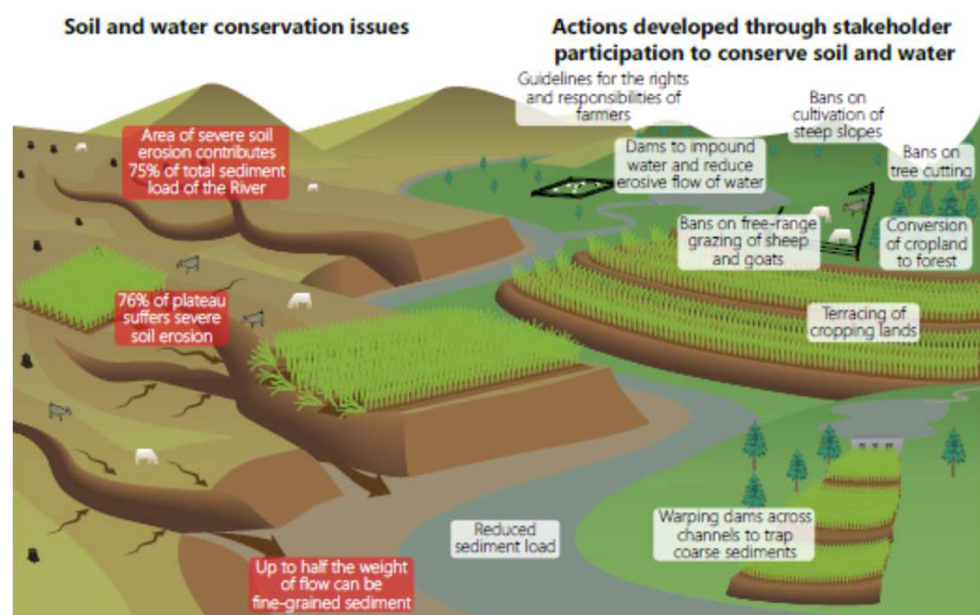
What is more, the Chinese government adopted **the Global Yellow River Basin Plan (2012-2030)** which focuses on flood prevention, the control of water and silting, the prevention of soil erosion, the distribution of water resources and their use, the ecological protection of water resources, and the overall management of retention basins.

The river and biodiversity

Persistent deforestation and soil erosion

In the northwest, the forest in the mountains that surround the Yellow River has disappeared to make way for cultivated plots. However, without the forests, the soil no longer retains the water, a function that reduces the impact of floods and helps to maintain a healthy discharge during dry periods. Directly exposed to the wind and rain, the soil is subject to severe erosion. On the Loess plateau, the regions most affected lose 100 tonnes of soil per hectare every year due to erosion. This has exhausted the agricultural land and reduced productivity, the prairies were over-grazed and more than a quarter of China was subject to desertification.

Since the 2000s, the Chinese government has made great efforts to replant forests to promote the infiltration of runoff water into the soil. Deforestation still continues to progress, though at a slower pace than before. **For example, on the Loess plateau, the revegetated areas have increased by 44% since 2000, i.e. from 26,000 to 33,000 km².** Other actions has been launched to conserve soil and water.



The river and biodiversity

Water pollution

The Yellow River crosses large cities, industrial zones including petrochemical installations, farmland and the largest coal bearing region of China (Inner Mongolia). This has generated heavy pollution of the water due to the use of agricultural pesticides, the lack of treatment of residual waters, and industrial pollution. In 2008, a third of the river water was still unfit for consumption, though the water quality in the main stream of the Yellow River has improved considerably thanks to the efforts of the YRCC. More than 60% of the large lakes and half the 197 Chinese rivers controlled were heavily contaminated by wastewater, ammonium nitrate, minerals and organic compounds.

In 2015, China implemented an action plan called **Water 10** that set out a route plan to prevent water pollution. From now to 2020, it aims to ensure that 70% of the country's hydrographic basins (Yangtze, Yellow River, Songhua, Huaihe, Haihe and Liaohe) will reach good status.

The first results: the volume of wastewater treatment in urban areas has risen from 52 million tonnes to 182 million tonnes a day over the last decade.

Preservation of aquatic fauna

The Yellow River basin is rich in fish, as it harbors 160 indigenous species distributed in 92 genera and 28 families, including 19 endemic species. The Cyprinidae (carps, gudgeons and minnows), which are typical of Asian rivers, is by far the most diversified family in the Yellow River.

However, due to pollution, overfishing, the dams and lower discharges, a third of the fish species present in the river have now disappeared, and several are considered threatened. In order to limit overfishing, in 2018 the Chinese Ministry of Agriculture announced the **banning of fishing in the waters of the Yellow River from 1 April to 30 June**.

Preservation of wetlands

On the upper course of the Yellow River, there are several types of wetland like alpine prairies, lakes and peatlands. But since the 1950s their state has declined or else they have disappeared: **over the last 40 years, the wetlands on the Qinghai plateau – Tibet have decreased by 13.6%**.

This situation is due to several reasons:

- climate change (reduced rainfall and higher temperatures),
- human activities: drainage and agricultural development, transformation into grazing land, the impact of road building.

The river and biodiversity

However, these wetlands provide many ecosystemic services: they cleanse water of toxic elements, they recharge groundwater, provide a habitat for different wild species, and so forth. They act as carbon sinks that mitigate the effects of climate change and they filter sediments, thus improving water quality, and they reduce the frequency of floods.

In 1998, the Chinese government approved the creation of a nature reserve for the **peatlands of Ruergai – the largest high altitude peatland in the world – in the province of Sichuan**. This reserve covering a surface area of 1,665.7 km² was classified as “a wetland of international importance” in 2008. Henceforth, the area now includes two national nature reserves, two designated RAMSAR sites and two provincial nature reserves. Several restoration methods have been implemented to preserve these peatlands and the alpine biodiversity they contain. To date, about 1,568 hectares of peatland have been restored with proof of successful revegetation.

The delta of the Yellow River is another important wetland ecosystem. Situated in the northeast of the province of Shandong, it covers a total surface area of 18,000 km² and accommodates a population of 5 million people.

In 1992, China became a member of the RAMSAR Convention on the conservation of wetlands. The same year, **the national nature reserve of the Yellow River delta** was created. It is the home of more than 1,500 wild animals, 265 bird species and 400 plant species. It provides a habitat for the reproduction and migration of birds.

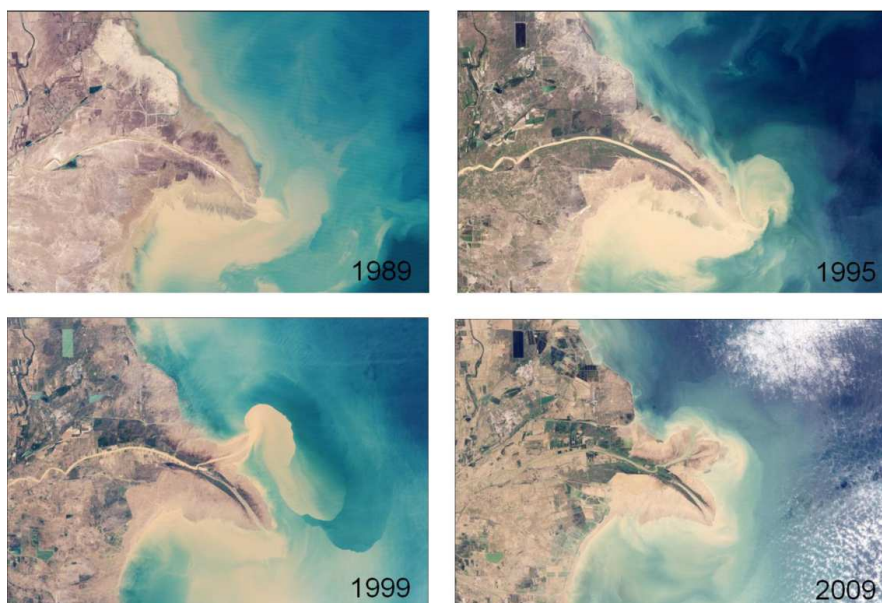
The delta is also rich in natural resources, with China's second largest oil deposits (the Shengli oil field, with reserves exceeding 4.6 billion tonnes). The delta's industrialisation and urbanisation have begun with the extraction of the oil, and have accelerated in recent years, leading to greater risks for the biodiversity.

All these phenomena are speeding up the morphological transformation of the delta, already known for its meanders caused by the influx of sediments and coastal erosion.

- **Since the 1970s, the Yellow River delta has shrunk by almost half and more than 40% of the fish and 30% of the bird species have disappeared.**
- **Since the 1950s, more than 57% of China's coastal wetlands have disappeared, in particular the mangrove forests, which have receded by 73%.**

The Yellow River

The river and biodiversity



Satellite images showing the sedimentary evolution of the delta for 20 years (progradation or advance into the sea) - NASA observatory. (http://earthobservatory.nasa.gov/Features/WorldOfChange/yellow_river.php)

The combat against invasive species

More than 540 exotic species have invaded China, posing a major risk for the environment and biodiversity. The 50 most dangerous invasive species identified by the International Union for Conservation of Nature have become widely dispersed in China. They include the well-known water hyacinth (*Eichharnia crassipes*), the American moth (*Hyphantria cunea*), and the pinewood nematode (*Bursaphelench xylophilus*).