

# Regional definition

## BOHAI SEA

This section describes the boundaries and the main physical and socio-economic characteristics of the region in order to define the area considered in the regional GIWA Assessment and to provide sufficient background information to establish the context within which the assessment was conducted.

### Boundaries of the region

The GIWA region Bohai Sea is located in China and is bordered by the Yellow Sea (GIWA region 34) in the south, the Sea of Japan (GIWA region 33) to the east and the Sea of Okhotsk (GIWA region 30) to the north. The Bohai Sea is not a transboundary water by GIWA definitions

and the report is therefore published as an appendix to the Yellow Sea regional assessment. Figure 1 shows the boundary of GIWA region Bohai Sea. The region includes the following sea, river basins, watersheds and their associated coastal and marine habitats:

- Bohai Sea, which consists of three bays: Liaodong Bay to the north, Bohai Bay to the west and Laizhou Bay to the south;
- Liaohe River Basin, coastal river basins in the Liaodong Peninsula, the Shuangtaizihe River Basin and their associated coastal and marine habitats in Liaodong Bay, north of the Bohai Sea;
- Hai River (Haihe) and Luan River (Luanhe) and their associated marine habitats in Bohai Bay west of the Bohai Sea;
- Yellow River (Huanghe) Basin, coastal river basins in the Shandong Peninsula and their associated coastal and marine habitats in Laizhou Bay, to the south of Bohai Sea.



Figure 1 Boundaries of the Bohai Sea region.

The Bohai Sea proper covers an area of 823 000 km<sup>2</sup>, but the river basins that drain into it account for 1.6 million km<sup>2</sup>, comprising about 15% the total land area of China, which is home to around 343.5 million people, amounting to 35% of the nation's total population (Wikipedia 2003). The region is part of the Bohai Bay Area, which covers the Bohai and Yellow seas and its adjacent provinces and municipalities, namely, the Liaoning, Hebei and Shandong provinces, and the cities of Beijing and Tianjin. The Bohai Bay Area is known as one of the major centres of economic development in China, and it experiences the downstream impacts of the region's freshwater systems and covers an area of more than 36 000 km<sup>2</sup>. In 1999, the area accounted for some 22% of the nation's GDP. It functions as an important maritime outlet for the country's landlocked great west and northeast provinces. It is also a Euro-Asian transportation link. The "National Economic and Social Development Programme" for the next five years, as recently adopted by the National People's Congress, accords high priority to the Bohai Sea Environmental Improvement and Management Project.

## Physical characteristics

### The Bohai Sea

The Bohai Sea is a large internal sea of China. It is the innermost gulf of the Yellow Sea in northeastern China and covers an area of approximately 823 000 km<sup>2</sup> bordering the Liaoning Peninsula to the east and the Shandong Peninsula to the south. The Bohai Sea consists of three bays: Laizhou Bay to the south; Laidong Bay to the north; and Bohai Bay to the west. Three large rivers, the Yellow River, the Liao River and the Hai River drain into the Bohai Sea. The provinces and municipalities bordering the Bohai Sea include: Shandong, Liaoning and Hebei provinces and Tianjin Municipality. The major port cities surrounding the rim of Bohai Sea are: Dalian, Yingkou, Jinzhou, Qinhuangdao, Tanggu, Longkou and Yantai. In the past two to three decades, petroleum oil and natural gas deposits have been found in and around the Bohai Sea and are being exploited (Wikipedia 2003). The Bohai Sea is an ecologically important and stressed body of water. Its marine resources are important to China, Japan, and North and South Korea.

### Fishery resources

The Bohai Sea is known as a "natural fishing ground" and harbours over 1 540 species, including 29 species of prokaryotes, 653 species of protists, 57 species of fungi, 96 species of plants and 705 species of animals. Apart from such sea treasures as prawn, sea cucumber and abalone, the Bohai Sea has over 100 species of major fishes among which the Small yellow croaker (*Pseudosciaena polyactis*) and the Hairtail

(*Trichiurus haumela*) are the fish species with the largest fish production in the Bohai Sea and also among the four major fish products in China's seas. Other species like Mullet (*Mugil so-iyu*), catfish (*Silurus* sp.), Spanish mackerel (*Scomberomorus japonicus*), Left-eyed flounder (*Tanakius kitaharae*), Genuine porgy (*Pagrosomus major*), Prawn (*Penaeus orientalis*) and Jellyfish (*Rhopilema esculenta*) are also distributed in the waters of the Bohai Sea. There are a number of fishing grounds in the Bohai Sea, including Wanghuazai, Juhuadao and Daqinghe estuarine fishing grounds in the north, Longkou and Yellow River estuarine fishing grounds in the south, and Hai River estuarine fishing ground in the west (Tang and Jin 1999, Jin 2003).

With a wide expanse of tidal flats and shallow waters, the littoral area of the Bohai Sea provides favourable environmental conditions for the industry of mariculture and stock enhancement, and the major cultured varieties are kelp (*Laminaria* spp.), shellfish and prawn, sea cucumber (*Holothuria* spp.) and abalone (*Haliotis* spp.). In 1999, the Bohai Sea area had a mariculture area of 394 450 ha with a total yield of 1.96 million tonnes (PEMSEA 2004).

The Bohai Sea is also one of the most intensively exploited areas in the world (Wigan 1998). According to the China Oceanic Information Centre (Jin 2003), the output of fisheries and mariculture reported by the surrounding provinces and cities of the region has increased in recent years. The catch from Bohai Sea reached about 1.6 million tonnes, and mariculture production was just over one tonnes in 1999. At the same time, the ecosystem in the Bohai Sea has degraded because of overfishing and the adverse impacts of mariculture, in addition to pollution from other industries and city sewage.

### River basins

#### Liao and Luan rivers

The Liao River Basin spans the provinces of Jilin and Liaoning, has a population of around 42 million, and is rich in natural resources, particularly oil and gas. The water resources in the Liao River Basin have been badly depleted and polluted by heavy industries (MOWR 2001). The Liao and Luan river basins drains the southern part of the Liao and Sungari plains of central Northeast China, in Liaoning Province and Inner Mongolia. The river system is about 1 345 km long with a drainage area of 230 000 km<sup>2</sup> and has an annual run-off of 14.8 billion m<sup>3</sup>. The Liao and Luan river basins is very flat, and floods frequently in the summer. It is very heavily polluted from industrial sources, carrying a heavy load of silt. The Liao River Basin is the agricultural and industrial base of the Liaoning Province and is the most polluted river in China, followed by the Hai River. Efforts to control pollution include the closure of many factories with obsolete technology and the construction of wastewater treatment plants.

### **Hai River (Haihe)**

The Hai River Basin is the historical heartland of China, and one of the most important agricultural and industrial regions in the country. Spread over the four provinces of Hebei, Henan, Shandong and Shanxi, and the municipalities of Beijing and Tianjin, the Hai River Basin is home to 117 million people and accounts for 15% of China's GNP. The Hai River Basin is also one of the most water-stressed basins in China and suffers from severe groundwater overdraft. The Hai River Basin covers an area of 264 000 km<sup>2</sup> of which 60% is mountainous and 40% plains, and has a mean annual run-off of 22.8 billion m<sup>3</sup>.

The Hai River Basin is a network of the smaller Chao, Yungting, Taching, Tzuya, Zhangwei, Tuhai and Majia rivers, coming together at, or just upstream of, the city of Tianjin before discharging into the Bohai Sea. The River Basin generally has low gradients and extensive dikes have built up above the level of the surrounding land for flood control. Flows in the rivers are variable because of seasonal variations in rainfall, with low rainfall during the dry winters when the rivers often dry up and heavy rainfall during summer when floods always occur. The Hai River Basin itself is inadequate to carry the amount of floodwater discharged, and for centuries, destructive floods occurred annually. Since 1963, the Hai River Basin has been the subject of a comprehensive water-control programme. On the upper reaches of the river and its tributaries, some 1 400 dams have been constructed, several of which are over 1 billion m<sup>3</sup> and are designed as multi-purpose flood control, hydropower, and irrigation storage reservoirs. In the plain itself, the major rivers have been banked, and their channels cleared and channelised using massive mobilisation of local labour. As a result, many of the Hai River's tributaries have been directed into new channels and given separate outlets. The Hai River thus no longer has to carry the entire flow of all these rivers during floods. These works have been integrated with large-scale construction of subsidiary drainage and irrigation works designed to reduce flooding and ameliorate droughts. A huge number of wells have also been sunk to provide supplemental irrigation (MOWR 2001).

### **Yellow River (Huanghe)**

The Yellow River Basin covers an area of 750 000 km<sup>2</sup> with a mean annual run-off of 59.2 billion m<sup>3</sup> and annual sediment transport of 1.6 billion tonnes. The Yellow River is the second largest river in China; 5 460 km long. It begins in the Kunlun Mountains in Qinghai Province and flows east, then northeast, through Gansu Province. It flows between the Ordos and Gobi deserts, and then south through steep valleys of yellow loamy soil (loess) between Shanxi and Shaanxi provinces. Silt picked up here gives the river its distinctive brown colour. It is estimated that the Yellow River picks up 1 billion tonnes of

silt annually. The River then runs east through Henan and Shandong provinces, through a flat, heavily populated region. The Chinese have tried to control the Yellow River's flooding for millennia with the use of dikes. This, combined with the settling out of the loess sediment, has raised the level of the river above the surrounding land; in some places as much as 20 m. The Yellow River eventually reaches the Bohai Sea, creating a massive delta with its sediment (MOWR 2001).

The River is well known for its flood disasters, which occur mainly in its lower reaches. There are levees with a total length of about 1 000 km on the main stem and its tributaries. The riverbed of the lower reaches of the Yellow River is suspended 5-10 m over the ground outside of its two levees as a result of millennia of sedimentation. The average flow of the river in its lower course is 56 km<sup>3</sup>/year and 17 km<sup>3</sup>/year is lost from Mongolia downstream to Zhengzhou, as a result of percolation, evaporation, and diversion for irrigation. Another 10 km<sup>3</sup>/year are drawn off across the North China Plain. In the Yellow River Basin more than 50% of China's wheat, cotton, and tobacco are cultivated.

The Chinese have managed to control normal floods in the Yellow River Basin, but they are only buying time. The really fundamental problems of the Yellow River are siltation and its corollary, upstream erosion, especially in the loess belt (Figure 2). The incredible erosion in the loess plateau is a natural phenomenon to some extent, but it has been greatly increased by human activity, especially deforestation, overgrazing, and overcropping. The upstream reservoirs in Shanxi Province are filling at a rate of 80 million m<sup>3</sup> of sediment per year, and are thereby losing not only volume but also the ability to absorb flood crests. The problem is getting worse rather than better. Perhaps 3 000 years ago, loess erosion was 1 billion tonnes per year from the plateau; it was 1.6 billion tonnes in the 1950s and was more than 2.2 billion in the 1970s. However, plans are being developed on conservation measures to reduce loess erosion sufficiently to mitigate the sedimentation problem.

The sediment load of the Yellow River averages 37.6 kg of silt per m<sup>3</sup> (compared with 0.07 for the Amazon and 0.6 for the Mississippi). Overall, the historic sediment load of the Yellow River since 1919 has been about 1.6 billion tonnes of silt per year. About 1.2 billion tonnes per year have been swept out into the Bohai Bay, and perhaps 0.4 billion tonnes have been deposited in the river bed in an average year, raising the bed another 10 cm. In the flood of 1933, 3.7 billion tonnes were deposited, and 0.9 billion tonnes in 1977. Given this background, a figure of only 0.2 billion tonnes deposited in 1986 can be seen either as a successful soil conservation or as the result of a dry year (MOWR 2001).



**Figure 2** Yellow River on Qinghai Plateau, China.

(Photo: Corbis)

## Climate

The hinterland of the region consists of the north, northeast and northwest regions of China. North China has no mountain ranges to form a protective barrier against the flow of air from Siberia, it thus experiences a cold and dry winter with temperatures that range from 3.9°C in the extreme south to about -10°C north of Beijing and in the higher elevations to the west in January. In July the temperature generally exceeds 26.1°C and, in the North China Plain, approaches 30°C. Almost all the annual rainfall occurs in summer. Annual precipitation totals are less than 760 mm and decrease to the northwest, which has a drier, steppe climate. Year-to-year variability of precipitation in these areas is great; this factor, combined with the possibility of dust storms or hailstorms, makes agriculture precarious. Fog occurs on more than 40 days per year in the east and on more than 80 days along the coast.

The climate of Manchuria is similar to, but colder than, that of north China. January temperatures average -17.8°C over much of the Manchurian Plain, and July temperatures generally exceed 22.2°C. Rainfall, concentrated in summer, averages between about 510 and 760 mm in the east but declines to about 300 mm west of the Greater Khingan Range.

Desert and steppe climates prevail in the Mongolian Borderlands and northwest China. January temperatures average below -10°C everywhere except in the Tarim Basin. July temperatures generally exceed 20°C. Annual rainfall totals less than 250 mm, and most of the area receives less than 100 mm. Because of its high elevation, the Tibetan Plateau has an arctic climate; July temperatures remain below 15°C. The air is clear and dry throughout the year with annual precipitation totals of less than 100 mm everywhere except in the extreme southeast (Anon. 2003).

## General land forms

The land resources of the region encompass those in the northwest, north and northeast regions of China. The northwest region consists of two basins; the Dzungarian Basin (Junggar Pendi) in the north and the Tarim Basin in the south, including the lofty Tien Shan (Tian Shan). The Tarim Basin contains the vast sandy Takla Makan (Taklimakan Shamo), the driest desert in Asia. Dune ridges in its interior rise to elevations of about 100 m. The Turfan Depression (Turpan Pendi), the largest area in China with elevations below sea level, commands the southern entrance of a major pass through the Tien Shan. The Dzungarian Basin, although containing areas of sandy and stony desert, is primarily a region of fertile steppe soils and supports irrigated agriculture (Anon. 2003).

The north region lies between the Mongolian Borderlands on the north and the Yangtze River Basin on the south and consists of several distinct topographic units. The Mongolian Borderlands is located in north central China and is a plateau region consisting mainly of sandy, stony, or gravelly deserts that grade eastward into steppe lands with fertile soils. This is a region of flat-to-rolling plains, partitioned by several barren flat-topped mountain ranges. Along its eastern border is the higher, forested Greater Khingan Range (Da Hinggan Ling). The loess plateau to the northwest is formed by the accumulation of fine windblown silt (loess). The loosely packed loess is subject to erosion, and the plateau's surface is transected by sunken boats, vertical-walled valleys, and numerous gullies. The region is extensively terraced and cultivated. The North China Plain, the largest flat lowland area in China, consists of fertile soils derived from loess.

Most of the plain is under intense cultivation. Located to the east, the Shandong Highlands on the Shandong Peninsula consist of two distinct areas of mountains flanked by rolling hills. The rocky coast of the peninsula provides some good natural harbours. To the southwest are the Central Mountains, which constitute a formidable barrier to north-south movement. Located in north central China, the northeast region comprises of all of Manchuria east of the Greater Khingan Range and it incorporates the Manchurian Plain (Dongbei Pingyuan) and its bordering uplands. The plain has extensive tracts of productive soils. The uplands are hilly to mountainous, with numerous broad valleys and gentle slopes. The Liaodong Peninsula, extending to the south, is noteworthy for its good natural harbours (Anon. 2003).

The North China Plain, which falls within the region, is made of the deposits of the Yellow River and is the largest alluvial plain of eastern Asia. The plain is bordered on the north by the Yen mountain range and on the west by the Taihang mountain range. To the south it merges into the Yangtze River plain and from northeast to southeast it fronts the Bohai Sea, the highlands of the Shandong Peninsula and the Yellow Sea. The plain covers an area of about 409 500 km<sup>2</sup>, most of which is less than 50 m above sea level. This flat yellow-soil plain is the main area of kaoliang, millet, maize and cotton productions in China. Wheat, sesame seed, peanuts and tobacco are also grown there. The plain is also one of the most densely populated regions in the world.

In addition, the fertile soil of the North China Plain gradually merges with the steppes and deserts of Central Asia and there are no natural barriers between these two regions. Although the soil of the North China Plain is fertile, the weather is unpredictable because of its location at the intersection of humid winds from the Pacific Ocean and dry winds from the interior. This makes the North China Plain prone to both flood and drought. Finally, the flatness of the North China Plain creates massive flooding when the River's flood control structures are damaged. In the

opinion of many historians these factors encouraged the development of a centralised Chinese state to manage granaries, manage hydraulic works, and man fortifications against the steppe peoples (Anon. 2003).

## Biodiversity

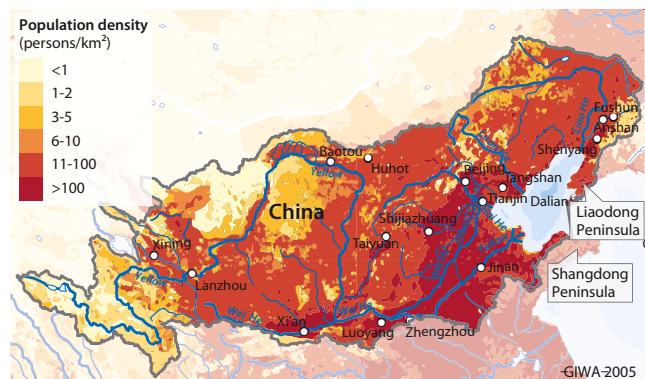
The biodiversity in the deltas of the region is substantial, this being an important stopover location for the Red-crowned crane (*Grus japonensis*) and the Siberian crane (*G. leucogeranus*). The rare Saunders' gull (*Larus saundersi*) uses the Huang He Delta as one of its four global breeding sites. It is estimated that at least 800 000 water birds use the 4 800 km<sup>2</sup> coastal wetland here, including at least 15 IUCN Red Data species. Although 1 500 km<sup>2</sup> of coastal wetland of the region has been declared a nature reserve, the Dongying Huang He Sanjiaozhou has already been severely disturbed (MacKinnon et al. 1996).

More than 265 bird species have been recorded in the region with total numbers estimated at more than 10 million. This includes seven species identified as meriting the Chinese first class of protection. There are an additional 40 species listed in CITES (Convention on International Trade in Endangered Species).

## Socio-economic characteristics

### Population and main urban areas

The total population in the region amounts 343.5 million. The region is very densely populated, especially in the coastal area (Figure 3). The region is the historical heartland of China, and one of the most important agricultural and industrial regions in the country. It consists of three basins: the Yellow River Basin, the Hai Basin and the Liao Basin. The Hai Basin spreads over four provinces, the Hebei, the Henan, the Shandong and the Shanxi, and two municipalities: Beijing and Tianjin.



**Figure 3** Population density in the Bohai Sea region. (Source: ORNL 2003)

It is the home to 117 million people. The Liao Basin spans the provinces of Jilin and Liaoning, and has a population of around 42 million; it is rich in natural resources, particularly oil and gas (Wikipedia 2003). The Yellow River Basin, with a population of about 156 million, begins in the Qinghai Province and flows east, then northeast, through Gansu Province. It flows between the Ordos and Gobi Deserts, and then south between the Shanxi and Shaanxi provinces. Finally the river runs east through Henan and Shandong provinces.

## Management of water resources

The major flood-prone areas along the major river basins of the region are presented in Figure 4. These include the following rivers:

### Yellow River

The Yellow River is well known for its floods, which occur mainly in its lower reaches. There are levees with a total length of about 1 000 km on the main stream and tributaries. In the lower reaches of the River, the levees are much higher (5-10 m) than the surrounding lands because of sedimentation. On the upper and middle reaches of the Yellow River, 173 large and medium-sized reservoirs have been built with a total storage capacity of 55.2 billion m<sup>3</sup>. Downstream of the Sanmenxia Reservoir, two large flood-retardation basins, the Beijinti and the Dongpinghu, have been constructed with a storage capacity of 2 billion m<sup>3</sup> each and detention areas of 2 316 km<sup>2</sup> and 627 km<sup>2</sup> respectively.

With regard to flow regulation of the River, 5 000 bank protection works totalling 585 km in length were built for controlling floods. They can withstand floods with a peak discharge of 22 000 m<sup>3</sup>/s (the 1958 flood) at the Huayuankou hydrological station, corresponding to a 60-year return period. A large flood control reservoir, the Xiaolangdi Reservoir, with a storage capacity of 12.65 billion m<sup>3</sup>, is under construction on the lower reach of the River. Once completed, it should protect the Yellow River downstream against frequent occurrence of floods (Zhang & Wen 2003).

### Hai River

The main stream of the Hai River is only 70 km long with five tributaries confluent in the vicinity of Tianjin City, the industry centre of north China. Large amounts of floodwater from upstream along with inadequate discharge capacity in the middle and downstream sections often result in flood disasters. In 1963, an unusually big flood caused a catastrophe in this river basin. After that, a comprehensive flood-prevention programme was implemented by the Chinese government. Thus far, 140 large and medium-sized reservoirs have been built, with a total storage capacity of 25.3 billion m<sup>3</sup>, equal to 92.7% of the River's annual upstream run-off. At present the Haihe River system can withstand a once-in-a-50-year flood.



**Figure 4** Flood prone areas along the main rivers in the Yellow Sea and Bohai Sea regions.  
(Source: Zhang & Wen 2003)

### Liao and Luan River

The Liao and Luan river basins, which cover most of the Liaoning Province, provides fertile areas for agriculture, while the coastal areas provide a good base for industries. Big floods in 1949, 1951, 1953 and 1960 hit the basins and flooded 3 to 5 million ha of cultivated land, resulting in substantial economic losses. As of 1993, 17 large reservoirs have been built with a total storage capacity of 12 billion m<sup>3</sup> and 11 000 km of levees have been strengthened or rebuilt. The levees along the rivers can withstand 10-to-20-year floods. Some important cities located along the rivers such as Shenyang and Fushun are protected against once-in-100-year floods.

### Economic sectors

The region is located within the Bohai Bay Area, which includes provinces around the Bohai Sea and the Yellow Sea. In 1994, the Chinese government developed key points of the Programme for Economic Development of the Bohai Bay Area to the year 2000, and extended the area to the Shanxi Province and the Inner Mongolia Autonomous Region. The Bohai Bay Area lays in the centre of the Northeast Asian economic sphere and at the meeting place of the northeast, north and northwest regions. It has communications links with the Yangtze and Pearl river deltas, Hong Kong, Macao, Taiwan and Southeast Asian countries to the south, with the Republic of Korea and Japan to the east, and Mongolia, and the Russian Far East to the north.

As China's reform and opening to the outside world has expanded, the pace of economic development in the Bohai Bay Area has quickened. Currently it is the engine of economic development in North China, and is the area with third largest rate economic growth in the country, following the Pearl River and Yangtze deltas. In the future the Bohai Bay Area will benefit from its advantages of advanced communications, large number of large and medium-sized cities, strong contingents of scientific and technical personnel and wealth of natural resources. The development of the automobile, electronics, and new- and high-tech industries and other pillar industries will be emphasised, as well as the construction of energy bases and transportation channels. Relying on the coastal large and medium-sized cities, a comprehensive Bohai Bay economic circle will be formed with the Liaodong and Shandong peninsulas, Beijing, Tianjin and Hebei playing the leading role (MF 2003).

### **Fisheries and marine aquaculture**

Fisheries and marine aquaculture in the Bohai Sea not only provide a source of seafood, but also sustain the livelihood of numerous fishermen around the Sea. Furthermore, the Bohai Sea is an important spawning and nursery ground for migratory species from the Yellow Sea and East China Sea. It is estimated that 40% of the fisheries resources in the Bohai Sea, Yellow Sea and the north area of East China Sea originate in the Bohai Sea. The Bohai Sea is the biggest mariculture base in China. The ecosystem in the Bohai Sea is fragile because of its nature as a semi-enclosed sea with long residence times. Both the excess fishing effort and the accumulating negative impacts from mariculture exert great pressures on the ecosystem. The fishing effort in terms of the number fishing vessels in China including the Bohai Sea has increased dramatically over the years. Numerous unregistered or unlicensed fishing vessels in a rapidly degrading ecosystem are the main problems with China fisheries. The illegal fishing and destructive fishing methods such as the use of electricity, explosives, toxins and other illegal fishing methods are often used because these methods usually have higher efficiency than conventional methods. Mariculture in the Bohai Sea, as an alternative supply of seafood for the large population around the Bohai Sea, is becoming more and more important (Dai 2001). At the same time, pollution from mariculture is accelerating as a result of the spatial expansion of aquaculture. The construction of mariculture areas damages natural spawning grounds and habitats, which exerts more pressure on wild fish stocks. The species that are introduced for mariculture, including genetically modified species, also pose a threat. Open-access fisheries and unregulated mariculture in the Bohai Sea impede the economic progress and the sustainability of the fisheries resource. The collapse of fish stocks in the Bohai Sea demonstrates that stakeholders in the fisheries and mariculture industries need to have a more conservation-oriented strategy in implementing their management (Jin 2003).

### **Salt making**

The Bohai Sea provides an inexhaustible supply of table salt, thus making the salt industry an ancient and eternal marine industry in the littoral Bohai Sea. In 2000, the littoral area of the Bohai Sea had a total of 16 salt-fields with a total salt-pan area of 273 470 ha, a salt-pan production area of 240 750 ha and a sea-salt output of 664.76 million tonnes, making it the largest salt industrial production base in China. Among the four major sea-salt producing areas, three are located in the Bohai Sea region. These are the salt-producing areas of Liaodong Bay, Changlu and Shandong, of which the Changlu salt-producing area is the largest. The Changlu salt produced from this area has won recognition both domestically and internationally (PEMSEA 2004).

### **Port development and marine transport**

The number of ports or harbours around the littoral area of the Bohai Sea ranks first in the country. In the littoral area of the Bohai Sea, 66 harbours have been completed, including 48 fishing harbours. Several key harbours in the region have a capacity greater than 31% of that of the major ports in China. Among them, the Dalian Harbour is an important outlet to the sea in the three provinces of northeast China as well as a focal foreign trade port of China; the Qinhuangdao Harbour is the largest energy-exporting port in the world and an important integrated foreign trade port; the Tianjin Harbour is the largest artificial harbour in China and also an international harbour. Thanks to its geographic location, it has become the gateway to the sea of Beijing, the capital of China, and is the largest commercial port in the north as well as an important port for ocean transportation. In addition, the Bohai Sea region also has small and medium-sized harbours, each with an annual handling capacity of over 1 million tonnes. The shipping capacity is complemented by more than 30 local harbours as well as a number of harbours that are being planned or are under construction. These concentrated harbours have led to the formation of a harbour group with the combination of large, medium-sized and small harbours (PEMSEA 2004).

In 2000, the Bohai Sea region had 13 first-class water transport ports, which can handle up to 265.4 million tonnes of cargo, accounting for 28.8% of the volume of freight handled by all the coastal ports. Ocean shipping constitutes not only the leading industry in the economy of the Bohai Sea, but also occupies an important position in the development of national economy (PEMSEA 2004).

### **Oil exploitation**

The Bohai Sea is rich in offshore oil and gas resources. The major oilfields are the Shengli, Dagang and Liaohe Oilfields. On the 27<sup>th</sup> February 1997 China made a major breakthrough in oil exploration in the Bohai Sea,

off the eastern part of China, by setting up the Chengdao Oilfield. The new field, which has an annual output of 1.05 million tonnes, is the largest offshore oilfield in the Bohai Bay, and has huge production potential. According to the China National Petroleum Corp (CNPC), the offshore oilfield was difficult to explore because of its complicated geological structure. To develop the Chengdao Field, a large array of new technology has been used, including a 3-D seismic survey and oil reserve tracking technology. The Bohai Sea area now has an annual output of 2.12 million tonnes of oil and 367 million m<sup>3</sup> of gas. Greater progress in oil and gas exploration in the Bohai Sea area can be expected in the coming years (PEMSEA 2004).

### **Tourism**

The coastal areas of the Bohai Sea boast many beautiful natural spots, favourable environmental conditions, and a natural marine landscape characterised by seawater, sand-beaches and islands, which provide ideal resorts for tourism and leisure travel. There are now more than 20 tourist sites in the coastal area, among which the more famous ones include the Beidaihe seaside, Shanhaiguan Pass, Dabishan Mountain, Xingcheng City, the wetland tourist zone at the Liaohe River mouth and the Cangli Golden Coast Nature Reserve. The well-known cultural ancient relics include the ancient Great Wall, the Penglai Dengzhou Aquapolis of the Ming Dynasty, the Penglai Taoist Temple of the Song Dynasty, as well as the ruins of Emperor Qin Shi Huang's Palace, the ruins of the Japan-Russian War and the Memorial Hall of the Liaoxi-Shenyang Campaign (PEMSEA 2004).

Many coastal cities in the Bohai Sea region have devoted major efforts to developing modern commercial tourism by making the best of their rich and colourful marine, natural and human landscapes. For example, the Tianjin Municipality is visited by large tourist ships on a regular basis which anchor alongside its shore; the City of Dalian welcomes modern commercial tourism by "performing operas of economy and commerce on the stage put up by tourism", which has resulted in the Garment Festival, Sophora Flower Festival and Marathon, which have been well received by tourists at home and abroad. In 2000, the Bohai Sea region was visited by 947 350 tourists from abroad with foreign exchange earnings of over 600 million USD from international tourism (PEMSEA 2004).

### **Mineral resources**

The Bohai Bay Area is rich in mineral resources, which are relatively evenly distributed and with favourable mining conditions. Statistics show that this area's reserves of iron, coal, petroleum, salt, natural gas and limestone account for 44, 40, 37, 50, 23 and 16% of China's totals, respectively. Shanxi is abundant in raw coal, its annual output accounting for 27% of the nation's total (MF 2003).

### **Agriculture**

The Bohai Bay Area has well-developed agriculture, with 26.57 million ha of cultivated area, over one-fourth of the nation's total. Its grain yield accounts for more than 23% of the nation's total. In addition, the output of oil-bearing crops, aquatic products, pork, beef and mutton also constitute heavy percentages of the nation's total. Shandong, Hebei and Liaoning provinces are China's important production and supply bases for agricultural and sideline products. The Inner Mongolia Autonomous Region is the largest animal husbandry production base in China.

### **Industry**

The Bohai Bay Area has a solid industrial foundation, where heavy and chemical industries are especially prominent. Some large-sized enterprises, such as the Anshan Iron and Steel Company in Liaoning, the Capital Iron and Steel Company in Beijing, the Taiyuan Iron and Steel Company in Shanxi and the Baotou Iron and Steel Company in Inner Mongolia, are located in this area. The Beijing Yanshan Petrochemical Group and Tianjin Bohai Chemical Group are China's two leading petrochemicals enterprises. In addition, Shenyang's heavy machinery and precision machine tool building industry, Beijing and Tianjin's electronic products and automobile industries, Shijiazhuang's cotton spinning, Hohhot's wool spinning and Taiyuan's mining machinery industries are all well known in China (MF 2003).

### **Legal and institutional framework**

The international programmes and initiatives as well as the specific laws that form legal and institutional framework for the environmental management of the region are provided in Annex III and IV, respectively. Several institutions are involved in the flood control of the major rivers in China (Zhang & Wen 2003):

#### **Ministry of Water Resources**

The State Council was restructured and streamlined in 1998, with a view to streamlining government operations and clarifying the respective responsibilities of the ministries and departments under it. The function and responsibilities of the Ministry of Water Resources (MWR) were adjusted; the administrative role of the MWR in hydropower development was moved to the State Economic and Trade Commission, and groundwater management originally under the Ministry of Geology and Mineral Resources and urban flood control originally under the Ministry of Construction were moved to the MWR. The ministry was mandated to take over the responsibility of managing water conservation all over the country, as well as the planning and monitoring of the water environment and recommending protection measures to the government at different levels.



The MWR is appointed as the Department of Water Administration of the State and discharges the responsibility for the unified management of water resources. In accordance with the reform scheme of the State Council in 1998, the main responsibilities of the MWR are:

- The formulation of policy, development strategy and long-term plans, drafting of relevant laws and regulations, and supervision of their implementation;
- Unified management of water resources including surface water and groundwater, formulation, supervision and implementation of the long-term water supply-and-demand plan and water allocation, assessment and verification of the available water resources and flood control measures, and implementation of water draw permit system and levy of a water resources fee, etc;
- Formulation and implementation of water conservation policy and plan;
- Water resources protection planning, water quantity and quality monitoring, evaluation and examination of pollution of water bodies;
- Water administration supervision and enforcement; mediation of water disputes;
- Formulation of economic regulatory measures in the water sector such as water pricing, taxation or loans;
- Issuance of technical guidelines, regulations, standards in the water sector, examination of proposal of large and medium-sized projects;
- Development and management of large rivers, large lakes and key projects crossing provincial boundaries;
- Water resource development and use in rural areas including hydroelectric projects and water supply;
- Soil and water conservation; and
- Undertaking the routine work for the State Flood Fighting and Drought Defying Headquarters (FFDDHS).

### **The river basin commissions**

There are seven major river basin commissions that are agencies of the MWR and perform the function of water administration in the river

basins. The main responsibilities of a river basin commission are:

- Execution of the Water Law, the Law of Water and Soil Conservation and related laws, regulations and rules;
- Mapping out strategic planning and mid- and long-term plans of a basin's water resource development;
- Working jointly with related departments and the relevant provincial authorities on the integrated river basin plan, relevant specialised plans and supervising their implementation;
- Unified management of the water resources of each basin;
- Unified management of the rivers, lakes, estuaries, tidal flats and that of key river reaches as authorised by the central government;
- Coordinating flood control and drought management;
- Mediation of water disputes;
- Comprehensive management of water and soil losses in key areas of the basin;
- Construction and management of trans-provincial water projects.

### **Local water resource management agencies**

Local water resource management is comprised of four levels, i.e. provincial, prefecture, county and village or town. The main functions and responsibilities of local water management are: (i) to be the departments of the local governments at all levels responsible for water administration; (ii) to work out the local water resource development plan and long-term water supply-and-demand plan; (iii) to implement local water resource development projects; (iv) to carry out flood control and drought management, water and soil preservation, water resource protection and water project management, within their jurisdiction; and (v) to be responsible for urban and rural water supply and economical water use. It is worthy to mention that there are village (or town) water conservancy stations almost all over China. They are not only the agencies of the water administration, but also the water organisations at the grass-roots level that serve and keep close ties to the rural residents.