IMPLEMENTING THE STRATEGIC ACTION PROGRAMME FOR THE YELLOW SEA LARGE MARINE ECOSYSTEM: RESTORING ECOSYSTEM GOODS AND SERVICES AND CONSOLIDATION OF A LONG-TERM REGIONAL ENVIRONMENTAL GOVERNANCE FRAMEWORK

(UNDP/GEF YSLME Phase II Project)

Adaptation plans of Dandong for Climate Change

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1. **Background**

Dandong city is located in the southeast of Liaoning province, China. It faces the Democratic People's Republic of Korea across the river to the east, Yellow sea is in the south of the city. The maximum east-west transverse distance is196 kilometers, the maximum north-south longitudinal distance is 160 kilometers, the coastline is 120 kilometers [1].

Dandong is the starting point of China's coastline in the north. It is an important cross point of northeast Asia economic circle, and Yellow sea economic circle. It is a city along the river, the coast and the border with the main feature of industry, commerce, logistics and tourism [1].

1.1 History of Dandong City

Dandong is a city with a long history. Dandong, formerly known as "Anton", was established in the tang dynasty as the governor and protector of Anton. Since ancient times, Dandong has been an important commercial and military stronghold in northeast China. Anton county was established in 1876, Anton city in 1937 and Dandong city in 1965.There are a lot of historical relics in the territory, such as the ruins of the primitive villages of the people of Qianyang who lived 18,000 years ago and the ancient temple buildings of Dagu mountain which started in tang dynasty[2].

1.2 Population and natural resources

Dandong covers an area of 15,200 square kilometers, and has jurisdiction over three counties (districts), three districts and a state-level border economic cooperation zone. The population is mainly concentrated along the Yalu river and in the coastal zone. The per capita disposable income of urban residents was 29,783 RMB; The per capita disposable income of rural residents was

15,439 RMB [2].

Dandong city is a multi-ethnic inhabited area, there are han, manchu, Mongolian, hui, korea, xibo and other 29 ethnic groups, in addition to the han ethnic minorities, manchu population is the largest, accounting for 32% of the city's total population. Manchu is mainly concentrated in Fengcheng, Kuandian manchu autonomous county town (township) and Donggang city he long manchu town; Mongolian is mainly concentrated in Dapu Mongolian town of fengcheng.The hui people mainly live in the urban areas and counties (cities) of Dandong city.The Korean nationality is mainly distributed in Dandong city area, kuandian manchu autonomous county along the Yalu river area and fengcheng, donggang two cities [2].

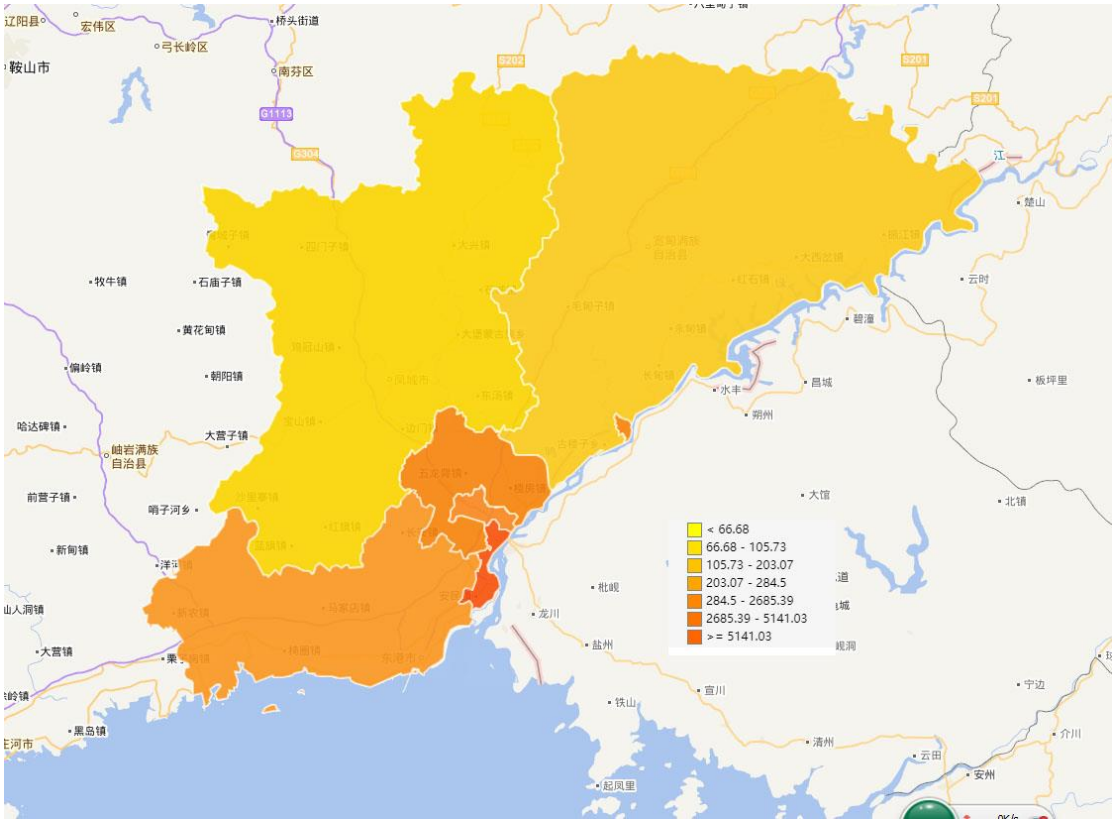


Figure 1.1 The density of population of Dandong (persons/km^2)

Dandong region is a part of the mountains and hills of Liaodong, which is a

branch or remnant of Changbai mountain extending to the southwest. The terrain gradually decreases from northeast to southwest. According to the height and topographic features, it can be divided into three types of large scale geomorphic units: the middle and low mountain areas in the north, the hilly areas in the south, and the coastal plain areas in the south margin. Mountain and hilly areas are the main part, and there are some small geomorphic units such as terrace, basin and platform. The city's forest coverage rate of 66 percent. With 35 national and provincial scenic spots, nature reserves and forest parks, it is an excellent tourist city and national garden city.

Dandong city belongs to hilly area, the terrain is high in the north and low in the south, 72.4% is hilly, 14.6% is plain valley area, 8.7% is water area, 4.3% is other.; In the north of Kuandian and Fengcheng, the terrain is the highest, with an average elevation of about 500 meters. There are 14 peaks over 1,000 meters. The average elevation of the south part of Fengcheng and the north part of Donggang is 300-500 meters. The urban area of Dandong city and the south part of Donggang have the lowest terrain, with the elevation above 20 meters and the lowest part below 2 meters [2].

Climate

Dandong is located in the mid-latitude zone of the east coast of Eurasia, belonging to the warm temperate sub-humid monsoon climate. The average annual rainfall is mostly between 800-1200 mm, and it is the region with the most rainfall in the north of China. Two-thirds of the precipitation is concentrated in summer. The rainstorm is concentrated from mid-July to mid-August.

The average annual temperature is 8-9℃ in the south and 6-7℃ in the north. Under the influence of monsoon, the seasonal changes are obvious and the four seasons are distinct. It is the warmest and wettest place in northeast China and a resort for summer tourism. The spring and autumn season are the

alternate season of south and north wind. In spring, cold air began to weaken and retreat northward, while warm air moved northward. Autumn is the opposite. Above weather characteristics, Dandong city, four distinct seasons.

Fresh water resource

Dandong area covered with rivers, mainly the Yalu river system, Dayang river system and coastal river system. There are 944 rivers over 2 kilometers in the city, including 4 big rivers with more than 4983 square kilometers river basin area, namely, the Yalu river, Hun Jiang, Ai River, Dayanghe river. Water per capita is 1.5 times the national average [6].

The Yalu river originates from Jilin province, China, and flows into the west Korea bay in the north of the yellow sea. It is 795 kilometers in length, covers a drainage area of 61,990 square kilometers, and has an annual runoff of 32.76 billion cubic meters.

The Yalu river estuary wetland located in Dandong city, with a total area of about 1010 square kilometers, among which the intertidal zone accounts for about 20%. The sediment of the intertidal zone is mud, silt, fine sand and sand successively from shore to sea, which is suitable for the growth of annelids and mollusks and provides enough food for migratory birds. The Yalu river estuary wetland is not only an important resting place for water birds to migrate, but also has many functions such as storing water and regulating flood, regulating climate and degrading pollution.

1.3 economics

Dandong industrial enterprises mainly include 36 categories of industries, which have formed transportation equipment manufacturing industry, agricultural and sideline products processing industry, energy industry, metal mining, smelting and rolling processing industry, textile and clothing industry,

machinery and equipment manufacturing industry and other advantages. Especially automobile and auto parts as the representative of the mechanical processing manufacturing industry. Dandong has more than 10 power stations of various types, including hydropower, thermal power and wind power.

Agriculture has initially formed high-quality seawater and Yalu river rare fishery belt and high-quality rice, chestnut, strawberry, blueberry and other agricultural bases, is the country's largest strawberry, chestnut and shellfish cultivation production and export base. The total area sown to crops in 2018 was 209,000 hectares, an increase of 1.1 percent over the previous year. Of this total, 178,000 hectares were sown for grain crops and 31,000 hectares for other crops [7].

China's total grain output for the year was 1.064 million tons, 15,000 tons less than that of the previous year. Among them, corn yield was 608,000 tons, down 6.8%. Rice output was 419,000 tons, up 11.3%. Soybean production was 14,000 tons, up 37.1 percent. Among cash crops, oil yield was 15,000 tons, an increase of 15%.Flue-cured tobacco output was 66,000 tons, down 19.8%;The output of fruits (including fruits and melons) was 334,000 tons, up 4.5%;The output of vegetables and edible fungi was 751,000 tons, up 5.1%;The yield of strawberries was 152,000 tons, up 12.9%.Tussah cocoon yield 20,000 tons, down 4%;Chestnut production dropped 4.8 percent to 112,000 tons [7].

In 2018, Dandong's gross domestic product (GDP) reached 81.67 billion RMB, ranking the 11th in the province. Calculated at comparable prices, Dandong's growth rate was 0.4% higher than that of the previous year, ranking the 14th in the province. The added value of the primary industry was 13.64 billion RMB, up 3.4%.The added value of the secondary industry was 24.96 billion RMB, down 0.5%;The added value of the tertiary industry was 43.08 billion RMB, down 0.5%.The proportion of the added value of the three industries in the GDP was 16.7:30.6:52.7.The annual per capita GDP was 34,193 RMB, an increase

of 1.2% over the previous year, which was converted to us $5,167.1 at the average annual exchange rate [7].

2. The main impacts of climate change for Dandong

2.1 Temperature change

Liaoning province, where Dandong is located, has seen an average annual temperature increase of 1.4℃ over the past 50 years, one of the fastest increases in China. In winter and spring, the temperature rise at night was higher than that at day, and the number of frost days decreased significantly. It is predicted that in the next 100 years, Liaoning province will still be one of the regions with the largest temperature increase in China, ranging from 2.5℃ to 6.5℃ [8].

2.1.1 Impacts for Agriculture

China's agriculture is a highly vulnerable area affected by climate change, which is mainly manifested by the northward movement of the agricultural climate belt. In the 1990s, the temperature increased by 0.91℃ compared with the 1970s, and the crop belt moved 150 kilometers to the north in the horizontal direction. The planting range of main varieties of maize expanded year by year, and the northern boundary of winter wheat moved 250 kilometers north. In winter, the permafrost period is shortened and the permafrost layer is thinner. The maximum permafrost depth in the past 50 years is reduced by 23 cm, soil moisture and nutrients in the root layer of vegetation are lost, and soil structure and composition are changed. Increased meteorological disasters, frequent extreme weather events such as drought and waterlogging, and increased prevalence of diseases and insect pests have led to higher agricultural production costs, increased agricultural production instability and increased yield fluctuations. Warmer winters increase the risk of outbreaks in livestock

and poultry.

2.1.2 Impacts for forest

The influence of rising temperature on forest and other natural ecosystems is mainly due to the advance of phenological period in spring, the northward movement of forest vegetation belt, the upward movement of vertical zone spectrum of mountain forest, the increase of forest fires, and the expansion and aggravation of disease and insect pest spread. The area of natural wetland decreased, the regulating function of wetland decreased, and the biodiversity decreased. The distribution area of major tree species and some rare tree species may shrink, and the loss of biodiversity may increase.

2.1.3 Impacts for water resource

The change of climate will lead to the gradual decrease of precipitation in the region. After the change of temperature has a certain impact on both rivers and snow cover, the snow will melt in advance and the river water will flow less or even dry up. These phenomena will affect the precipitation in the region.

Dandong's water cycle is divided into two parts, one is the water cycle on land, the other is the atmospheric water cycle.

It is surrounded by the energy balance between the amount of water on land and the amount of water in the atmosphere. The water cycle is a benign process generated by the flow of water resources and rainfall in urban areas. The change of climate will break the benign process of the water cycle and destroy the water circulation between the atmosphere, which has a very adverse impact on the normal use and development of air and land water resources.

2.2 Saline intrusion and sea level rise

In the past 30 years, the sea level along the coast of Liaoning province has risen by about 100 mm, with an average annual rise rate of 3.2 mm. Sea level rise is aggravating seawater intrusion disaster at the coastal areas. The combination of sea level rise and extreme weather events will aggravate the Marine disasters such as storm surge, salt tide invasion and red tide, aggravate the decrease of Marine biomass and degradation of Marine ecosystem, and increase the erosion degree of coastal wetland ecosystem.

2.2.1 Impact for coastal communities

Most of the people in Dandong live near the coast, the coastal communities are the most vulnerable area to climate change. By establishing an evaluation system and model, we assessed the vulnerability of regional sea level rise, which involves diverse aspects such as nature, society and economy. This requires that the evaluation of regional economic, social, and natural and other aspects

The areas of each vulnerable degree and their proportions are shown in Figure 2-1. The largest proportion covered by the moderately vulnerable area (4167.45 km^2) and severely vulnerable area (3875.33 km^2), accounting for 28.64% and 26.63% of the total area of Dandong, followed by the vulnerable area (2912.45 km^2) and extremely vulnerable area (2505.63 km^2), accounting for 20.01% and 17.22% of the total area of Dandong. The smallest vulnerable area is the low vulnerable area, which is 1091.48 km^2, accounting for only 7.5% of the total area [9].

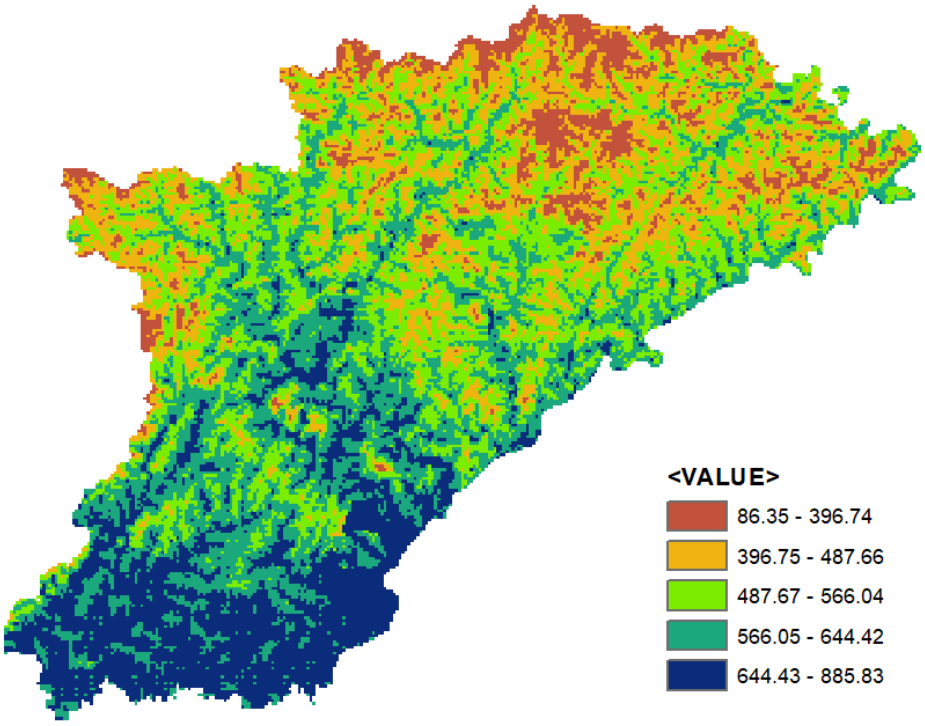


Figure2-1 Spatial distribution map of vulnerable areas at all levels

2.2.2 Impact for the wading birds

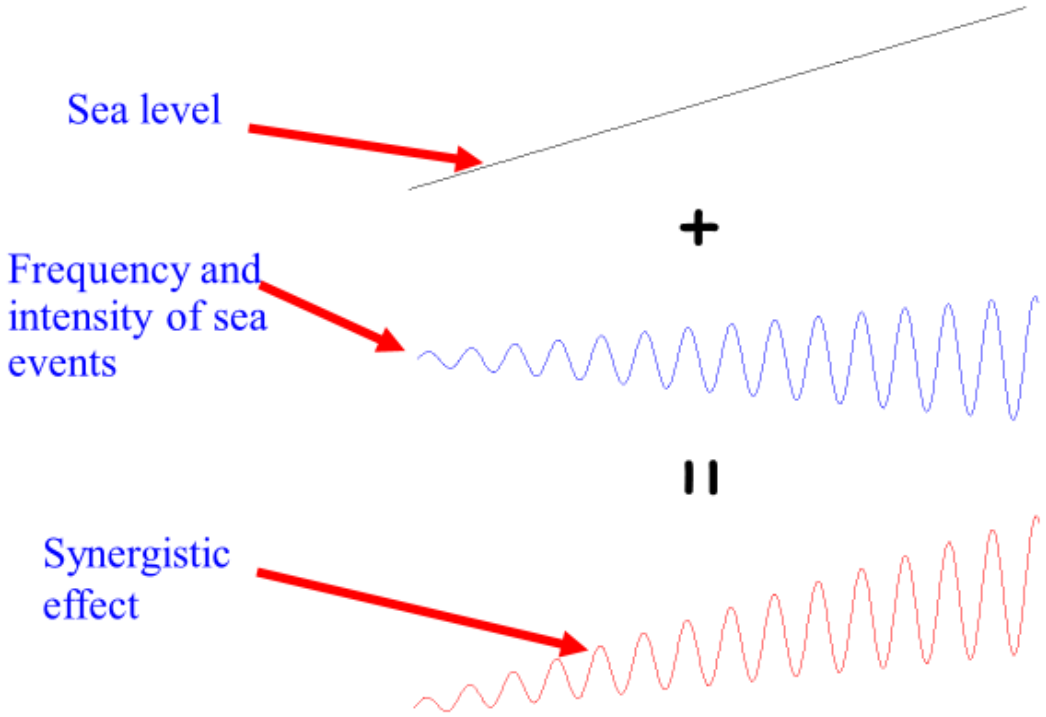
The Yalu river estuary, located in Dandong city, is a very important resting place on the east Asia-Australia bird migration route. The rising sea levels will change the habitat of migratory wading birds, thereby affecting their population number, especially for the endangered species [10].

2.3 Extreme weather events

Over the past 50 years, the number of extreme high temperature events has increased, with increasing intensity and increasing number of very hot days. Extreme precipitation events tend to increase, precipitation tends to concentrate, drought and flood events increase. It is predicted that around 2070, the extreme maximum temperature will increase by 1.5℃ to 2.5℃, the number

of extreme high temperature days will increase, and the number of extreme minimum temperature days will decrease.

The frequency of ocean events is correlated with sea level. Sea level rise will increase the frequency and intensity of ocean events (Figure 2-2).



Figre 2-2 The relationship between sea level and sea events

2.3.1 Storm

Storm around the world seem to be intensifying as the global warming. The scientists predict the frequency of extratropical cyclones will rise sharply across a wide area of the northern hemisphere, with more extratropical cyclones and severe storms becoming more frequent, leading to greater flooding and severe impacts on local communities.

2.3.2 Flood

Dandong city is located on the bank of the Yalu river. Affected by the topography

and the discharge capacity of the estuary, Dandong city is more vulnerable to the flood. The discharge of floods from the sea-level top-to-sea channels at high sea levels increases the difficulty of flooding and drainage in coastal area and aggravates flooding. The main urban area of Dandong City is only 30 km from the mouth of the Yalu river, and the Dandong section of the Yalu River belongs to the tidal section. With the tide rising and falling, a large number of marine sediment was brought upstream by the tide, covering the entire river bottom and shoal, the river bed was gradually raised, affecting the flood discharge.

Kuandian county of Dandong is mountainous terrain, under the influence of heavy rain, the risk of debris flow is high.

From August 19 to 21, 2010, the Dandong section of the Yalu river was flooded by heavy rain (Fig. 2-3). Power and communication were cut off in some areas, houses collapsed and the railway was suspended. The river near the Yalu river bridge overflowed its Banks, and more than 1 meter of water collected in some sections along the river in Dandong city. The whole city is under emergency flood control. In Dandong, 44 towns and villages were badly hit, with power and communications cut off and 230 houses collapsed. A mudslide occurred in Kuandian county, and many Bridges were washed away, embankments, revetments and sluices were damaged to varying degrees [11].

Figure 2-3 Yanjiang road was flooded on August 21st， 2010

2.3.3 Sea ice

The Yalu river water level changes frequently, the heat energy and power energy of the water flow, the normal year will not freeze, the freeze-up situation is also difficult to see. But once the special conditions facilitate the short-term freezing of the river, the damage will happen as the tides push down the ice (Figure 2-4). If the freeze-up period together with an astronomical tide, The powerful tide will break the ice， and the huge ice will rise and fall, and the drift ice will cause enormous damage to the two sides of the river, which ship and its water building facilities will be collided and squeezed along the river pier. The main factors of the Yalu river ice include temperature, flow and tide. The condition of this is the occurrence of continuous low temperature weather; The second is the dry water period of the Yalu river; Third is the astronomical tide. Climate change will increase the frequency of sea ice disasters [12].

Figure 2-4 The Tourist dock was closed by sea ice， January 21，2018

3. Major challenge to Dandong about Climate change

3.1 Challenges to the existing economic development model

The industrial structure is still dominated by resource-consuming industries. With the rapid economic growth, the problem of high energy consumption per unit of GDP cannot be fundamentally solved, and energy consumption and corresponding carbon dioxide emissions will still show a trend of rapid growth, which poses a severe challenge to the existing economic and social development model to cope with climate change.

3.2 Challenges for the coal-led energy structure

Coal consumption accounts for a large proportion and energy consumption has a relatively high carbon dioxide emission intensity. This pattern cannot be fundamentally changed in the short term. With the sustained and rapid economic growth, energy demand will continue to grow at a fast rate. However, the proportion of clean energy, such as nuclear power, wind power, biomass and solar photovoltaic power generation, as well as coal clean utilization, in the energy mix cannot be increased in the short term, posing long-term challenges to the adjustment of energy consumption structure.

3.3 Challenges to agriculture.

Due to climate change, temperature rises, precipitation and other factors are unevenly distributed in time and space, and various agrometeorological disasters will occur more frequently. In the future climate change, reasonable adjustment of agricultural production layout and structure, further improvement

of agricultural production and development conditions, effectively reduce the prevalence of diseases and insect pests, reduce production costs, prevent potential desertification increase trend, will be a long-term task to ensure the sustainable and stable development of agricultural production.

3.4 Challenge the protection of forests and wetlands.

The ecological environment in Dandong is fragile, and drought, soil erosion and wetland degradation are serious in some areas. As climate change intensifies in the future, the protection of existing forests and wetlands, afforestation, conversion of farmland to forests and restoration of wetlands are facing great challenges.

3.5 Challenges to water resources

Water resources system is lack of ability to adapt to climate change. With the rapid development of economy and the acceleration of urbanization, the contradiction between supply and demand of water resources will be further intensified in the future, meanwhile the climate change will reduce available water resources， which poses more realistic challenges to the scientific development and utilization and effective protection of water resources.

3.6 Challenge the ability of coastal areas to adapt to climate change.

Coastal areas are a huge engine of economic and social development and a new economic growth point. Some coastal areas are low-lying and flat, and are vulnerable to various Marine disasters caused by sea level rise caused by climate change. In the future, the rising sea level will aggravate the problems of coastal erosion, seawater intrusion and backflow, soil salinization and estuary seawater backflow, and pose new challenges to the economic and urban development, infrastructure construction and industrial layout of the

coastal areas of Dandong.

4. Adaptive strategies and actions（ICM）

4.1 Objectives

(1) Reduce energy consumption per unit of GDP by 15% within five years through industrial restructuring, promoting energy-saving technologies and developing clean energy.

(2) Improve forest coverage and increase the capacity of forest carbon pool to fix carbon dioxide. Through returning farmland to forest and afforestation project, the forest coverage rate of the whole city will increase from 65.9% to 67%. Urban green coverage rate reached 39.5%.

(3) Establish an effective adaptive management mechanism

On the basis of the existing coastal zone management mechanism in Dandong city, the integrated coastal management mode (ICM) is constructed to enhance the ability of management departments to cope with climate change through adaptive management mechanism.

4.2 Actions to reduce greenhouse gas emissions

4.2.1 Transform the growth model and promote industrial restructuring

Promote economic restructuring, accelerate the transformation of the mode of economic development, focus on reducing resource and energy consumption, promote the optimization and upgrading of the industrial structure, and strive to achieve an economic development mode featuring "less input, less consumption, low emissions and high efficiency".

Strengthen the safe, green, and clean use of traditional energy, and accelerate the development of clean and renewable energy. Control total coal consumption,

reduce the proportion of coal consumed, promote the use of high-quality and clean coal, and promote the conversion of coal to gas and electricity. We will actively and orderly develop hydropower projects and rationally build pumped storage power stations.

4.2.2 Strengthen technological innovation and improve energy efficiency

Relying on scientific and technological progress, we will encourage and support enterprises to carry out technological upgrading and innovation in energy conservation and emission reduction, make use of new technologies, processes, equipment and materials that conserve energy and reduce emissions, accelerate energy conservation in key energy-intensive industries, and eliminate outdated processes and equipment.

1) Energy conservation in industries with high energy consumption

We will control energy consumption in power, metallurgy, petrochemicals, building materials and other energy-intensive industries, speed up the promotion and application of energy-efficient mechanical and electrical products, and speed up the elimination of outdated mechanical and electrical equipment. We will implement a tiered pricing policy to promote reform of energy-intensive industries through pricing.

2) Energy conservation in construction industry

We will improve the system of green building construction standards and strictly enforce building energy efficiency standards. We will accelerate the transformation of existing buildings to conserve energy and measure heat supply, vigorously promote the application of renewable energy in buildings, and encourage the use of solar energy, geothermal energy, air heat and industrial waste heat to meet the needs of building energy.

3) Energy conservation in transportation

We will accelerate the construction of a toll collection system for non-parking on expressways and promote the use of non-parking detection systems. Vigorously promote energy-saving and new energy vehicles, liquefied natural gas powered ships. We will increase the proportion of clean energy and new-energy vehicles in urban passenger vehicles, and encourage passenger bus lines, chartered tourist vehicles, and freight transport enterprises to give priority to choosing vehicles that use natural gas and other clean energy. Give priority to the development of public transport within the city.

4) Energy conservation in commodity circulation

We will publicize the green market standards and encourage the green market development. We will promote the development of green hotels. We will accelerate the construction of green storage facilities, encourage the use of clean energy such as solar energy in storage facilities, and encourage the construction of green logistics parks. Promote green packaging, promote recyclable packaging, reduced packaging and biodegradable packaging, limit excessive packaging, reduce the use of disposable products.

5) Energy conservation in agriculture

We will promote energy-saving agricultural machinery, equipment and fishing boats [13, 15, 17].

4.2.3 Developing clean and renewable energy

We will accelerate the development and utilization of renewable and clean energy. Make use of geographical resource advantage, develop wind power energetically.

Natural gas will be gradually cultivated into one of the main energy sources of our modern clean energy system, natural gas infrastructure construction will be

improved, the Zhuanghe-Dandong natural gas pipeline project will be implemented, the urban and rural natural gas pipe network of the city will be improved, and the coverage of natural gas pipe network will be increased. We will establish a complete, orderly and efficient natural gas market. By 2020, we will comprehensively promote the extensive use of natural gas in urban gas, heating, industrial fuels, transportation fuels, and natural gas distributed energy, and strive to use more than 150 million cubic meters of natural gas annually.

4.2.4 Developing circular economy and improving the efficiency of resource utilization

We will strengthen the standardized and orderly disposal of urban waste. We will promote the centralized treatment and recycling of kitchen waste, construction waste, garden waste, urban sludge and other typical urban wastes, encourage professional organizations and charities to recycle and reuse waste textiles, promote the generation of electricity from urban wastes such as coal-burning coupled sludge, and improve the long-term mechanism for recycling and utilizing waste from public institutions.

We will promote comprehensive utilization of bulk solid waste. We will actively establish industrial bases for the comprehensive utilization of industrial wastes, and promote the comprehensive utilization of industrial solid wastes such as tailings, gangue, fly ash, gypsum, smelting and chemical waste. We will promote coordinated disposal of municipal solid waste by cement kilns. We will vigorously promote the utilization of crop straws, improve the service system for collecting, storing and transporting straws, and support the construction of high-value utilization projects in the "five-materialization" utilization of straws. We will promote the recycling of manure from large-scale farms and develop biogas projects.

We will actively promote the construction of demonstration bases for recycling

industries, encourage enterprises engaged in recycling resources to gather, park, and coordinate among different regions, and make the recycling industries cleaner and more valuable. The extended producer responsibility system is implemented in four categories of products, including electrical and electronic products, automobiles, lead-acid batteries and packaging products. We will promote the cascade utilization and standardized recycling of power batteries. We will vigorously develop the remanufacturing industry and promote the remanufacturing of auto parts, large industrial equipment, office equipment and other products. We will actively promote the construction of demonstration bases for remanufacturing industries and pilot demonstration projects for remanufacturing mechanical and electrical products. We will accelerate the integrated development of the Internet and resource recycling, support renewable resource enterprises in optimizing the distribution of reverse logistics outlets by using big data, cloud computing and other technologies, establish integrated online and offline recycling networks, and gradually build online waste recycling and trading platforms in cities at and above the prefecture-level.

4.2.5 Reduce agricultural greenhouse gas emissions

We will vigorously develop ecological agriculture and strengthen scientific breeding and management. Vigorously promote the implementation of biological organic fertilizers, scientific application of chemical fertilizers, the use of high efficiency, low toxicity, low residue of new pesticides, reduce the emission of nitrous oxide farmland. Develop superior varieties, adopt scientific irrigation technology, and strive to reduce methane emission intensity in rice fields. Reduce the use of chemical fertilizers and pesticides. Research and develop good ruminant breed technology, large-scale feeding management technology, reduce the methane emission intensity of livestock products. We will strengthen the scientific management and comprehensive utilization of animal, animal and poultry waste, and strive to reduce nitrous oxide emissions

from farms and compost. We will vigorously develop rural cleaning projects, and promote the conversion of human and animal manure and crop straws into fertilizer, fuel and feed resources.

4.2.6 Increase forest carbon sinks

The policy of strictly prohibiting commercial logging of natural forests.

We will carry out projects to return farmland to forests. Transplantation of natural trees is strictly prohibited for greening.

4.3 Actions to adapt to climate change

4.3.1 Improve agriculture's ability to adapt to climate change

1) Adjusting the structure of agriculture

We will carry out fine regionalization of agroclimatic resources, improve the distribution of crops and varieties, and cultivate and select in a planned way anti-drought, anti-waterlogging, anti-high temperature and low-temperature resistant varieties in view of the trend that the future climate warming will lead to the northward movement of the province's agricultural climate belt. We will strengthen research, testing, demonstration, and promotion of appropriate agricultural technologies that adapt to climate change, and strive to make significant progress in resisting adversity, developing facility agriculture, and developing precision agriculture and animal husbandry.

2) Strengthening capacity building for grain production security

We will strengthen monitoring of crop growth and agrometeorological disasters, carry out assessment of the impact of climate change on the yield, quality and major agrometeorological disasters of major crops, and carry out risk zoning for

agrometeorological disasters. This paper analyzes the possible impacts of future climate change on the yield, variety distribution and planting system of major crops, and puts forward countermeasures and suggestions for adapting to climate change based on the results of climate change monitoring and impact assessment, so as to serve the food production security and food production increase plan.

3) Strengthening farmland infrastructure

We will promote water-saving irrigation technology for agriculture, improve the utilization rate of irrigation, and reduce the quota of farmland irrigation.

4) Strengthening the prevention and management of diseases and insect pests

Developing biotechnology, breeding new varieties of crops and livestock that are highly adaptable to climate change, adopting technical measures to prevent and resist disasters, stabilize and increase yields, and prevent agricultural diseases and pests that may worsen. We should be alert to the hidden danger that climate change may lead to high temperature in winter and lower mortality of overwintering diseases' eggs (pupae), and strengthen the research on meteorological conditions forecasting technology for the occurrence and development of major diseases and insect pests.

4.3.2 Improve the ability of forests and wetlands to adapt to climate change

1) Selecting breeding sources to improve the climate adaptability of species

The forest tree species should be adjusted, the coniferous and broad mixed forest dominated by Korean pine should be expanded, and the stand quality and multifunctional benefit of secondary forest ecosystem should be improved.

Adopt thinning and rotation felling to adapt to climate change and management and management strategies to strengthen the ability to resist fire, disease and insect pests.

2) Strengthening the prevention and control of forestry pests

We will implement sustainable disaster control and control projects for major forest pests, accelerate the development of systems for monitoring and early warning, quarantine against disasters, and disaster prevention and mitigation, and put in place a monitoring and management system for the prevention and control of forest pests.

3) Starting wetland protection and restoration project

We will strengthen the protection and management of wetlands and their biodiversity, strictly control the reclamation of beaches and reclamation of sea areas, and carry out a number of projects to restore the ecological environment of coastal zones in the wetland areas at the mouth of the sea, with the focus on solving the ecological environment problems such as coastal erosion and seawater intrusion caused by quarrying and dredging rocks and sand in coastal zones and overexploitation of groundwater. Using satellite remote sensing technology to carry out dynamic monitoring of wetland ecosystem. Through reasonable allocation and management of water resources, returning farmland to moisture, vegetation restoration, habitat restoration and other measures, the ecological functions of important wetlands are gradually restored.

4) Improving the ability of nature reserves to adapt to climate change

We will strengthen ecological resilience to adapt to climate change. We will carry out ecological environmental protection and construction, rationally formulate policies and measures for regional ecological restoration, arable land and environmental protection. To establish an estimation model applicable to vegetation productivity, forest fire, vegetation phenology and vegetation belt

change, and to analyze the impact of climate change on vegetation productivity, forest fire, vegetation phenology, vegetation belt, carbon budget and dust change.

4.3.3 Improving the ability of water resources to adapt to climate change

1) Intensifing efforts to build a water-conserving society

Gradually establish a water price formation mechanism with water-saving as the core, and implement water-saving technologies and appliances throughout the industry. We will focus on saving water in industry, support enterprises in upgrading water-saving technologies, build water circulation systems and reclaimed water reuse systems, and reduce water consumption for industrial products. We will intensify efforts to conserve water in urban areas, implement rationed water use by implementing water-saving appliances for domestic use, accelerate the establishment of a recycling system for water used in residential areas and urban environments, improve water use efficiency in urban areas, and accelerate the transformation of old and out-of-repair pipe networks in cities.

2) Strengthening the construction of water supply facilities

We will continue to accelerate the construction of water supply projects in accordance with the principle of giving priority to the use of surface water, rational exploitation of groundwater, and encouraging the use of reclaimed water, seawater and inferior water.

3) Strengthening the ability of weather modification

The comprehensive artificial precipitation monitoring system, catalytic operation system and information transmission system operation command and effect evaluation system shall be built to enhance the artificial precipitation operation capacity and improve the precipitation efficiency.

4) Strengthening the construction of flood control system

4.3.4 Improve the ability of coastal areas to adapt to climate change

1) Strengthening capacity building for Marine environment monitoring and observation

We will accelerate the building of our capacity for monitoring and observing the Marine environment, track and monitor sea level rise, regularly check and verify alert tide levels, and prevent sea level rise from affecting coastal zones and areas.

2) Strengthening Marine forecasting capacity and network system

Research on the causes of Marine disasters, early warning and prediction, and analysis and evaluation shall be carried out. Establish a network transmission system for ocean observation and prediction. Accelerate the development of a numerical prediction system for the Marine environment and a support platform for emergency decision-making, improve the level of Marine forecasting and disaster warning, improve the accuracy and timeliness of Marine forecasting, and provide support for Marine disaster prevention and mitigation.

3) Strengthening the construction of Marine monitoring and observation infrastructure

Accelerate the tide well, sea Marine observation infrastructure construction such as automatic buoy, increase ocean observation instruments, equipment and facilities, construction of air-sea interaction - Marine climate observation and evaluation of business system, actively carry out to sea level rise, coastal erosion, seawater intrusion and saline water and climate change is closely related to the business of Marine disaster monitoring. We will build a monitoring network of high-frequency ground-wave radars, Marine buoys, subsurface

beacons and underwater observation systems, and strengthen the monitoring of conventional Marine sections and voluntary ships.

4) Strengthening the Marine disaster prevention and reduction emergency response system

We will establish and improve an emergency response system for Marine disasters, improve the emergency response mechanism, and comprehensively improve the coastal areas' ability to defend themselves against Marine disasters. We will establish a consultation system for Marine disasters, and formulate and improve contingency plans for tsunamis, storm surges and red tides.

4.3.5 Strengthen the capacity for early warning and response to climate disasters

1) Strengthening monitoring capacity building

We will improve the integrated climate observation system, and carry out groundwater level observation and phenological observation. An atmospheric composition observatory was established to observe atmospheric haze, aerosols, reactive gases, atmospheric visibility and solar radiation. The meteorological disaster monitoring network of coastal economic belt is constructed by automatic coastal weather station (island), ocean meteorological buoy observation station and wind profiler radar. The artificial precipitation monitoring network consisting of rain and drought monitoring stations shall be established, and the mobile meteorological monitoring system composed of mobile meteorological emergency vehicles shall be established.

2) Strengthening the capacity building of forecasting and warning services for extreme weather events

We will improve the early warning service system for extreme weather events

such as heavy rain, snow storms and sandstorms. A meteorological disaster warning service system has been established for drought, flood, forest fire, freezing and geological disasters. The coastal economic belt and the Marine meteorological disaster early warning service system shall be established.

3) Establishing air quality prediction and protection warning system

Study on the changes of environmental meteorological factors such as visibility, haze, atmospheric dust, acid rain, urban heat island and O3 in the context of climate change, and carry out the impact assessment of climate change on urban air quality, so as to provide a basis for urban development model and urban planning.

4) Strengthening climate change information platform construction and climate feasibility studies

A climate change information database and a climate change information sharing platform will be established to carry out climate change monitoring and detection, impact assessment and future trend prediction. Climate analysis, demonstration and impact assessment shall be incorporated into major project construction and urban planning.

4.3.6 Optimize the spatial distribution of the population

According to the assessment results of coastal zone vulnerability, the future urban spatial layout should be rationally planned, the population distribution should be promoted to fit the urban development planning, the orderly flow and reasonable distribution of population should be guided, and the sustainable development of population, resources and environment should be realized.

We will integrate planning for economic and social development, cities, land, and the environment into population planning. We will formulate and improve population policies that are compatible with functional zones, and scientifically

determine the number of people that can be carried by different functional zones. We will guide the population toward key development areas, and encourage the voluntary relocation of people from development areas that are restricted or prohibited from development. Encourage the population to gather in key towns and new urban areas. Try to make a policy of restricting the number of people moving into areas that are not suitable for people to live or live in all year round, and promote ecological migration in an orderly manner.

5. Supporting measure

5.1 Laws and regulations

At present, there are national and provincial laws and regulations, like China's national plan on climate change, clean production law of the People's Republic of China and other relevant laws. In the future, it is necessary to strictly implement national laws and standards on energy conservation and environmental protection, and improve local laws and standards. We will accelerate the formulation of local standards and relevant technical specifications.

5.2 Technical support

By introducing universities, research institutes and enterprises to actively participate in scientific research and technological research, we will establish a high-level scientific research team for scientific research and technology development in response to climate change, and initially establish a scientific and technological support platform for climate change impact assessment. We will establish a database of experts on climate change, and organize experts to consult, study and solve major scientific and technological problems related to climate change in a timely manner. Cooperate with universities and research institutes in the following areas: renewable energy, clean production technology, waste disposal and resource recovery technology, energy saving and emission reduction technology, etc.

5.3 Public awareness and education

The government should take raising public awareness as an important work to

cope with climate change, and further improve the awareness of climate change among leading cadres at all levels of government and decision makers in enterprises and public institutions. Harness the power of all sectors of society to increase public awareness and participation in the fight against climate change.

Through the use of books, newspapers, audio-visual media and other mass media, the public at all levels of society should conduct publicity activities on climate change, encourage and advocate a sustainable way of life, advocate the saving of electricity and water, and enhance the awareness of garbage classification and recycling. Through the use of modern information dissemination technology and other effective means to publicize national and provincial policies to address climate change. The education and training of the public on climate change should be strengthened, relevant knowledge on climate change should be popularized as soon as possible, and the awareness of the whole society on climate change should be enhanced, so as to form a good social atmosphere to cope with climate change.

Encourage public participation. We will establish an incentive mechanism for public and business participation, and give full play to the role of enterprise participation and public supervision. We will improve channels and systems for releasing information on climate change, expand channels for public participation and oversight, and give full play to the role of the media in monitoring and guiding public opinion. Increase transparency in decision-making on climate change and promote scientific and democratic management in the field of climate change. The role of civil society groups and non-governmental organizations should be brought into full play, and the public and all sectors of society should be encouraged to participate in the mitigation of global climate change.

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