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Salvation of Landscape: Landscape Remediation of Desertification in China

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SALVATION OF LANDSCAPE:
LANDSCAPE REMEDIATION OF DESERTIFICATION IN CHINA

A Thesis

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Finally, I want to thank my parents and all my friends for their support and encouragement.

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ABSTRACT

The evolution of human civilization has been accompanied by the replacement of the Earth's natural landforms. The cities, oases and grasslands from 1000 years ago may have now been transformed into desert. Now, desertification has become a global environmental problem. Many regions and countries are facing development constraints and environmental challenges posed by desertification. Arid and semi-arid areas are extremely prone to land degradation leading to desertification. China faces the threat of a quarter of its land being degraded. Desertification is one of the most serious outcomes of land degradation. Ironically, the part of China with the most serious desertification is Inner Mongolia, which once had a large grassland area. In this paper, the planning and design site, Bayan Nur, is situated in the Yellow River basin in central Inner Mongolia. The extensive expansion of desertized land has resulted in the serious degradation of grassland and cultivated land. This paper mainly discusses how to use landscape ecological planning and desertification ecological prevention technology in order to slow down and prevent the spread of existing sandy land. This is the 21th century new landscape view mentioned by more than 700 landscape architects in the Landscape Architecture Declaration in 2016.

"Across borders and beyond walls, from city centers to the last wilderness, humanity's common ground is the landscape itself. Food, water, oxygen – everything that sustains us comes from and returns to the landscape. What we do to our landscapes we ultimately do to ourselves. The profession charged with designing this common ground is landscape architecture."

Desertification is a major global environmental problem. How can landscape architects use a broader perspective in working with other disciplines to address desertification? At the same time, what roles do landscape architects play in the process of desertification prevention? These two problems are what this paper attempts to solve.

CHAPTER 1. INTRODUCTION AND BACKGROUND

1.1 Global desertification issue

Desertification is set against the background of global environmental problems. Climate changes and human overexploitation lead to large-area land degradation. Desertification is one of the consequences of land degradation. The most serious desertification areas are in arid and semi-arid and sub-humid regions of the Earth. These areas are concentrated above 35 degrees north latitude with average annual rainfall less than 200mm. Desertification threatens the human living environment, and causes poverty and widespread famine in many countries. Desertification is extremely harmful to the sustainable development of the Earth. The United Nations Environment and Development report says more than 250 million people are directly affected by desertification, and about 1 billion people and more than 100 countries are indirectly under threat from desertification.

Desertification is usually regarded as areas with desert or sand dunes. By its definition, however, it refers to the process changing from degraded land to desert land, forming desertification through wind erosion and water erosion. In the long history of mankind, desertification is not a problem that has just arisen now. Desertification in some regions is attributed to climate changes. However, in recent years, the formation rate of desertification is 30-35 times of the historical rate according to statistics and analysis by anthropologists and historians. The immediate cause is rapid population growth. So, new topics that contemporary landscape architects need to consider from the perspective of global environmental problems are how to address the threat posed by desertification and how to put forward reasonable ecological solutions.

In this thesis, the core is that landscape architects use methods of landscape ecology for re-planning and prevention of desertification areas. At the same time, through the studies of global desertification formation areas and their causes, landscape architects want to find suitable ecological solutions by means of interdisciplinary exchanges and cooperation to carry out land analysis. A comprehensive system for land management, water resources management and humanistic environment reconstruction would be established finally over the studying process with the planning methods of landscape ecology, just as the solutions to global desertification proposed by United Nations Convention to Combat Desertification (UNCCD).

“What can be done?
Reforestation and tree regeneration;
Water management — saving, reuse of treated water, rainwater harvesting, desalination, or direct use of seawater for salt-loving plants;
Fixating the soil through the use of sand fences, shelter belts, woodlots and windbreaks;
Enrichment and hyper-fertilizing of soil through planting;
Farmer Managed Natural Regeneration (FMNR), enabling native sprouting tree growth through selective pruning of shrub shoots. The residue from pruned tress can be used to provide mulching for fields thus increasing soil water retention and reducing evaporation.”

In this paper, the landscape prevention of desertification land is interpreted prospectively by means of adaptive landscape ecology design. In five chapters from the global distribution and formation of desertification to the regional research and systematic governance model, as well as the final site system, the prototype of the future global integrated governance scheme for desertification is proposed. The aim is to improve the human living environment and improve the ecological resilience of desertification regions.

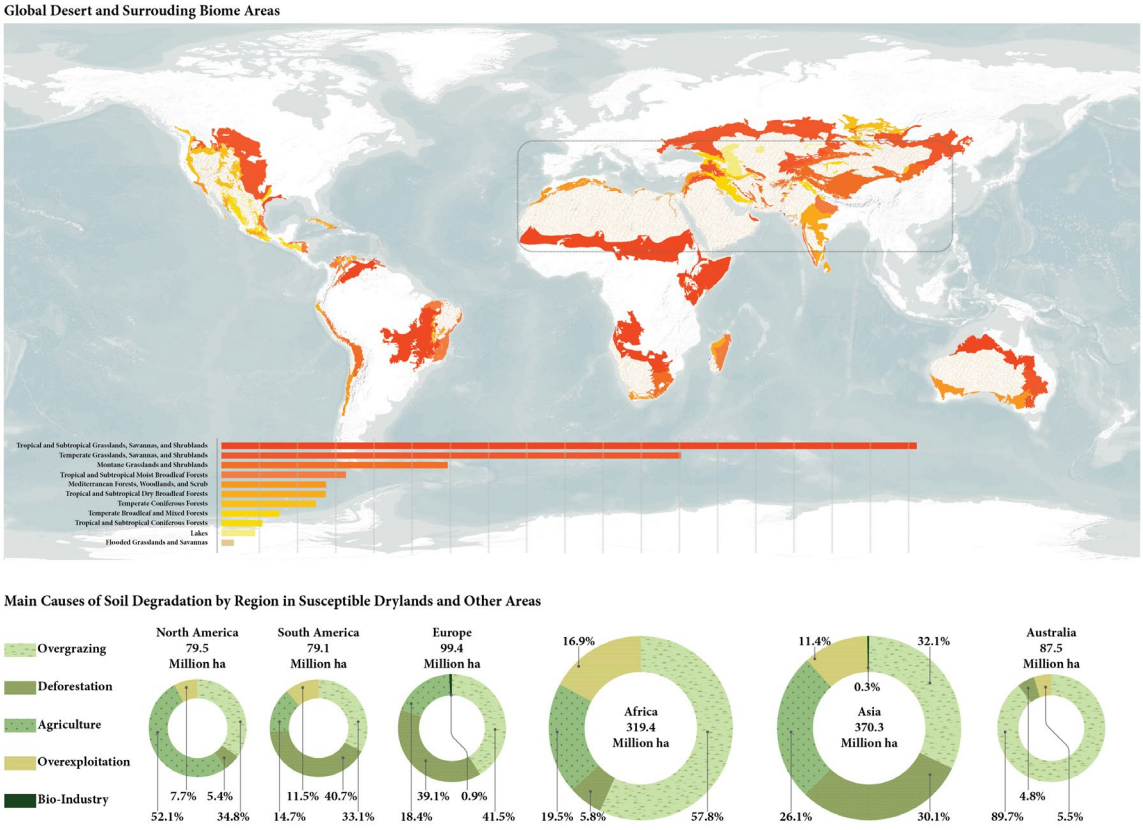

Figure 1.1: Global desertification mapping and causes

1.2 The cause and process of desertification

Human activities and climate changes are regarded as the main causes of desertification. According to the paper "Global Desertification: Drivers and Feedbacks", land degradation and desertification are caused by a variety of factors, among which climate changes are a long-term factor and human activities are a short-term effect. In other words, climate changes have a sustained effect on the formation of desertification, while human activities contribute to land degradation in a short time as a catalyst. These two factors can form a vicious circle of land degradation. Especially in arid and semi-arid areas, the formation rate of desertification would be accelerated by wind erosion and water erosion when the land loses its original soil nutrient. According to statistics, the most serious desertification regions have arid land, covering 41% of the Earth's land area and affecting 35% of the global population. The following mainly describes how human activities and climate changes lead to desertification.

1.3 Human activities

Human impacts include deforestation, overgrazing, over-irrigation and over-exploitation. These human activities essentially reflect the irrational management and development of land and water resources. In this thesis, the design will use a systematic methodology to rethink how to establish a new management approach of land and water resources to mitigate the expansion of desertification within the site. From the global perspective, there are different ways of human activities and living habits in different regions, at the same time, the changes of topography and landform also limit the scope of human activities. From agriculture to animal husbandry, human beings are increasing the risk of land degradation while expanding production area and improving production efficiency. Soil, as the most basic factor in production, provides the necessary conditions for human cultivation and production, but in fact, frequent human activities are also consuming soil nutrition, thus bringing about land degradation. In the future, people must find a way to restore soil that has gradually lost planting capacity, thereby reducing the impact of human activities on land desertification. The ecological planning and landscape prevention in desertification areas would be a correction of irrational land use.

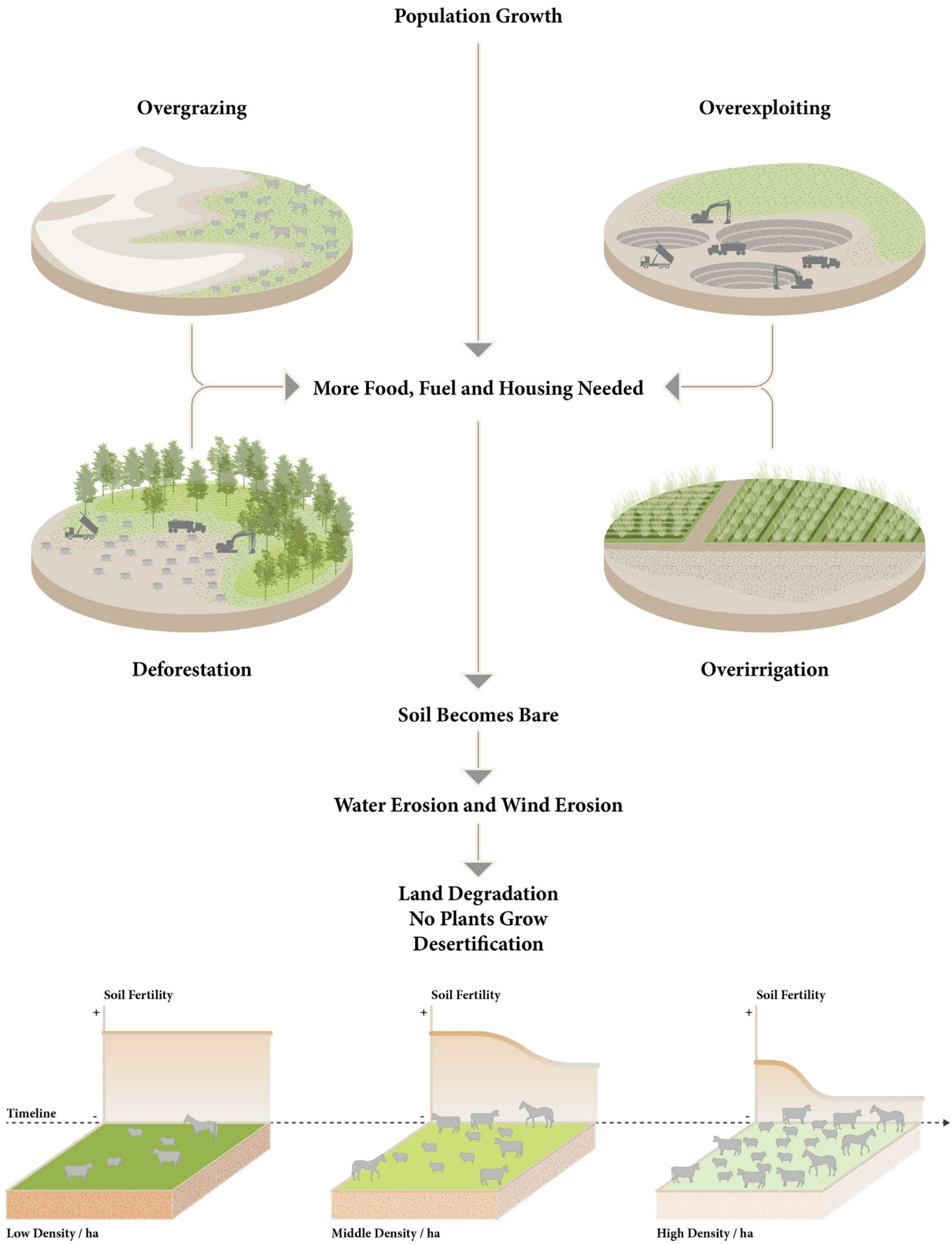

Figure 1.2: Desertification cause and process diagram

1.4 Climate variations

People tend to ignore the impact of global climate changes while emphasizing their impacts on desertification. Deserts and desertification regions are mainly distributed in arid and rainless areas according to the studies. As global temperatures gradually rise, arid climates in these regions exacerbate land cracking and soil moisture loss. On the basis of statistics, the population affected by the arid climates is about 2 billion, of which 90 percent is in developing countries, and the development in the arid regions accounts for 4- 8 percent of the GDP of these countries every year, leading to an increasing number of people facing the problem of regional development imbalance. At the same time, rainfall, temperature and evaporation are the factors helping to assess the extent of desertification, because soil moisture content is an important indicator of land degradation. On the basis of observations and statistics, deserts and desertification regions have many similar characteristics, such as low rainfall, low evaporation, and wide temperature distribution (such as tropic, temperate and low temperature zones). This suggests that desertification can possibly form in a lot of areas. In the design, we should consider the reasonable artificial management system, and consider how to use the corresponding technical means to address climate change, and put forward an effective prevention strategy for adaptive landscape.

Climate changes not only affect land degradation, but also biodiversity. This creates a chain effect forming a vicious circle in the processes of desertification, climate change and biodiversity loss. The interaction of the process is explained in the chart.

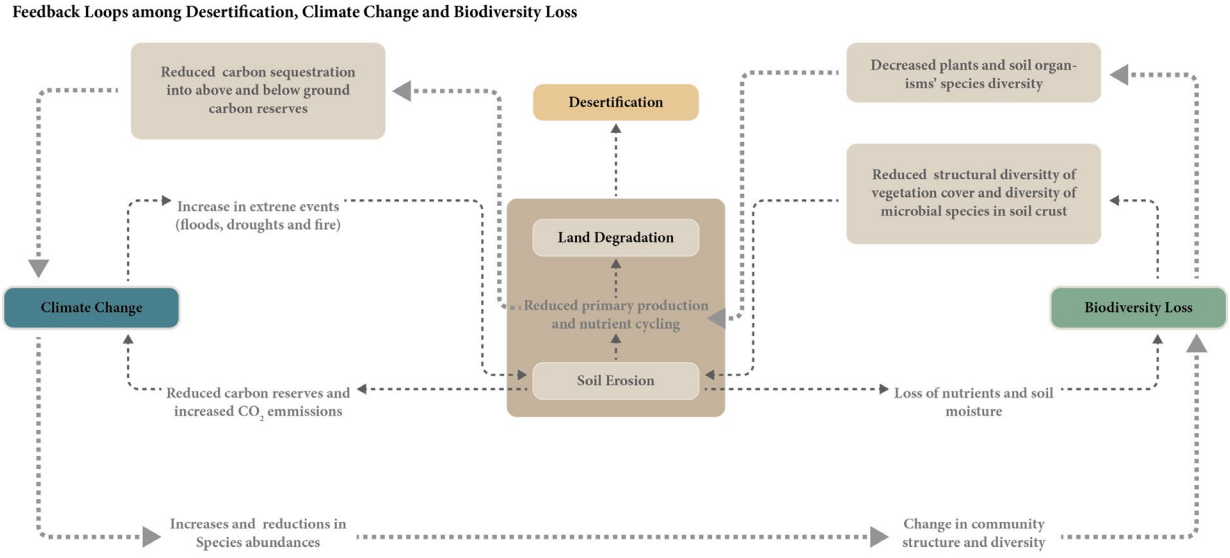

Figure 1.3: Feedback loops among desertification, climate change and biodiversity loss

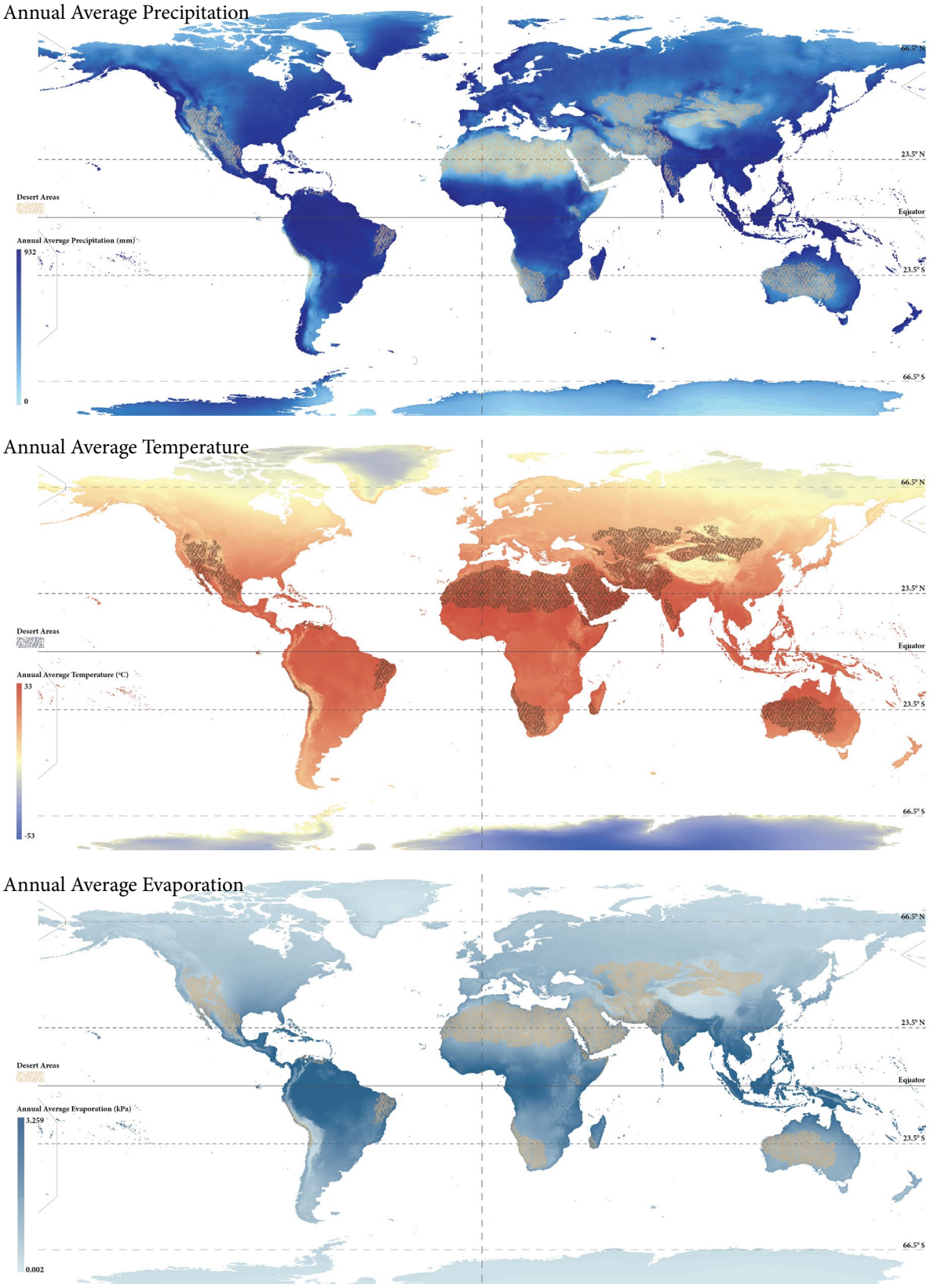

Figure 1.4: Global desert area and annual average precipitation, temperatur and evaporation

1.5 Current state of China desertification

In China, deserts are mainly distributed between 35 and 50 degrees north latitude. These regions extend from Central Asia in the west to the northeast of China, covering an area of more than 1.6 million km2. In this area, China's eight great deserts and four big sand fields are distributed, accounting for about 1/5 of China's land area. At the same time, 60% of the area still uses traditional management for animal husbandry and agriculture, directly affecting the lives of 200 million people. Since the humid Indian Ocean monsoon is blocked by the Himalayas Range, the climates in China's desert regions are mainly arid and semi-arid. The expansion direction of desertification regions in China is from northwest to east, which brings serious environmental problems at the same time. Sandstorms are one of the environmental problems formed in the desertification areas. They affect a wide area and last for a long time, and also have an extremely bad damaging effect to urban dense areas in eastern China. For example, the most significant impact is air pollution in Beijing caused by sandstorms, which has an impact on people's respiratory health. Moreover, sandstorms also bring about unbalanced development in China's economic construction between the east and west regions, with the developed east and the relatively backward west. If we want to find a way to eliminate sandstorms, we need to find the root cause of sandstorms in order to mitigate and prevent desertification.

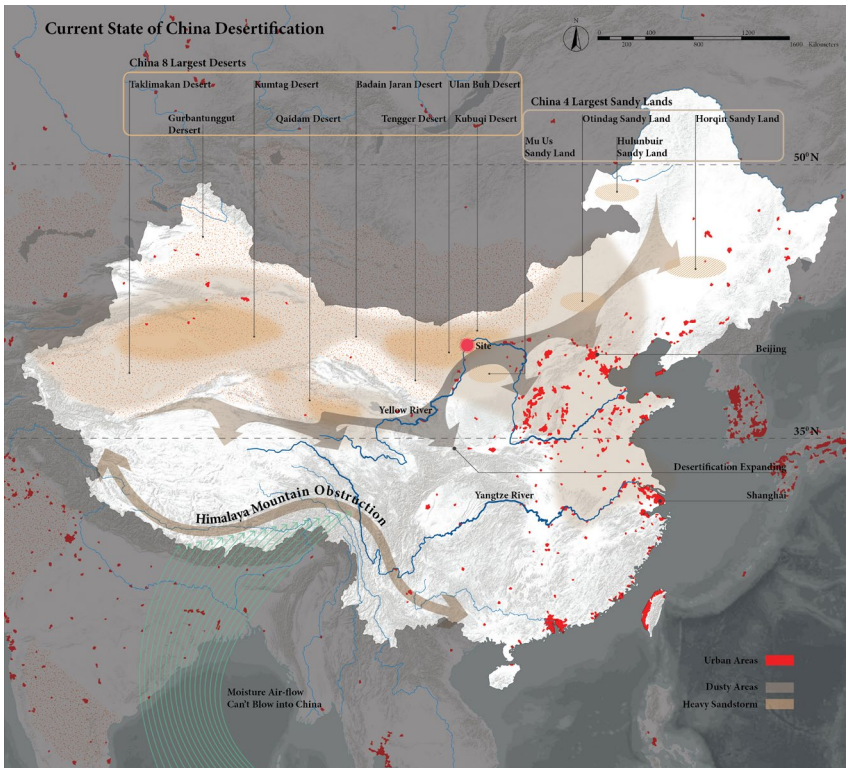

Figure 1.5: Current state of China desertification

China has a long history. In different historical periods, people have experienced different social transitions and historical changes. The desertification process in China is not growing linearly. In different dynasties, the various land management policies from the governments and the diversified life characteristics of different ethnic groups lead to a process of rises and troughs in the Chinese desertification regions in different time periods. Population migrations, wars, trading activities and cultural exchanges change the natural environments while changing social forms. Desertification is one of the results of environmental changes. Especially in the Yuan Dynasty, China was ruled by Mongolian nomads for 98 years. During this period, grazing was the main mode of production, and a large area of grassland was overgrazed by nomadic people. Up to now, the most serious desertification problems still exist in Inner Mongolia. But the fastest expansion of desertification in modern China was from 1970s to early 1980s. In 2000, the rate of desertification was only 19% original. The rate of desertification is decreasing, which is related to the establishment of the "three North Shelter Forest" system in the 1990s in China. However, desertification as a chronic environmental issue has been threatening the life and development of people in the affected areas.

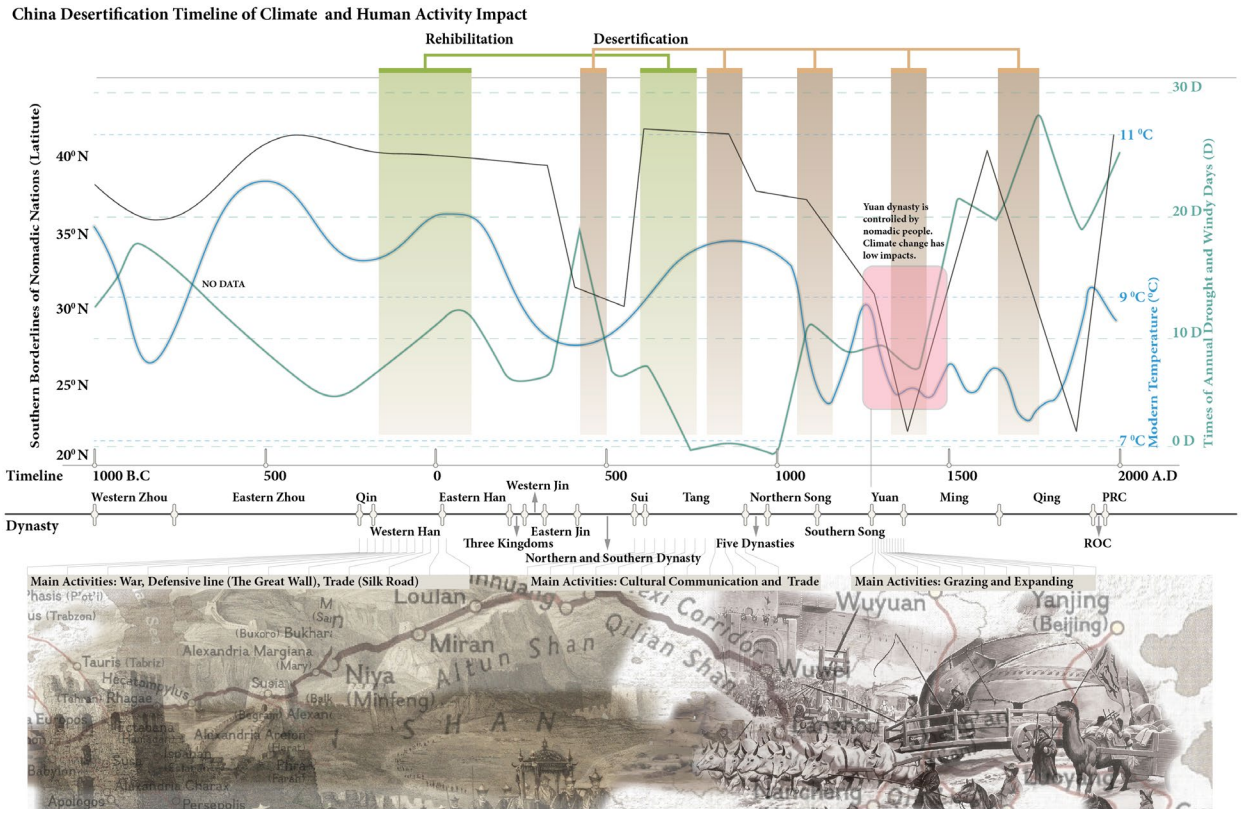

Figure 1.6: China desertification timeline of climate and human activity impact

CHAPTER 2. SITE INVENTORY AND ANALYSIS

2.1 China Three-North Shelterbelt case study

The China Three-North Shelterbelt project serves as an opportunity to prevent desertification, which promotes desertification governance in different regions of China. At the same time, it also provides a new ecological industry chain for the regional development. The project spans 12 provinces in northern China, with an east-west span of 4480 km and an overall governance area of 4.07 million sq km. At the same time, the project spans 73 years, from 1978 to 2050, and is divided into three major stages and eight phases. The first stage is from 1978 to 2000, the second stage is from 2001 to 2020, and the final stage is from 2021 to 2050. The Three-North project based on the three processes of sand prevention, sand control and remediation.

According to statistics, from 1978 to 2013, the construction of protective forests effectively controlled the number of days of dust storms in spring in northern China, from the previous 10 days to 2-3 days. Not only this has different ways of governance in different regions. In the western part of China, Xinjiang sandy oasis desertification prevention project uses grass grid technology to efficiently fix sandy area accounts for 20% of the total area of the area. The entire sector of shelter forest established by the Shaanxi Yulin sandy land prevention project accounts for 38.9% of the total area of the area, and the active control area of the sandy land is 68.4%, and a water-saving agricultural system has been established. In the Inner Mongolia region of northern China, the Chifeng sandy land prevention project restored 58% of the sand. From different perspectives, these regions have put forward relative strategies for the treatment and prevention of desertification in China. At the same time, the prevention methods have also been improved in different areas with different geomorphological and climatic features.

Through further study, the Three North Shelter Forest is not without its drawbacks. According to statistics, 7.4% shelterbelt forest is degrading in the control area, with a total area of 32,260 sq kilometer. These include 20% of the agricultural forest, 30% of the sand fixation forest, and 50% of the soil conservation forest. Through the degradation data and geographical analysis of the Three North Shelterbelt, the main causes of degradation are the selection of trees and the way of water use. These two causes also put forward new directions for the design in the later period. How to improve the using efficiency of irrigation water and how to choose adaptive sand-fixing plants and shelter forest tree species are the core issues.

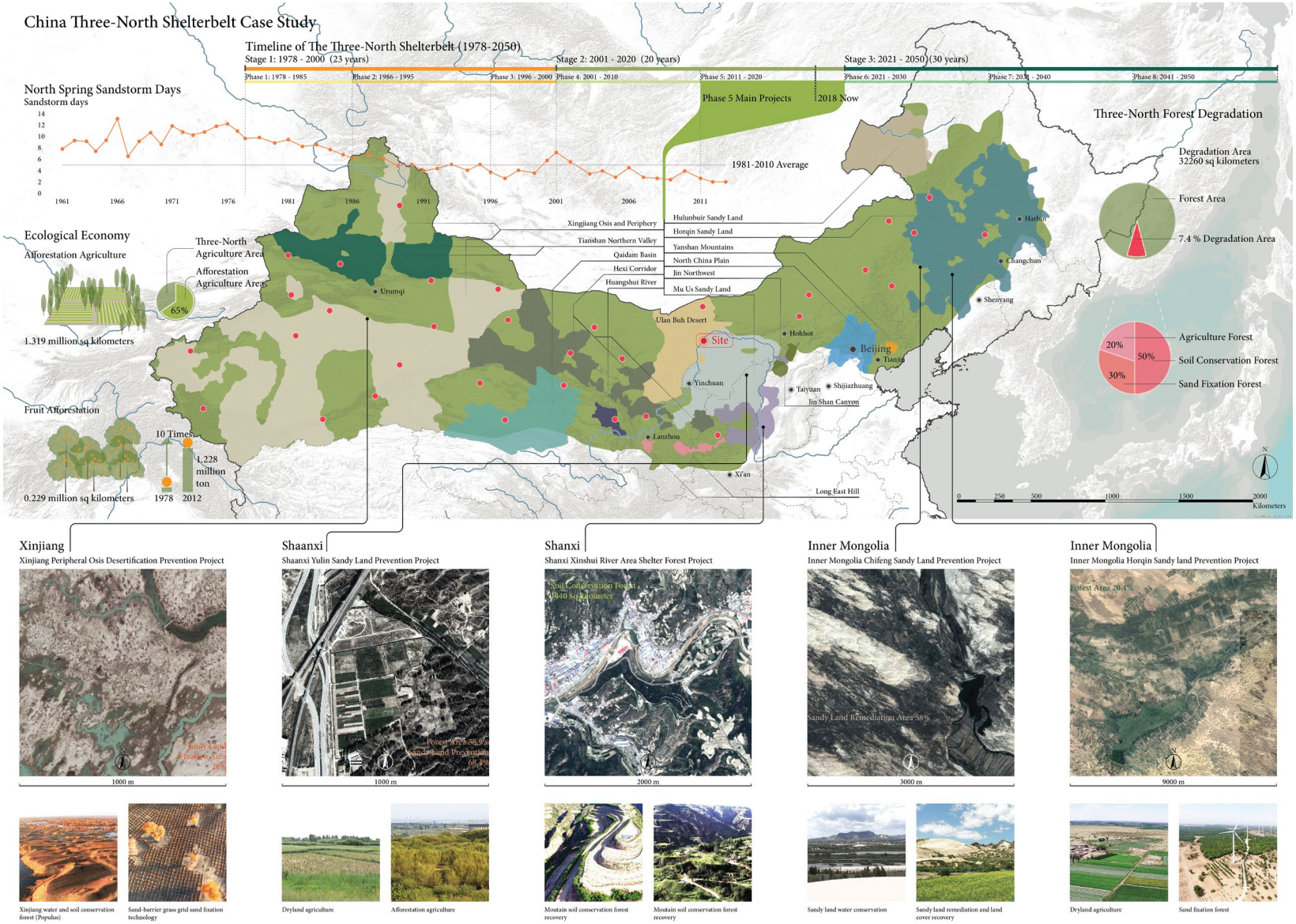

Figure 2.1: China Three-North sheltbelt case study

2.2 Site location and context

The site is Bayan Nur, located in the Hetao Plain area of Inner Mongolia, China. The north is the Yinshan Mountains, and the two sides are Mu Us sandy land and Ulan Buh desert. The Yellow River passes through the edge of the sandy areas and plains. At the same time, the city is also an important transportation node that is connecting the east and the west. The national expressway G110 and the Bantou-Lanzhou railway pass from Bayan Nur. The administrative area of the area is 65,788 sq km. According to the 2010 census, the total population of the city is 1,669,915. The people in the design and planning area is 520,300. From geographical data analysis, the area has various landforms, including mountains, flooding plain, alluvial plain and mobile dunes. The Hetao Irrigation District in Bayan Nur is the most significant artesian irrigation area in Asia. The Hetao Plain in the country has the reputation of "the Jiangnan of Northern Frontier." The city's organic milk production accounts for more than half of the country's total. The export of agricultural and livestock products rank first in Inner Mongolia, and it is the largest plush production area in the country. Furthermore, the arable land is 59,995.4 hectares in Bayan Nur, 0.35 hectares per capita arable land, 3.5 times the national per capita arable land.

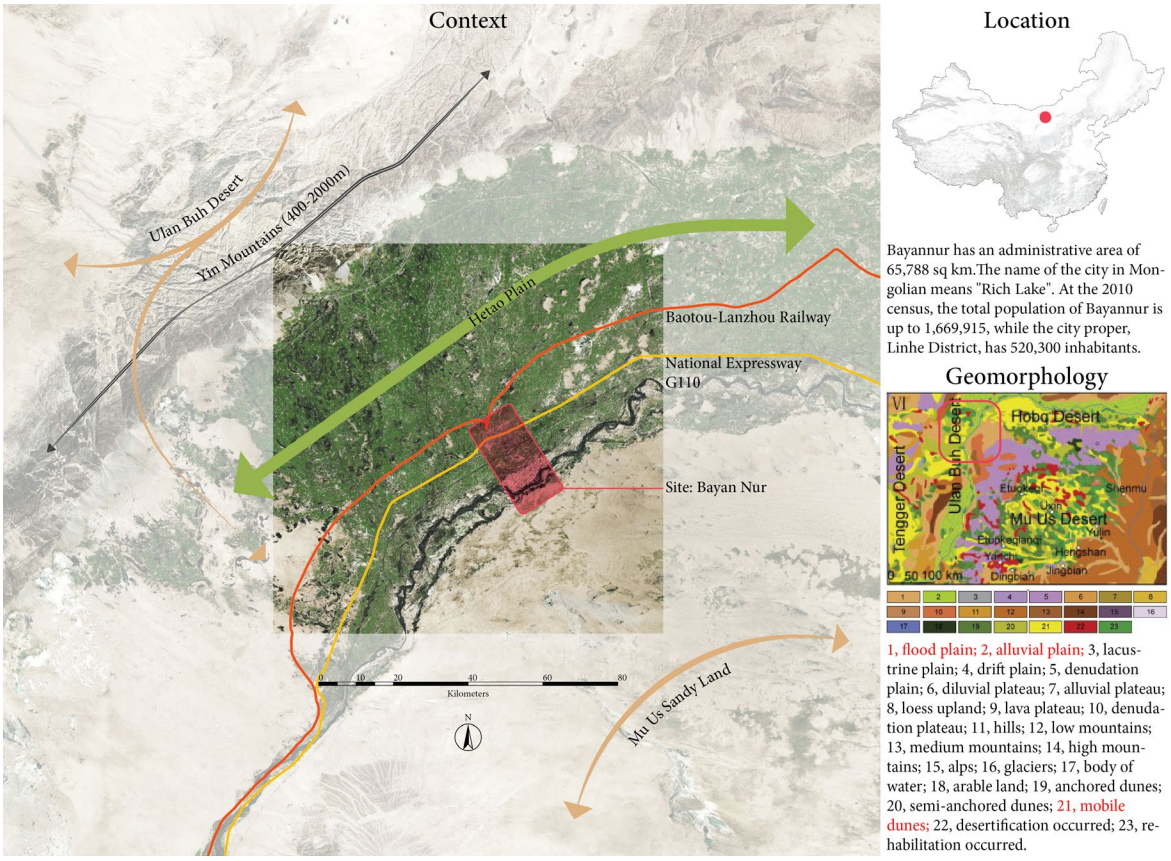

Figure 2.2: Bayan Nur context

2.3 Water resource

Bayannur means “rich lake” in Mongolian. The area is rich in water systems. The south of Yinshan Mountain in Bayan Nur city is the Yellow River system, and the north of Yinshan Mountain is the inland river system. The mountain is a runoff area, the northern high plains and the Hetao Plain are non-producing areas. Bayannur City is rich in lake resources, with more than 300 lakes, with an area of about 47,000 hectares. In the Hetao Plain irrigated area, there are 10 lakes with an area of 100 hectares or more, of which 30,000 hectares located at the eastern end of the Houtao Plain. The city’s annual average runoff volume was 331 million cubic meters (excluding the Yellow River’s transit water volume), and the average per capita water consumption was 234.75 cubic meters. The drainage area of the Yellow River basin is 34,000 sq kilometers, accounting for 52% of the total area of the city. The average annual runoff is 237 million cubic meters, accounting for 71.6% of the city’s average annual runoff. The city’s comprehensive recharge of groundwater is 3.21 billion cubic meters, and the exploitable storage of groundwater is 1.81 billion cubic meters. The transit water is mainly Yellow River water, and the average annual runoff volume is 31.5 billion cubic meters. The city cited the Yellow River water volume of 4.1 billion cubic meters.

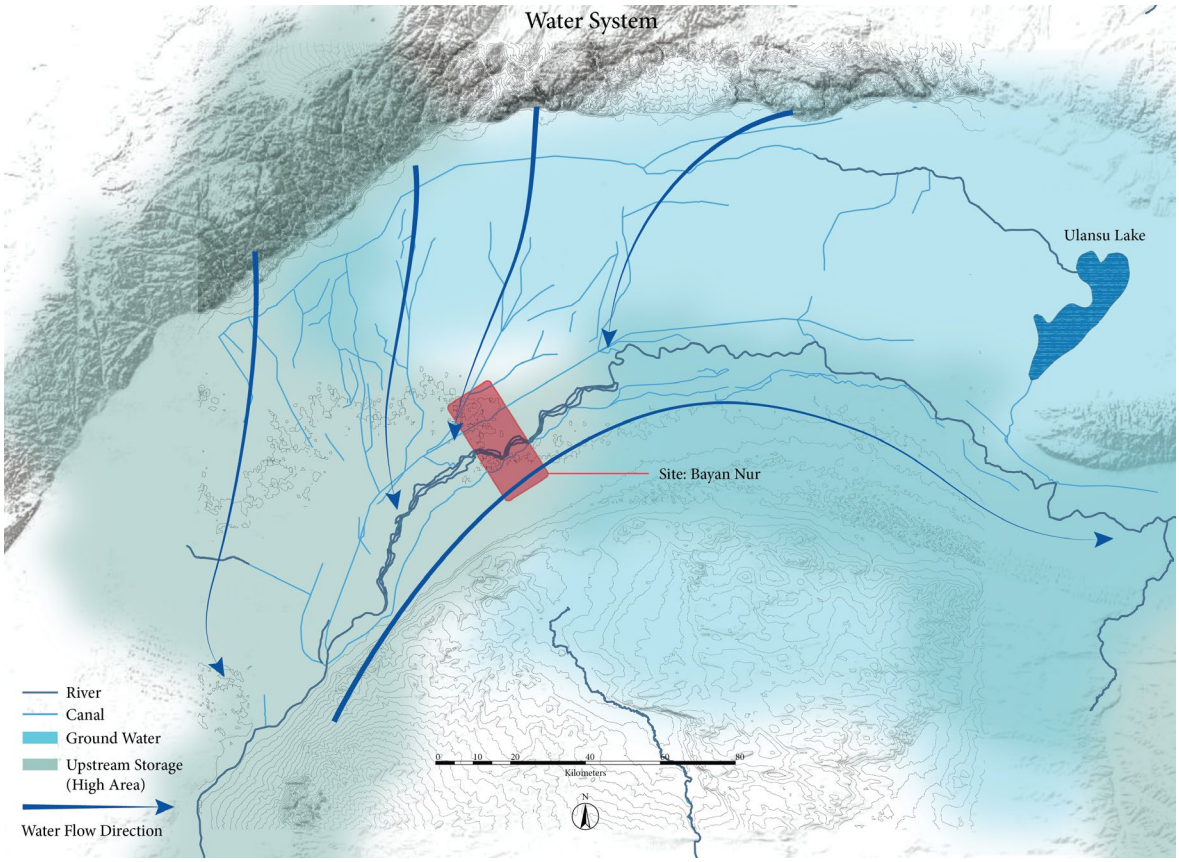

Figure 2.3: Bayan Nur water system

2.4 Land use

As of 2016, the built-up urban area in Bayan Nur has an area of 108.7 sq kilometers, of which 42 sq kilometers are in Linhe District. The area is mainly residential land with a total area of 2042.4 hectares. The east side of the city is the old city, and the west is the new city. The direction of future urban expansion will be southward and westward. The surrounding area of the city is a large area of farmland. The canal passes through the edge of the city and farmland. From the perspective of urban profiles, from north to south, they are farmlands, the urban area and the canal. The design study area is on the south side of the city, along with the Yellow River's agricultural and sandy land. As the population grows gradually year by year, domestic water use is also increasing, and the city is expanding quickly. How to allocate urban and agricultural space rationally is also one of the issues that need to be considered. The desertification also threatens urban development in the future. Doing preventive measures well in advance is a prerequisite for the protection of sustainable development in the region.

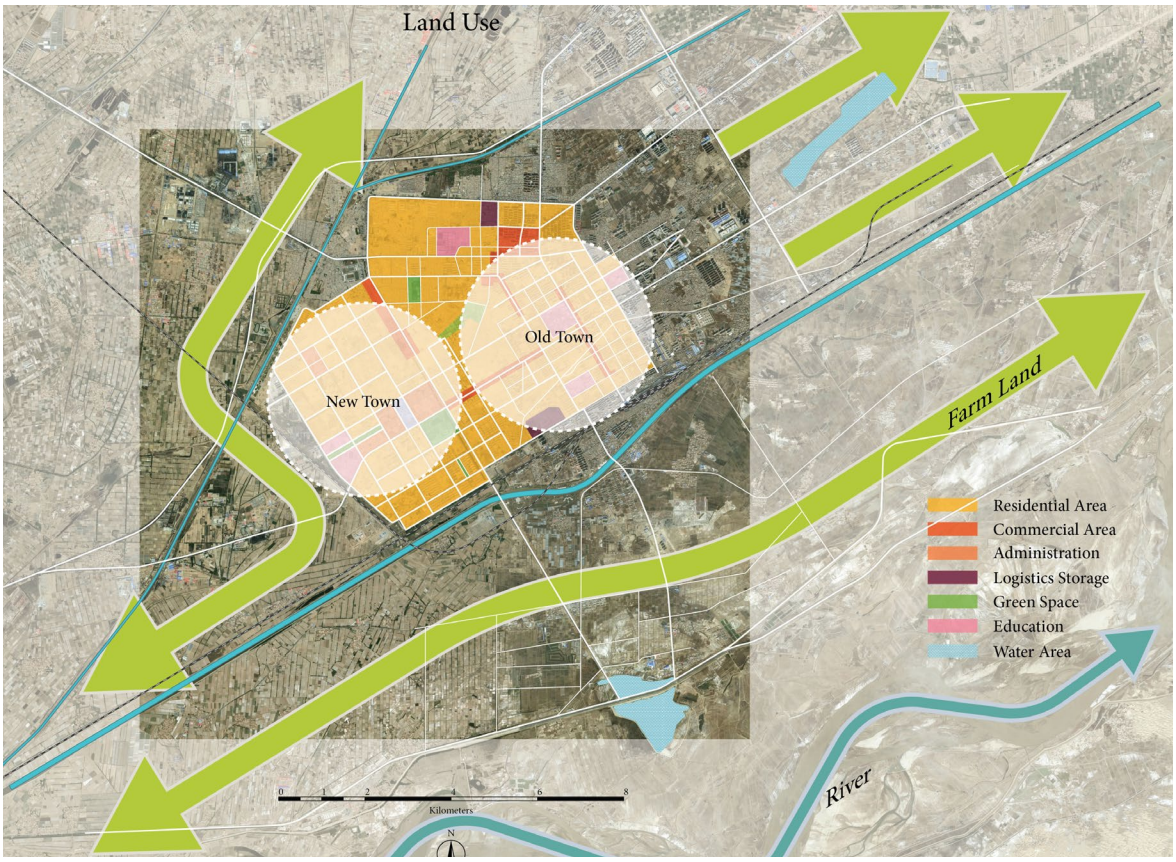

Figure 2.4: Bayan Nur land use

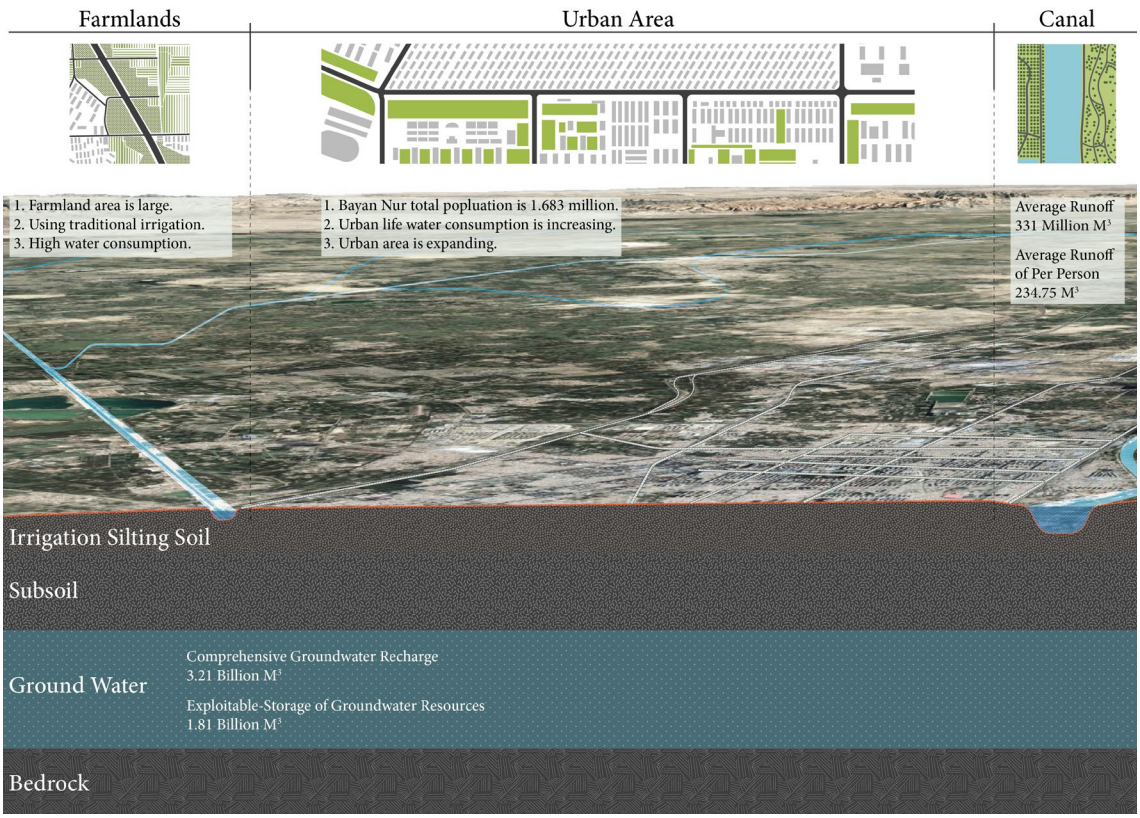

Figure 2.5: Bayan Nur urban section analysis

CHAPTER 3. PLANNING AND STRATEGY

3.1 Existing section perspective

Within the scope of planning and design, it is mainly divided into three sections for analysis, followed by little family farms, Flooding Plain and sandy land. All three regions have the potential to form desertification. In the little family farm area, the farmland irrigation method is mostly traditional irrigation, which is the high-water-consuming agriculture and lacks agricultural planning. Farmland is also potentially threatened by floods. In flooding plain areas, floods have a wide range of impact. Due to the rapid runoff of the Yellow River, soil erosion is more serious, and surface cover plants are gradually losing. In sandy areas, dunes are mostly mobile dunes. The effect of wind erosion is severe and the ground cover is also decreasing. At the same time, an expressway passes through it.

3.2 Strategy proposal and prevention phases

Through the previous profile analysis, the potential desertification process, in the site, will be controlled through three systems. They are water-saving agriculture, riparian remediation and sandy land fixation methods. At the same time, different governance areas and systems have multiple prevention phases, which depend on the purpose and sequence of governance.

The first is a water-saving agriculture area where irrigation and water storage are conducted using drip irrigation techniques and unique step-style planting methods. This approach can effectively control agricultural water use, thereby increasing the efficiency of agricultural water use. Traditional agriculture relies on groundwater for irrigation. The Bayan Nur, which is rich in surface runoff, can diverse the Yellow River to irrigate. Before this, we must establish a new water treatment system and water recycling system. At the same time, the green room also has drip irrigation and water-recycle system.

Followed by the riparian ecological design. Its purpose is to prevent soil erosion. The design is to establish several small levees at different heights via the original terrain. Its function can reduce the impact of water flow, thereby reducing water erosion. Protect the soil on the river bank and create a good riparian habitat ecosystem. On this basis, the human activities space on the river bank will be increased, which will create a unique landscape value.

Sandy land fixation belt design is in the sandy area. It is divided into two parts. The first part is the expressway protection belt and the second part is the sand planting area. The expressway protection belts mainly use grass grid sand fixation as the primary protection method, followed by planting drought-tolerant plants and desert plants and preventing wind erosion from causing damage to highways. In the sand planting area, the planting is not a traditional crop, but a desert crop, such as Cistanche, which has a specific medicinal value, but it grows in the sand and requires a dry climate.

Through design analysis, the three regional designs all require three phases to complete. The first phase is infrastructure construction, such as the construction of water treatment infrastructure and the design of grass grid sand fixation. The second phase is the restoration of ecosystems, such as water-saving agricultural systems, riparian protection belts, and sandland protection forests. The third phase is designed for sustainable development, such as the establishment of afforestation agriculture and sand planting areas.

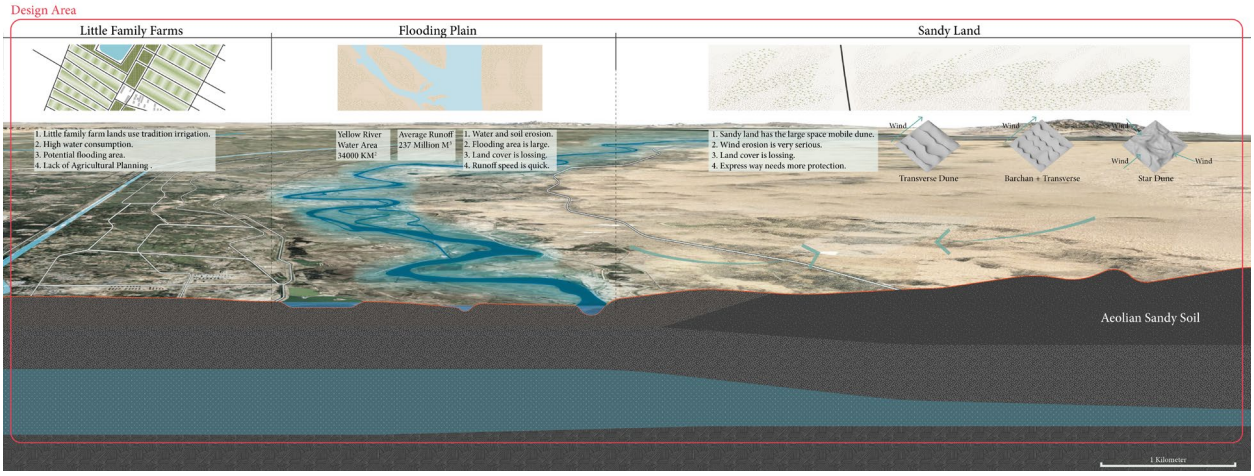

Figure 3.1: site existing section analysis

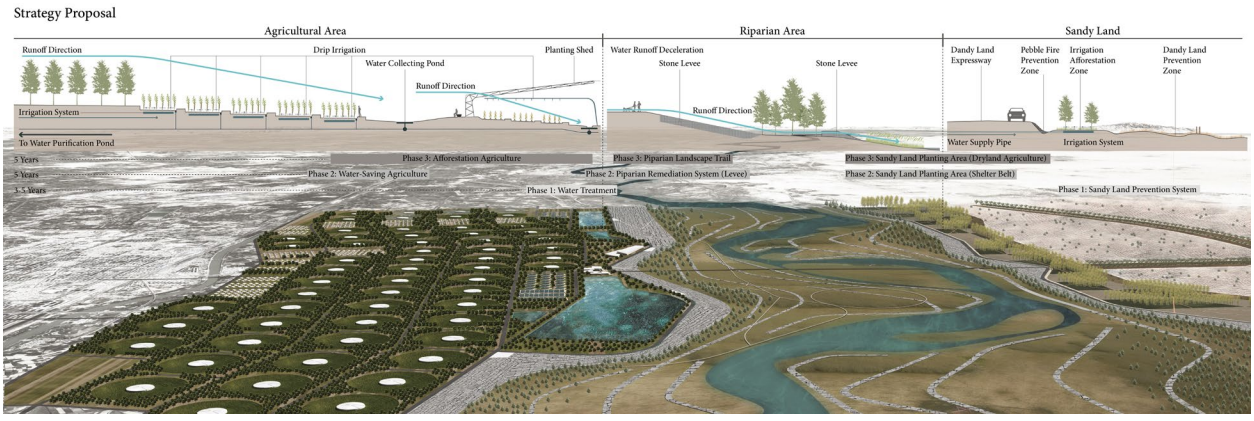

Figure 3.2: Strategy proposal and prevention phase (bird view)

3.3 Master Plan

The master plan is divided into six regions, including the agriculture area, water management area, riparian area, dryland agriculture area and sandy land area. In the process of governance, these planning regions would also change with the progress of desertification land prevention. The governance evolution process will be explained in the discussion of the sustainable cycle. Through the planning and prevention of six regions, the prevention model of desertification is established, and the linkage and coordination of all parts are systematically explained. The master plan presents a vision of the later stage prevention and forecasts the future forms of desertification landscape prevention. The planning for each region combines its functions and ecological technology to carry on the detailed design. The protective region mainly takes the shelter-forest system as the core, combines the sand land fixation technology and the sand plant, and forms the multi-level sand control zone. At the same time, the desertification protection mixed agriculture with farmland as the center and woodland as buffer zones is established with interlude planning of farmland. On the other hand, the ecological agricultural development region relies on water-saving agriculture to improve the water use efficiency to irrigate the desertification area agriculture. At the same time, drip irrigation technology and water storage technology are also planned in the ecological agriculture development region, combined with the supervision of planting sheds, to maintain the water resources in the desertification areas. Finally, the riparian remediation region is designed to prevent soil and water loss caused by the impact of water flow and form multi-level riparian remediation zones. Based on the soil-fixing plants in the floodplain, the ecosystem of the floodplain is reconstructed and the ecological aesthetics in the desertification control process is formed by combining the landscape design. At the same time, the establishment of six regions with different characteristics and the functions of tourism and education activities would promote the development of local ecological economy in the process of desertification governance.

3.4 Deserticulture

With the deepening of the desertification prevention, the ecological system restoration of desertification in the process of prevention has also formed a new type of industrial development, called Deserticulture. Generally it refers to an economic activity to use unique advantages of sand land, desert, semi-desert areas for economic development by social investment and to realize self-circulation. The concept of Deserticulture was put forward by Chinese scientist Qian Xuesen in 1980s.

He predicted that the creation of knowledge intensive Deserticulture and grass industry would be the sixth industrial revolution that would appear in China in twenty-first century. Qian also agreed that the deserticulture should make full use of the favorable conditions such as sunshine and temperature difference in the desert Gobi, promote the use of water-saving production techniques, and engage in knowledge-intensive modern agriculture. The carrier of this new type of industry is one of the foundations of agricultural landscape and desertification ecological prevention. It produces crops and fruits with local characteristics through special climate regulation in desert areas, and develops eco-tourism industry, and promotes local GDP through sustainable development. The formation of deserticulture is also the final embodiment of the results of desertification remediation. By statistics, it is predicted that deserticulture on the 1.6 billion mu desert and Gobi in western China will increase hundreds of billions of yuan of output value to the country in the future, driving the economic development of the western regions.

Compared with the formation of desertification, deserticulture is also a new industrial system for the formation. It is the development strategy based on the premise of controlling desertification, improving the local production mode and restoring its ecosystem, so as to promote agricultural landscape and ecological landscape. Through the systematic illustration of deserticulture, we can see how it forms a new industrial chain through the desertification remediation. At the same time, it also increases the landscape value of tourism.

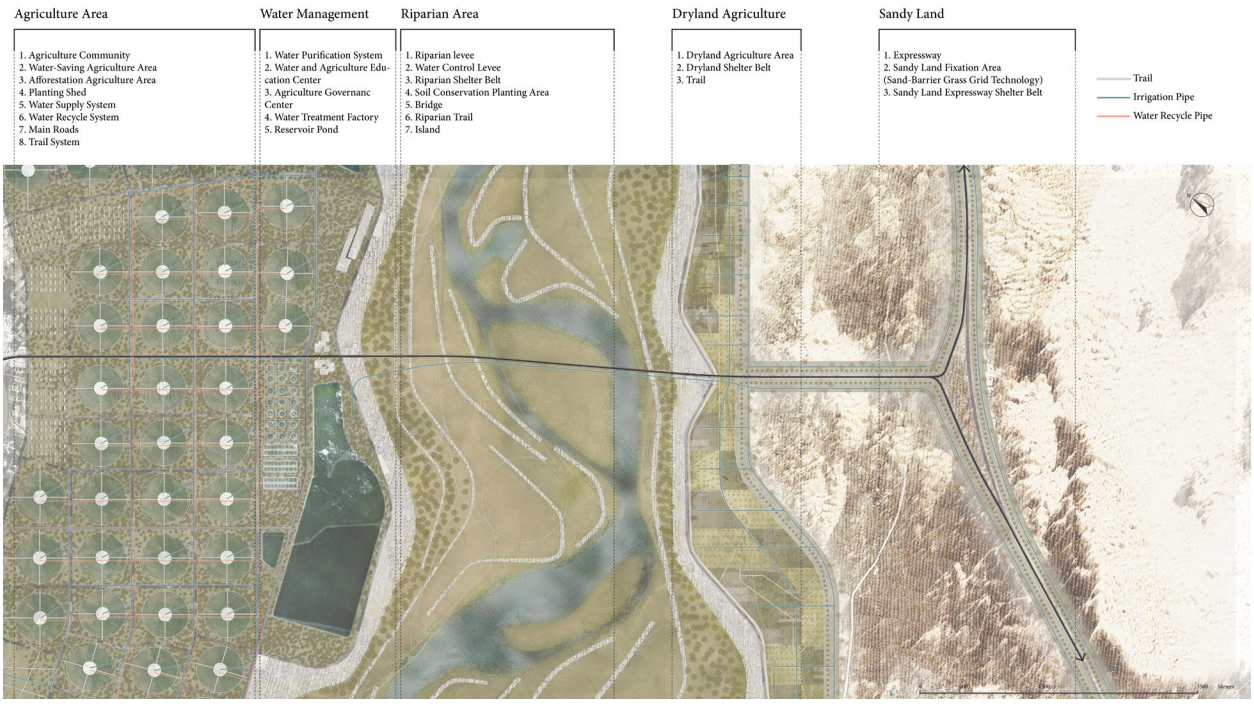

Figure 3.3: Master Plan

CHAPTER 4. SITE SYSTEM

The fourth chapter mainly describes the deepening design of typical regions based on the ecological prevention planning of three systems. The vision of desertification governance after landscape prevention is demonstrated by means of plants selection, system diagrams and impression drawings. The purpose of system design is to deeply express the practical design method of landscape prevention. It combines the basic methods of landscape design to illustrate the details through topography, systems, plant or crop configurations, and aesthetic exploration of ecological landscapes. The system design is divided into three parts, including Sandy land prevention system, Water management system, and agriculture and afforestation system.

4.1 Site system_1 Sandy land prevention system

The establishment of the shelterbelt system, the development of water-saving agriculture and the design of riparian remediation are all indirect solutions to combat desertification. But in order to fundamentally find the direct solutions to desertification, the core of the problem is how to control and find the ecological function of sandy land. In the traditional sand control process, there are two main ways. One is sand-barrier grass grid sand fixation technology, where reed and grass woven into lattice form on the surface of easy-moving sand dunes and sand soil stop sand from being transported by the wind. The other is binder sand fixation technology. This is a new kind of sand fixation technology, emphasizing sand fixation and playing a facilitating role in restoring the planting function of desertification land. It can be used in desertification areas with water sources, where sand can be polymerized by mixing water with organic binders to store water and microbes and promote plant growth. The original sand land without binder does not have a water storage function, and there are no nutrients stored in it. In this design, the method of binder sand fixation can be tried in a small area in the site located along the Yellow River. And the binder is extracted from the plant fiber, so there is no harm to the environment.

The above mentioned two desertification control technologies should be combined with ecological planning, and reasonably applied in the design with the actual situation of the site considered. In the planning of the site, there are two parts to using these two kinds of sand fixation technologies. One is the shelter-forest area around the highway, and the other is the agricultural production area.

Highway shelter-forest areas:
Highway shelter-forest areas consist of five main components, pebble fire prevention zone, irrigated afforestation zone, grass barrier plant zone, front sand blocking zone and sand seal grass zone. Among them, the grass barrier plant zone uses the sand-barrier grass grid sand fixation technology to fix the mobile dunes. This is to provide protection for transportation in desertification areas.

Agricultural production areas:
Afforestation agriculture in agricultural production areas mainly uses binder sand fixation technology to fix sand in shelter-forest outside farmland. This can provide adaptive growth environment for shelter-forest, and thus strengthen the agricultural afforestation protection system established in desertification areas.

The design pays more attention to the function of sandy land prevention and sand fixation. The sand control zone in the site is designed by using the sand control system, and the sandy land prevention design is carried out in the desertification area. The design of the area takes more account of the existing conditions in the site. According to the shapes of sand dunes and the direction of wind erosion within the site, the spatial functional design is carried out for the sand prevention forest, sand fixation zone and sandy land agriculture area. And the corresponding sandy drought-tolerant plants are selected for zonal design and stretched design.

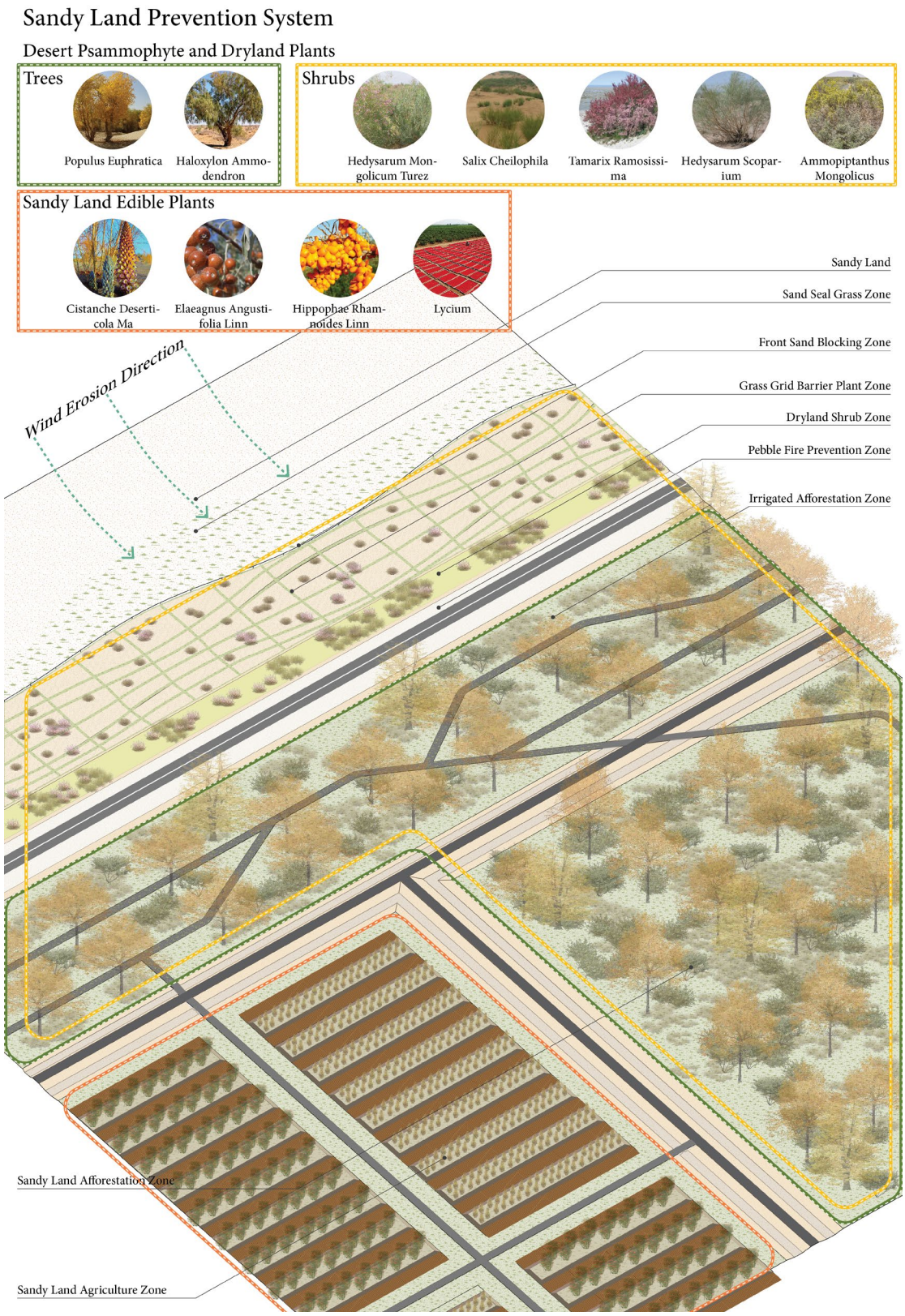

Figure 4.1: Sandy land prevention system

4.2 Site System_2 Water management system

In Bayan Nur, the annual average temperature is 3.7°C-7.6°C, the annual rainfall is 130mm-285mm, the rainy season falls between June and September, and the runoff volume varies greatly between periods of high water and dry water. A large amount of rainfall in a short period of time can easily cause mountain torrents, so there is a lot of sediment in the runoff, causing soil erosion. But the water flow in the Yellow River and mountain flood with high sediment content and organic substances, is a good water source for flood diversion and silt irrigation. Most of the water resources within the design site are used for agricultural irrigation in addition to the daily life of the residents in Bayan Nur City. However, the design area is not a rainy area, and the surface runoff is relatively fast, so the establishment of a sustainable water system should a prerequisite for the prevention of desertification.

The management of water systems in the site is carried out in three main stages:
First, a riparian ecological system on the floodplain should be restored. The soil erosion caused by the Yellow River water scour and surface runoff is reduced by planting the river beach soil-fixing ecological plants. At the same time, the restoration of floodplain can increase local biodiversity and improve the integrity of the ecological chain in desertification prevention area. Riparian landscape recovery design is mainly for the ecological remediation along the Yellow River within the site, and the purpose is to prevent water and soil loss caused by water flow scour and to enhance the appreciation value of local landscape ecological aesthetics. From the designed section, we can see that the main body of riparian landscape recovery is divided into three regions. The first is the embankment protection region, where the bank protection embankment is made of natural stone with a special shape. On the premise of ensuring a certain amount of permeability, it also hinders the discharge of large particles of sediment, thus alleviating soil loss and sediment deposition into the Yellow River. The second is the floodplain remediation region, where the design focuses on the ecological remediation of the floodplain with local suitable soil-fixing plants. The restoration of the floodplain ecosystem is conducive to the establishment of habitats for animals and plants. At the same time, the water erosion can be weakened by the river bank plant cover. The third is the riverway water maintenance region, by means of the design of the embankment and the remediation of the floodplain. When the water flow formed by surface runoff reaches the channel waters, running water is cleansed to a certain extent, and provides the later irrigation water, which is the water source basis for later agricultural restoration. Through practical research, we know that the sand dust accumulative quantity is 1m wide and 50m high cross-section as the sample for

one year is 9.2 tons in the desertification area, and reduced by 73% in the oasis area. So the ecological restoration of river banks can reduce local sand-dust impact.

Second, a recyclable and collectable water system should be established. The water system involves two aspects, the treatment of sewage and the reuse of irrigation water, as well as the collection of rain water and surface water. This sustainable water system will alleviate land degradation caused by groundwater consumption in desertification areas and will also provide water infrastructure support for the development of local water-saving agriculture. Moreover, the establishment of water storage equipment can also adjust the local microclimate, increase humidity, and alleviate desertification caused by drought.

Third, an effective water transportation system should be established. Water transportation is not only provided through ditches, but also pipelines for agricultural drip irrigation technology. Effective monitoring water requirements in each area through data collection by sensor devices and computer analysis are the basis for building efficient water transport. In the end, the system will rationally distribute the water in every region, which can reduce the waste of water resources and improve the agricultural water saving rate.

An effective water system of desertification is constructed by three water resource management methods. It also relates to the transformation of agricultural technology, the prevention of land degradation and the reconstruction of riparian ecology during the repair process. These are the most effective ways to use and distribute water resources in the process of desertification governance. Combined with the overall development planning in the site, a more ecological and sustainable water network system should be produced in the desertification area.

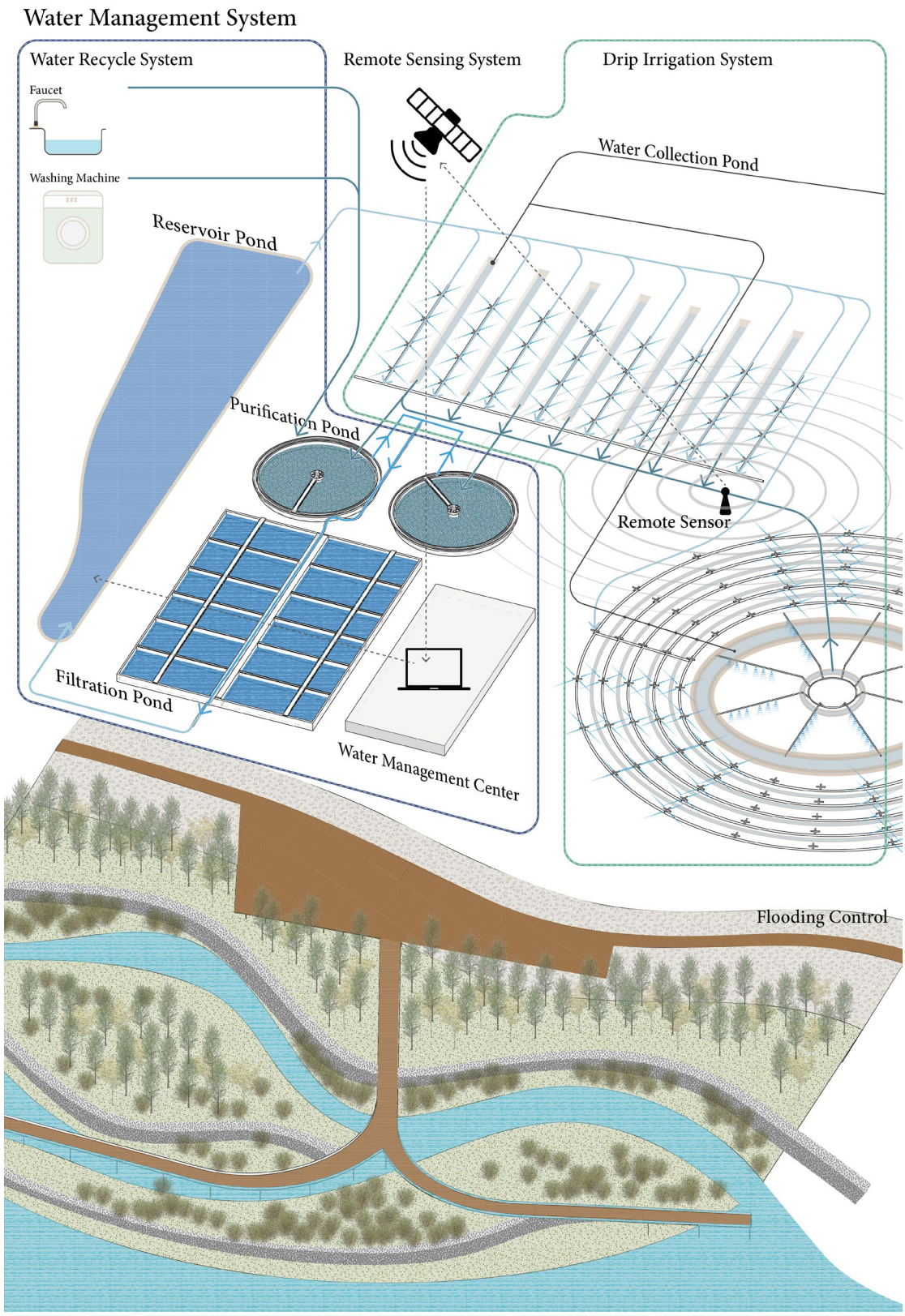

Figure 4.2: Water management system

4.3 Site system_3 Agriculture and afforestation system

Compared with the traditional agriculture with high water consumption, the design is seeking a variety of new more efficient water-saving and desertification-control agricultural forms in the desertification area. By studying, there are two new types of agriculture able to effectively relieve the burden of land degradation caused by excessive water use in agriculture in the desertification areas. They are respectively dryland agriculture and afforestation agriculture. According to research, not all agriculture will lead to land degradation and the potential threat of desertification, only the agriculture with excessive consumption of groundwater resources will lead to land degradation. Instead, proper agricultural farming can stimulate soil self-remediation and increase soil fertility. Moreover, the soil desertification is serious in desertification areas due to wind erosion, and the bad weather also destroys agriculture. Therefore, the new forms of agriculture would also play a protective role in maintaining the security of agricultural development.

First, dryland agriculture is a kind of water-saving agricultural form able to reasonably distribute water resources in arid areas. Its core is how to efficiently use limited water resources to irrigate crops in arid areas, and wisely choosing more adaptable crops is also the basis of developing dryland agriculture. In this design, the drip irrigation technology and the agricultural monitoring planting sheds are used in the agricultural production process of desertification remediation in order to utilize the dryland agriculture. In dryland agriculture, crops must have high drought tolerance, such as wheat, sorghum, millet and avena chinensis. These are cash crops that can be grown in desertification areas. Some edible plants need to be planted in sandy land area, and they also have specific medicine value, for example the Cistanche deserticola ma, Elaeagnus angustifolia linn, Hippophae rhamnoides linn and Lycium. These crops are effectively monitored to observe the required amount of irrigation to achieve efficient water use for agriculture in desertification areas.

Another kind of mixed agriculture takes the water resource consumption in arid areas into account, and provides a method of agricultural protection in areas with great impacts of wind and sand. Afforestation agriculture is one of the most widely used agriculture modes. The crop damage caused by wind and sand can be protected by taking farmland as the core, and shelter-forest as the buffer zone. The density of shelter forest can be adjusted on the basis of the actual prevention conditions, and this ecological planning form can also be applied to the process of pasture remediation within the design scope.

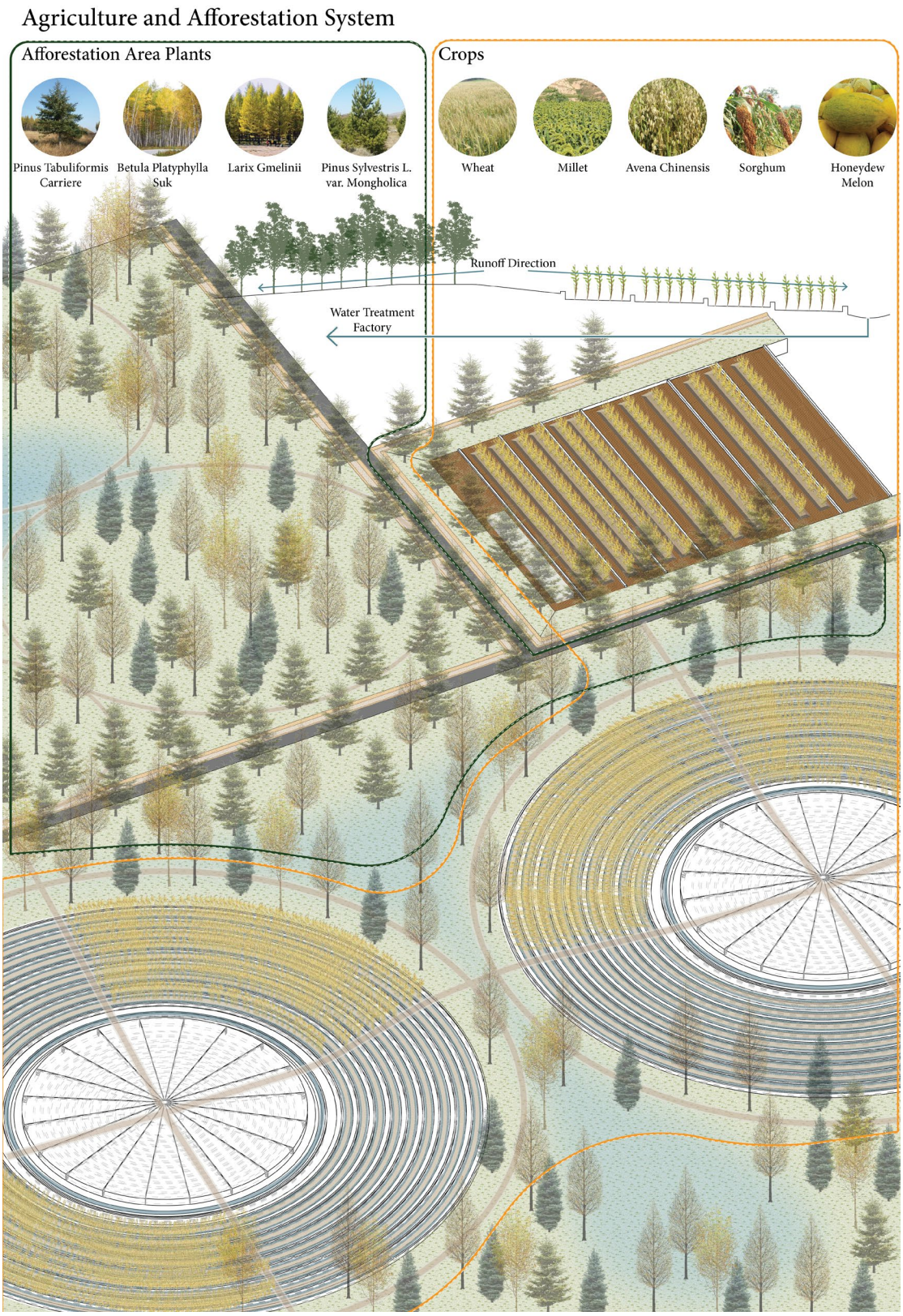

Figure 4.3: Agriculture and afforestation system

CHAPTER 5. CONCLUSION

As a new perspective on landscape design in twenty-first Century mentioned in the beginning of the thesis, landscape design is not limited to the design of parks, gardens and squares today. By the researches of natural science and human development processes, landscape designers are constantly expanding the subject field, and this interdisciplinary development is based on cooperation. The deep thinking of landscape ecology can promote the two-way cooperation between landscape ecological planning and environmental remediation, which is the process of interaction between landscape technology and environmental science. The project of this paper is the study of desertification. Desertification, as a global environmental problem, not only threatens the survival of human beings, but also bears responsibility for the deterioration of the global environment. So, what role does landscape play in the process of desertification governance? Landscape, as a part of environment, plays a coordinating role in solving environmental problems. And the landscape design of the site is based on ecological planning, and reintegrates space resources in desertification areas through ecological prevention technology and environmental engineering methods, where space resources include water resources, human production resources and environmental remediation resources. The planning of these space resources and the reconstruction of the environment need the coordination of landscape design.

The prevention of landscape desertification is to explore solutions to the two causes of formation. Global climate changes have led to the expansion of arid and semi-arid areas, and land degradation has been accelerated by human overdevelopment. The two causes of the desertification formation interact with each other. The thesis seeks solutions from the root of the problem, and uses the ecological prevention technology with the system theory to plan the site. Finally, a complete ecological prevention prototype of desertification is formed by using the detailed design method to reflect the linkage between various prevention systems.

Based on the study of desertification prevention, this thesis is also thinking about a deep problem involving people and the environment. Humans have been emphasizing that we are saving the Earth. However, after hundreds of millions of years, even billions of years of transitions, from the species extinction to the emergence of human civilization, the Earth still exists no matter how many changes it has undergone. But it quietly watches the replacement of human civilization and history like a spectator. So are humans saving the Earth or saving themselves? Everyone has his own answers, but the desire for humans to eliminate environmental problems is consistent.

In fact, from a landscape architect's point of view, the title of the paper "Prevention of Landscape" can express our position, optimizing the environment saves human beings. Landscape as part of the environment is the first carrier we can improve or repair. Landscape design in the 21st century and in the future will constantly think about its subject field, and more and more landscape architects will rethink the ecological remediation, social development, urban expansion and other issues through the landscape in the context of globalization. The project of "The Prevention of Desertification in China" is based on the global environmental problems and the saving of human beings, discussing how to prevent desertification from the perspective of landscape ecological planning, so as to achieve "win-win" for humans and the environment. Landscape is only a design technique. In the environment, people need to use this technique with more methods of technology and economic development to create a new industrial system of sustainable development. As shown in the final bird view, the prevention of desertification drives innovation in the regional ecological industry.

REFERENCES

Wang, Xunming. Chen, Fahu. Hasi, Eerdun. Li, Jinchang. 2008. "Desertification in China: An assessment." *The Journal of Earth-Science Reviews.*

Wang, Feng. Pan, Xubin. Wang, Dongfang. Shen, Chongyang. Lu, Qi. 2012. " Combating deserti fication in China: Past, present and future." *The Journal of Land Use Policy.*

Chen, Fahu. Li, Guoqiang. Zhao, Hui. Jin, Ming. Chen, Xuemei. Fan, Yuxin. Liu, Xiaokang. Wu, Duo. Madsen, David. 2013. " Landscape evolution of the Ulan Buh Desert in northern China during the late Quaternary." *The Journal of Quaternary Research.*

Bayan Nur City Planning Department. 2015. "Assessment Report of Bayan Nur City Planning (2011-2030)." *Report of Bayan Nur Government.*

Zheng, Xiao. Zhu, Jiaojun. 2015. " A new climatic classification of afforestation in Three-North regions of China with multi-source remote sensing data." *Theoretical and Applied Clima tology.*

D'Odorico, Paolo. Bhattachan, Abinash. Davis, Kyle. Ravi, Sujith. Runyan, Christiana. 2012. " Global desertification: Drivers and feedbacks." *The Journal of Advances in Water Resourc es.*

Wang, Zhan. Deng, Xiangzheng. Song, Wei. Li, Zhihui. Chen, Jiancheng. "What is the main cause of grassland degradation? A case study of grassland ecosystem service in the middle-south Inner Mongolia." *The Journal of Catena.*

Ellis, Erle. Ramankutty, Navin. "Putting people in the map: authropogenic biomes of the world." *The Ecological Society of America.*

Ma, Wenyuan. 2016. "The Three-North shelterbelt forestry degradation survey report." *The Jour- nal of Forest Science and Technology.* 2016(3):10-15.

Dai, Liming. Wang, Xianli. Wang, Jingxi. 2000. "The Three-North shelterbelt ecological effect analysis and assessment." *The Journal of World Forestry Research.* 2000(02):47-51.

United Nation. 1994. *The United Nations Convention to Combat Desertification (UNCCD)*. http://www.un.org/en/events/desertificationday/desertification.shtml

The Landscape Architecture Foundation (LAF). 2016. "The new landscape declaration." https://lafoundation.org/about/declaration-of-concern/

VITA

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