

HISTORICAL REVIEW: INVESTIGATION AND RESEARCH ON THE EVOLUTION OF HUMAN-ENVIRONMENT RELATIONS IN MINQIN COUNTY, GANSU

RuoYu Xia
Beijing 101 High School, Beijing 100091, China.

Abstract: Minqin County, located in the lower Shiyang River basin between the Tengger and Badain Jaran Deserts, is a key ecological barrier and a typical setting for studying long-term human–environment relations. This paper reconstructs that history through field survey of six archaeological sites (Triangular City, Liuhudun, Liancheng, Sifangdun, Dong'an City, and Shashan Fort) dating from the Shajing Culture to the Qing Dynasty, together with interviews in three modern villages (Sifangdun Desert Control Base, Shangrun Village, and Xinhua Village). Site distributions show a persistent north-to-south retreat of settlement. In the Shajing period, abundant river and marsh water supported dense occupation along Zhuye Marsh. Western Han immigration and garrison farming still found the oasis habitable, and many later county seats overlay earlier Shajing remains. From the Wei–Jin and Tang onward, northern sites were abandoned as inflow declined, lakes shrank, and desertification advanced; Ming–Qing activity contracted further south amid expanding cultivation and chronic water disputes. The overall pattern is “people retreating and sand advancing.” Twentieth-century reclamation intensified these pressures, producing severe sandstorms, falling groundwater, and rural out-migration. Since the early 2000s, canal conveyance, restricted irrigation, large-scale *Haloxylon* afforestation, and public-welfare campaigns (notably more than 80,000 mu planted at Sifangdun) have raised county forest coverage from about 3 percent to 18.28 percent by 2025 and reduced storm intensity, realizing “people advancing and sand retreating.” Remaining problems include the drying of natural channels and die-off of riparian trees, high irrigation costs, capped farmland, aging villages, and the risk that abandoned fields will again become sources of sand. The study traces a shift from limited early human impact, through intensification after the Tang, to deliberate ecological restoration in the present.

Keywords: Minqin County; Human-environment relations; Desertification; Shajing Culture; Oasis governance; Afforestation

1 INTRODUCTION

Human activities and the natural environment mutually influence each other, and the later the era, the more significant role human activities play in this relationship. Minqin County is located in the northeastern part of the Hexi Corridor in Gansu Province, situated in the lower reaches of the Shiyang River, between the Tengger Desert and the Badain Jaran Desert, serving as the frontier zone preventing the two deserts from merging. Within Minqin County, historical and cultural remains from prehistoric times to the modern era are preserved, and their developmental trajectory is an important witness to local environmental changes. This region is a typical area for the study of human-environment relations.

Therefore, Minqin County was selected as the research site. Through investigations of remains from different historical periods and interviews with local residents, this study seeks to reconstruct the historical evolution of environmental governance in the region.

2 CULTURAL REMAINS AND ENVIRONMENTAL CHANGES

A total of 6 ancient sites were investigated in this survey (Figure 1).



Figure 1 Distribution Map of Surveyed Sites in Minqin County
Ancient sites (black text): Sanjiaocheng Site, Liancheng Site, Sifangdun Site, Shashanpu Site, Liuhudun Site;

County and towns (red text): Minqin County Seat, Hongshaliang, Donghu, Shoucheng, Shuangzike, Daba, Changning, Jiahe, Xuebai (Redrawn based on the Wuwei City imagery map. Map source: <https://gansu.tianditu.gov.cn/bzdt/standeredMap>)

2.1 Triangular City Site

The Triangular City Site is located 5 kilometers west of the fifth group of Xiaodong Village, Hongshaliang Township, Minqin County, in the desert. It covers an area of about 3 million square meters. Most of the surface of the site has been buried by shifting sand, and the surface vegetation is mainly modern *Haloxylon ammodendron* forests. There is a naturally formed rock platform in the site, with walls built of adobe blocks and sandy soil at the edge of the platform, 78.3 meters long and 38.1 meters wide, overall triangular in shape, hence named Triangular City Site (Figure 2).



Figure 2 Triangular City Site (Northeast–Southwest)

A large number of pottery shards are scattered on the surface of the site. According to the characteristics of the pottery shards, they can be divided into two periods: the Shajing Culture period and the Han Dynasty. The remains of the Shajing Culture period mainly include sand-tempered red pottery and brown pottery, with coarse sand and gravel, all hand-made, and surface decorations including cord marks, string patterns, and incised patterns, etc. Some rim and neck pottery shards have stacked clay strip patterns, which are typical characteristics of Shajing Culture pottery [1]. These potteries were most likely produced and sold by local ancestors themselves, and the fuel for producing pottery were most likely local wood. Additionally, whetstones, grinders, copper slag, and agate fragments can be seen on the surface. Han Dynasty remains mainly include sand-tempered gray pottery, fewer in number, all wheel-made. Pottery surface decorations include cord marks and impressed grid patterns, consistent with the surface decorations of pottery unearthed from Han Dynasty tombs at Heishui Guo in Zhangye, Gansu [2].

2.2 Liuhudun Site

The Liuhudun Site is located west of Changcheng Village, Xuebai Township, Minqin County, and 2.5 kilometers south of the Shajingzi Forest Farm, in the desert. It covers an area of 4 million square meters and has been announced as a provincial-level cultural relics protection unit by the People's Government of Gansu Province. Most of the surface of the site has been buried by shifting sand, and the surface vegetation consists mainly of modern *Haloxylon ammodendron* and *Tamarix*. Grass checkerboards have been planted on the shifting sand for sand fixation (Figure 3).

A large number of pottery shards are scattered on the surface of the site. According to the characteristics of the pottery shards, they can be roughly divided into three periods: the Shajing Culture period, the Han Dynasty, and the Wei-Jin period, with Shajing Culture remains predominating. The Shajing Culture pottery shards are basically the same as those at the Triangular City Site, mainly sand-tempered red pottery and sand-tempered brown pottery, with surface decorations of cord marks, incised patterns, and stacked clay strip patterns. Han Dynasty remains mainly include gray pottery shards and blue bricks; some bricks are deformed due to over-firing and appear dark green in color. There may be Han Dynasty tombs here. Remains of the Wei-Jin period are mainly sand-tempered gray pottery shards, darker in color, with surface decorations of wave patterns, etc., identical to the pottery decorations of the Wei-Jin period unearthed in Wuwei and other places. Their number is relatively small.



Figure 3 Liuhudun Site (Southeast–Northwest)

2.3 Liancheng Site

The Liancheng Site (site of the former Han Dynasty Wuwei County seat) is located 12.5 kilometers northwest of Tuanjie Village, Quanshan Town, Minqin County, in the desert. Because the eastern and western cities are connected, it is called Liancheng (Connected Cities). The western city faces south, measuring 297.7 meters east-west and 359.6 meters north-south. A city gate opens in the middle of the east wall, with a barbican outside the gate measuring 16.7 meters east-west and 27.1 meters north-south. The foundations of the south, west, and north walls of the eastern city remain, and traces of the east wall can still be discerned; it measures 370 meters east-west and 359.6 meters north-south (Figure 4). Judging from the remains, the four corners of the eastern city have corner platforms; there is one side platform on the north wall, and two side platforms on the west wall. The walls and corner platforms of both cities are rammed-earth constructions, with rammed layers 0.1–0.15 meters thick. At the southeast corner of the western city there is a circular low platform, around which soil blocks, stone blocks, copper slag, and iron slag are scattered; it may be a smelting site. A large number of ancient remains are scattered on the ground inside and outside the site, including pottery shards, glazed pottery shards, copper slag, copper pieces, copper coins, iron blocks, bricks, millstones, whetstones, and stone blades. The pottery shards mainly include red pottery, brown pottery, and gray pottery, with gray pottery predominating; all are wheel-made, with surface decorations of string patterns and cord marks, etc. Red pottery and brown pottery are fewer in number, hand-made, with surface decorations of incised patterns, cord marks, etc. All are coarse sand-tempered pottery. The glazed pottery shards are low-temperature lead glaze and are fragments of Tang Sancai. The bricks are gray; some are deformed due to excessively high firing temperatures and appear dark green in color.



Figure 4 Liancheng Site (Southeast–Northwest)

According to the collected cultural relics, they can be divided into three periods: the Shajing Culture, the Han Dynasty, and the Tang Dynasty. Remains of the Shajing Culture period include sand-tempered red pottery, brown pottery, and stone blades, etc., fewer in number; Han Dynasty remains mainly include sand-tempered gray pottery, gray bricks, etc., greater in number; Tang Dynasty remains include Tang sancai fragments, etc. In addition, one fragmentary copper coin was collected, on which the character “tong” is clearly visible; it may be a fragment of a “Kaiyuan Tongbao.”

According to the *Hanshu: Treatise on Geography*: “Wuwei, with Xiutu Marsh to the northeast,” and also the *Shuijingzhu*: “Duye Marsh is northeast of Wuwei County. The county is three hundred li north of Guzang City, and to the northeast is Xiutu Marsh,” its location is close to that of Liancheng, and a large quantity of Han Dynasty period artifacts remain within the city site, indicating that the Liancheng Site is the seat of Han Dynasty Wuwei County [3-5].

2.4 Sifangdun Site

The Sifangdun Site is located 8 kilometers northeast of Fukang Village, Changning Township, Minqin County, on a barren sandy beach. It measures 2,250 meters east-west and 1,250 meters north-south, with a distribution area of more than 2.8 million square meters. Scattered artifacts include coarse sand-tempered red pottery shards, cord-marked gray pottery shards, black-glazed, green-glazed porcelain shards, and white porcelain shards, etc. Decorations include cord marks, basket marks, etc. Vessel forms include double-eared jars, single-eared cylindrical cups, etc. A relatively large number of Han Dynasty tomb bricks are scattered on the surface, and contiguous small pits can also be seen, which are early looting pits. The eastern part of the site has been buried by sand dunes. According to the surface artifacts, they can be roughly divided into three periods: the Shajing Culture, the Han Dynasty, and the Ming-Qing periods. Among them, the Shajing Culture period is represented by coarse sand-tempered red pottery shards, Han Dynasty remains by gray pottery shards and Han Dynasty tomb bricks, and Ming-Qing period artifacts by black-glazed, green-glazed porcelain shards and white porcelain shards.

There is a square beacon tower at the site, with a base side length of 30 meters, a top side length of 21 meters, and a height of 15 meters. It is entirely constructed of rammed earth, with rammed layers 0.1–0.15 meters thick. There is ash from the burning of firewood on the platform, and residual beams and rafters extending outward at the four corners. There is an enclosing wall outside the platform, which is not very distinct on the surface. The author used a drone to take photographs and exported a DEM elevation map of the platform and its surroundings using Metashape software (Figure 5). The extent of the enclosing wall is basically clear; overall it runs east-west, measuring 243.5 meters east-west and 164.3 meters north-south. Some scholars believe that the Sifangdun beacon was first built in the Han Dynasty and continued to be used in the Western Xia [6].

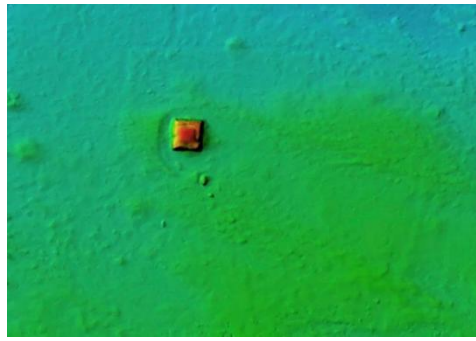


Figure 5 DEM Elevation Map of the Sifangdun Beacon

2.5 Dong'an City Site

The Dong'an City Site is located 2 kilometers south of Sanhe Village, Suwu Township, Minqin County, on a barren sandy beach. Its plan is square and consists of three nested cities. The outer city has a side length of 274.6 meters, with the gate opening to the southeast; outside the gate there is a barbican with its gate facing northeast. The inner city is located at the northeast corner of the outer city; its northeast and northwest walls utilize the outer city walls, while the southwest and southeast walls were newly built, with rammed-earth layers 0.2 meters thick, and a gate opening to the southeast. Its plan is square with a side length of 136.3 meters. Inside the inner city, at the northeast corner, there is a small city whose plan is rectangular, measuring 37.3 meters east-west and 46.5 meters north-south. All are constructed of rammed-earth board-built walls, with rammed-earth layers about 0.1–0.2 meters thick. At the northern corner inside the city there is a huge corner platform in the shape of a truncated pyramid, with a remaining height of 7 meters and a top side length of 10 meters; on the platform there are architectural remains built of adobe (Figure 6).



Figure 6 Dong'an City Site (East–West)

A small number of artifacts are scattered inside the city, including sand-tempered red pottery shards, blue brick fragments, and sauce-glazed porcelain bowl fragments, etc. According to local cultural relics workers, armor was unearthed inside the city in the 1960s, and local people also picked up flat flasks for carrying drinking water from the Western Xia period, etc. According to the artifacts inside the city, the remains within this city site can be divided into the Shajing Culture, Han Dynasty, Western Xia to Yuan periods, and others. According to Wu Renxiang's survey, this city is the only city site constructed by the Western Xia within Minqin territory and was still utilized in the Ming Dynasty [7]. According to Volume 5, "Military Defense Gazette: Forts and Bastions," of the *Wuliang Quanzhi Jiaozhu · Zhenfan Xianzhi*: "Dong'an Fort, twenty li east of the city, commonly called Siba Fort, now collapsed, silted with sand, and without residents." Thus it can be seen that by the Qianlong period of the Qing Dynasty the city had already been abandoned [8].

2.6 Shashan Fort

Shashan Fort is located 200 meters northeast of the desert control station at Changcheng Village, Xuebai Township, Minqin County, on a sandy beach. The fort's plan is rectangular, measuring 120 meters east-west and 90 meters north-south, with one gate opening to the south. The fort walls are constructed of rammed-earth board-built construction, with rammed-earth layers 0.15 meters thick. Parts of the enclosing walls remain, with remaining heights of 1.5–7 meters; the north wall is thicker, with a base width of 6 meters and a top width of 4 meters. Brown- and black-glazed coarse porcelain shards and blue-and-white porcelain shards are scattered on the site, along with a small number of red and gray pottery shards, green-glazed porcelain fragments, etc. The site is generally well preserved. The fort walls have collapsed severely; some wall bodies remain, while parts are buried under sand. According to Volume 5, "Military Defense Gazette: Forts and Bastions," of the *Wuliang Quanzhi Jiaozhu · Zhenfan Xianzhi*: "Fifteen li west of the city. One city gate, facing south." Thus it can be seen that this fort was still in use during the Qing Dynasty and was later abandoned [8] (Figure 7).



Figure 7 Shashan Fort Site (North–South)

Of the sites selected for this survey, five are located west of Minqin County seat and one is located east of the county seat. The dates of the sites range continuously from the Bronze Age to the Qing Dynasty, with good temporal continuity. Through the investigation of the sites it was found that all these sites have now been abandoned, surrounded by desert; some sites have been buried by shifting sand and have become completely desertified. The dramatic environmental changes over the long time span of the entire historical period are very evident.

Overall, among the six sites surveyed, except for the Shashan Fort Site, Shajing Culture remains were discovered at the other five sites, distributed from north to south. The Sifangdun Site is located at the westernmost end of the county territory; another 20 kilometers further west is the famous Triangular City Site in Jinchuan District, a relatively large Shajing Culture site cluster that includes city sites and tombs, etc. According to the survey by Xie Yaowen and others, a large number of Shajing Culture period remains are continuously and densely distributed in the Minqin Oasis (Figure 8), and are mainly concentrated on the northern side of the oasis. As previously cited from the *Shuijingzhu*, “Duye Marsh is northeast of Wuwei County.” During this period the water volume of the Shiyang River and Jinchuan River, the water sources of the Minqin Oasis, was relatively large, and at the same time human activities in the upper and middle reaches had no obvious impact on the rivers, so water resources could flow sufficiently into Zhuye Marsh; these site points were distributed along the rivers and Zhuye Marsh. At the same time we also collected a small number of freshwater shellfish, indicating that water resources in the Minqin Oasis were abundant during this period. The natural environment of the Minqin area was relatively superior, and ancestors were frequently active on both banks of the Minqin Oasis.



Figure 8 Distribution Map of Shajing Culture Remains in the Minqin Oasis

(From top to bottom and left to right) Sanjiaocheng, Huoshitan Site, Liancheng, Chaiwan Site, Xiaojingzitan Site, Gucheng, Liaojiang Beacon Tower, Lugu Beacon Tower, Shishanzi, Xituwa Ranch, Donganpu, Shajing Culture Site, Tengger Desert

Image taken from *Development and Evolution of the Minqin Oasis*, p.77

(Source: <https://book.scienceandreading.cn/shop/book/Booksimple/show.do?id=B2FDEDE20A257400A881FF087D4E8570C000>)

After the establishment of the four commanderies of Hexi in the Western Han, Wuwei and Xuanwei counties were established within Minqin territory, subordinate to Wuwei Commandery. The seat of Wuwei County is the present Liancheng Site. In order to fill the “empty Hexi land” situation after the “Hexi Campaign” between the Han and the Xiongnu, the Western Han government repeatedly immigrated people to Hexi. Of the six sites surveyed this time, except for Shashan Fort, the other five sites all contain Han Dynasty remains, including not only city sites but also tomb remains, indicating that these immigrants took the Minqin Oasis as their home and lived there long-term. Moreover, all five of these sites contain artifacts of the Shajing Culture period, indicating that the county seats and townships established by the Western Han government were built upon the original Shajing Culture remains, showing that environmental changes in the Minqin Oasis during the Han Dynasty were not obvious and that it was still suitable for human habitation and garrison farming. According to the *Atlas of Chinese Cultural Relics: Gansu Fascicle*, the Han Great Wall on the northern side of the Minqin Oasis was distributed along the Shajing Culture remains [9]. However, at the Triangular City Site, the remains mainly include those of the Shajing Culture and Han Dynasty periods, with a small number of Wei-Jin period artifacts. It can be seen that this site was abandoned after the Han Dynasty; people still were active there in the Wei-Jin period, but on a scale inferior to that of the Han Dynasty. The reason for abandonment may

have been environmental deterioration caused by excessive reclamation; at this time the process of desertification had already begun, and it was less suitable for human activity.

From the Wei-Jin to the Tang Dynasty, the Minqin area successively belonged to various administrations. According to the survey results, except for a few Wei-Jin period artifacts, no Sui-Tang period remains are found at the Triangular City Site. During this period the area centered on the Triangular City Site had been completely abandoned. In contrast, a large quantity of Wei-Jin and Tang Dynasty remains are found at the Liancheng Site to the south of this site, and the Liuhudun Site also contains a large quantity of Wei-Jin period pottery shards and other artifacts. This indicates that the distribution of remains during this period as a whole retreated southward, confirming that desertification phenomena already existed in the northern part of the Minqin Oasis. According to research by Xie Yaowen, during the Sui-Tang period the water volume of lakes within Minqin County decreased rapidly; some river channels and tributaries changed from perennial flowing water to intermittent rivers; Zhuye Marsh was renamed Baiting Sea; because of reduced upstream inflow, it gradually separated into several small lakes [10]. Artifacts after the Tang Dynasty are rarely seen at the Liancheng Site, indicating that after the Tang Dynasty this area was gradually abandoned and eventually desertified. In the Ming Dynasty, Zhenfan Guard was established on the basis of the Xiaohetan City of the Yuan Dynasty, subordinate to the Shaanxi Regional Military Commission. During this period the main range of human activity further retreated southward. The Ming Great Wall was distributed along the guard city; beyond the Great Wall there may have remained only forts such as Sifangdun for warning and sentry duty. This southward retreat was of course due to the military contest between the Ming and the Mongols, but it was also influenced by the natural environment. Ming Dynasty period remains are rarely seen or basically absent at sites on the northern side of the Minqin Oasis; the Triangular City Site and Liancheng Site completely lack Ming Dynasty artifacts, and remains after the Tang Dynasty are also relatively scarce. This indicates that after the Tang Dynasty, due to the influence of desertification in the northern part of the oasis, the scale of human activity was far inferior than before. This is reflected not only in the northern part of the oasis; at the Liuhudun Site as well, no artifacts after the Wei-Jin period are seen, and this site is located in the southern part of the Minqin Oasis. Overall, water resources in the Minqin area were relatively abundant during this period. When Xia Nai and Yan Wenru investigated the Liuhudun Site, they called it “Liuhudun” (Six Lakes Mound) [11]. This name most likely circulated during the Ming-Qing period, indicating that there were still quite a few lakes in this area during this period. The Sifangdun beacon was still in use in the Ming Dynasty; about 216 meters to the west there is a meandering ancient river channel. This confirms that upstream water could still flow to the area north of the oasis.

In the Qing Dynasty, because of reduced upstream inflow, the area of lakes in the northern part of the Minqin Oasis further decreased. At the same time, as the population increased, in order to support the continuously growing population, the area of cultivated land continuously expanded, and water-use disputes between regions became a normal state of local life. According to the Wuliang Quanzhi Jiaozhu, local residents of Minqin often went to court with people from upstream areas over water use; relatively large cases included the “Jiaowei Canal Case,” the “Yangxiaba Case,” the “Hongshui River Case,” and others [12]. It can be seen that during this period the upstream inflow of the rivers could no longer satisfy the water needs of the downstream population. Except for Shashan Fort, none of the other five sites contain remains of this period; the Dong'an City Site had already been completely abandoned by the Qianlong period of the Qing Dynasty. When Yan Wenru investigated the Liuhudun Site, sand ridges undulated, and there were no fields or households; Liuhudun was originally an earthen platform that had already been abandoned. Today the earthen platform has long been buried by shifting sand.

Through the above review, it can be seen that human activity remains experienced a process of retreat from north to south over time; the farther north, the earlier the era in which the area of the site was abandoned and desertified, forming a process of “people retreating and sand advancing.” In the Ming-Qing period, because of reduced river inflow and shrinking lake areas, large amounts of cultivated land along river channels and lake edges were reclaimed, increasing the water use for cultivated land while also intensifying the destruction of the natural environment.

3 MODERN VILLAGES AND ENVIRONMENTAL GOVERNANCE

While investigating historical remains, the author selected three relatively typical modern villages and conducted interview work with local residents, mainly to understand the impact of environmental changes on production and life, as well as the measures taken.

3.1 Sifangdun Desert Control Base, Changning Town

The Sifangdun Desert Control Base is located south of the Sifangdun Site. This area was once one of the five major wind-sand mouths of Minqin County; within the zone, mobile sandy land, semi-fixed sandy land, and Gobi interlock, directly threaten the surrounding villages and farmland of Changning Town. The Sifangdun Desert Control Base is operated by Qingshuo Public Welfare; the person in charge is Ma Junhe, a local of Minqin, affectionately called “Brother Ma” by everyone. According to staff, the main purpose of the Sifangdun Desert Control Base is to block the northwest wind and protect the Hongyashan Reservoir to the southeast; this reservoir is the main water source for the lower lake area of Minqin. At the beginning of public-welfare tree planting and desert control, facilities within the base were simple; the living area consisted mainly of tents that could accommodate only a few dozen people. With the continuous addition of social forces, the base area continuously expanded, and prefabricated houses were also added;

facilities such as accommodation areas, toilets, shower rooms, and kitchens were gradually improved. From 2016 to the present, all funding for the Sifangdun Desert Control Base has come from donations, and the “Come to Minqin to Plant a Tree” campaign initiated by “Brother Ma” has attracted volunteers from all over the country to the base to plant trees and combat sand, jointly participating in public-welfare desert-control and tree-planting activities. At the same time, in order to attract more social forces to participate in afforestation, the base has designed wooden and stone commemorative plaques, establishing different commemorative plaques according to the area of public-welfare afforestation.

The trees planted are mainly *Haloxylon ammodendron*, interspersed with *Tamarix*, *Hedysarum*, etc. The trees within the base are arranged in orderly rows and are growing vigorously (Figure 9). Staff among the trees are watering them. According to introductions, *Haloxylon* forests first need continuous watering for two years, after which they can survive naturally.



Figure 9 Sifangdun Public-Welfare Forest

After years of effort, the Sifangdun Desert Control Base has afforested more than 80,000 mu, effectively curbing the risk of desertification in this area and truly realizing the concept of “people advancing and sand retreating.”

3.2 Shangrun Village, Dongba Town

Shangrun Village is located at the northeastern corner of the Minqin Oasis, on the eastern side of Dongba Town; the eastern and northern sides of the village border the Tengger Desert. China Central Television has conducted interviews here regarding targeted poverty alleviation, ecological governance, and rural revitalization work (Figure 10).



Figure 10 Overall Scene of Shangrun Village

According to the village Party branch secretary, population outflow in this village is relatively serious; the registered population is more than 400 people, but the permanent resident population is only a little more than 170; most young people go to work elsewhere, leaving only the elderly at home to farm. In the 1980s and 1990s, wind and sand were relatively severe locally; larger sandstorms often beat crops to death, and crop yields became worse year by year. Environmental deterioration and reduced income directly led to population outflow. In recent years, with the continuous development of tree-planting and desert-control work, the natural environment has improved significantly, the number of windy and sandy days has gradually decreased, and the intensity of sandstorms has further reduced, with relatively smaller impacts on crops. Every spring the local government also organizes villagers to carry out afforestation work, mainly planting *Haloxylon ammodendron*, while also providing certain subsidies. Such work is willingly undertaken by local people, as it both plants trees to control sand and increases income.

Because it is located in the northern part of the Minqin Oasis, with continuous water conveyance through upstream canals, its local agricultural production has been further developed. At the same time the government continuously optimizes the planting structure according to the situation of cultivated land and the natural environment; locally a production structure with fennel and maize as the main crops has been formed, and fennel stalks have further promoted the development of local sheep-raising; sheep fed on fennel stalks have become one of the calling cards of Minqin's local animal husbandry.

Local housing was originally mainly rammed-earth buildings; now most are concentrated-resettlement brick-and-tile houses. The original rammed-earth houses were mostly dangerous buildings and have mostly been abandoned and demolished (Figure 11).



Figure 11 Collapsed Rammed-Earth House in Shangrun Village

3.3 Xinhua Village, Dongba Town

Xinhua Village is located on the eastern side of the Minqin Oasis, northeast of Dongba Town, 8.6 kilometers southwest of Dongba Town. We interviewed an elderly man surnamed Liu who had just returned from Shenzhen; Grandpa Liu has lived here for generations. According to Grandpa Liu, there was originally a Liu family old residence (not Grandpa Liu's own family) to the northeast; it was the ancestral residence of a large local Liu clan, in which four generations of Liu descendants once lived. The large Liu clan made a living from camel raising; business was prosperous, and the ancestral residence had its own mill, livestock pens, etc. In the 1960s a flood occurred in spring; because the Liu family old residence was located on the riverbank, it was flooded, and the Liu clan members later dispersed to live in surrounding villages.

The Liu family old residence is located at the southeast corner of Xinhua Farm, 4.8 kilometers northeast of Xinhua Village. Its plan is rectangular, 40 meters long and 21.9 meters wide, with corner platforms at the northeast and northwest corners. It is entirely constructed of rammed earth, with distinct rammed layers (Figure 12). Outside the courtyard on the eastern side there was originally a well, which no longer exists; beside the well there is a poplar tree whose trunk circumference at the base exceeds 2 meters; it may have been planted after the Liu family old residence was completed (Figure 13).



Figure 12 Liu Family Old Residence (South–North)



Figure 13 Poplar Tree

According to Grandpa Liu, Xinhua Village originally had a population of a little more than 170; now only 70–80 people remain, mostly elderly, ranging in age from 50 to 90. As with Shangrun Village, most young people work outside. Grandpa Liu's own two sons have established families and careers in Shenzhen and Aksu respectively, and they have no intention of returning. In earlier years each person in the village still had more than 10 mu of cultivated land to plant,

and income was still considerable. However, as the groundwater level continuously declined and the natural environment continued to deteriorate, the government adopted measures such as water restrictions and restrictions on cultivated land area to ensure water supply to the lower lake area of the Minqin Oasis. At present each person may cultivate only 4 mu of land; water costs are relatively high, with irrigation water fees of 300 yuan per mu.

In order to effectively supply water to the northern lake area of the oasis, the original natural river channels have been completely abandoned and artificial canals are used for water conveyance, effectively reducing underground seepage. However, this has also caused the original vegetation on both banks of the rivers to wither and die. When Grandpa Liu took us to the Liu family old residence, we passed the original river channel, which is completely dry; most of the trees on both sides have also died. Grandpa Liu told us that in the 1960s and 1970s this place was shaded by green trees, and in summer the ground saw no sunlight; now only dry tree trunks remain, replaced by large areas of Haloxylon forests (Figure 14).



Figure 14 Dead Trees and Haloxylon Forests

Through interviews at the above three locations, it can be seen that before the 1980s and 1990s there was large-scale reclamation of farmland within the Minqin Oasis; the available land on both banks of the original rivers and along the lakes was mostly reclaimed as cultivated land, and at the same time, with the construction of irrigation canals, land in the marginal areas of the original oasis was also reclaimed; the Minqin Oasis experienced a development period of nearly fifty years. According to Director Sun of the Minqin County Museum, in the early 1990s when he first started work, his salary was relatively low; agricultural development in Donghu Town was better, and the income of local farmers was even higher than that of civil servants. However, in the late 1990s environmental deterioration intensified, and “people retreating and sand advancing” became obvious; in order to ensure water volume in the lake area, irrigation water for cultivated land along the way was gradually reduced, causing farmers’ incomes to continuously decrease. This is also consistent with the research results of Xie Yaowen and others [13].

From the beginning of the twenty-first century, Minqin County has continuously carried out large-scale afforestation activities, while strengthening publicity on water conservation and afforestation. Most of the slogans by the roadside in Minqin take water conservation and afforestation for desert control as their themes, such as “Determine greening by water, determine land by water, determine population by water, determine production by water,” “Calculate carefully and use water resources well, manage water resources strictly and meticulously,” “Everyone goes up, generation after generation transmits, step by step walks, and works hard and bitterly,” etc. (Figure 15), while “Diligent and simple, tenacious, united as one, build a solid barrier, and forever protect the oasis” is the official expression of Minqin County. On the screen in front of the hotel building where the author stayed, water-conservation slogans continuously scrolled. During this period the natural environment improved markedly, the area of green vegetation gradually expanded, and by 2025 the county’s forest coverage rate had risen from the original 3% to 18.28%. Extreme severe weather decreased; although sandstorms and other natural disasters still occur, their intensity and destructiveness have been markedly reduced.



Figure 15 Roadside Slogan

4 CONCLUSION

Through the investigation of historical remains and the survey interviews of modern villages, the relationship between natural environmental changes and human activities in each period of the Minqin Oasis has been basically clarified. From the prehistoric period to the Tang Dynasty, the impact of human activities on nature was relatively limited; from the Tang Dynasty to the Qing Dynasty the impact of humans on the natural environment gradually intensified; in modern times people have consciously improved human-environment relations, especially the government's emphasis on the restoration of the natural environment, making the improvement of the natural environment one of the key tasks of local government work. Under more than twenty years of effort, the natural environment of the Minqin Oasis has been effectively improved, and the vegetation coverage rate has been greatly increased; at the same time practical and effective governance methods have been formed. Through reasonable and effective publicity, more volunteers from all over the country have been attracted to join the work of tree planting and desert control, and the local government actively cooperates with public-welfare desert-control activities. It is understood that in recent years, as the number of volunteers has continuously increased, the local government has timely lowered the meal prices of restaurants within the county and increased the variety and quantity of dishes, ensuring that every volunteer can eat their fill and striving to let every volunteer eat well.

However, some problems were also discovered in the course of the survey.

First, at present water is mainly conveyed to the northern part of the oasis through artificial canals; the natural river channels are gradually drying up, causing large numbers of the original trees on both banks of the rivers to wither and die, seeming to have a tendency to intensify desertification.

Second, in order to ensure the volume of water conveyed to the northern lake area of the oasis, water use by residents along the way has been markedly reduced, especially with regard to irrigation water, whose cost is relatively high; at the same time the cultivated land area of residents along the way is restricted, causing farmers' incomes to decrease markedly, which has also led to obvious population outflow. Many villages are left with only middle-aged and elderly people, with no young people to be seen. In another twenty or thirty years, after all the remaining elderly people have passed away, the villages and cultivated land will all be abandoned. This is yet another potential risk of desertification.

That concludes the report and summary of this survey and research. Any inadequacies are open to the experts' criticism and correction.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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