

Migration, Urbanization, and Environment: An Examination of Human-land Interactions in the Tarim River's Lower Reaches during the Qing Dynasty

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Abstract

This article examines the central government's exploitation of the lower reaches of the Tarim River during the late Qing through systematic reviews of historical documents and field research. To bolster border security, the central government initiated migration to the Tarim River's lower reaches. As a result, this area, where the Lob people subsisted primarily through fishing and hunting, was transformed into one characterized by a primarily agricultural economy. The increased population and regional economy enabled governors to establish counties in that location. Lob Nor's early settlement was located in a low-lying area along the Tarim River. However, due to the arid climate, uneven water distribution, and excessive farming-induced soil salinization, the local authority and settlers were forced to relocate to the central part of the piedmont alluvial fan, which had better drainage conditions. Simultaneously, the municipal center was relocated northward from Puchang City, which was located in the reclamation area's geographic center, to Karagong, which is now Yuli County, in the heart of a foreland pluvial fan. This case study demonstrates that in most cases, the tension between humans and land in arid areas can be alleviated through human behavioral adaptations. As a result, man-land connections in environmentally sensitive places must be analyzed in the context of their unique natural and social environments.

Keywords

Tarim River's Lower Reach; Human-land Interactions; City-building; Late Qing Dynasty.

1. Introduction

Land degradation in ecologically sensitive places is the inverse of the evolution of earth surface systems caused by excessive human economic activity [1], and it is strongly correlated with the frequency and intensity of human activities [2]. Additionally, in-depth studies of human activities in arid/semi-arid regions have revealed that human-driven ecosystems are primarily a result of water resource redistribution, and that reallocated water resources have a positive correlation with the uneven spatial distribution of human activities. Human-induced land degradation in arid/semi-arid environments occurs mostly in places with substantial water supplies [3]. However, it cannot be denied that certain desert places have thrived with a certain level of agriculture and have been relatively unaffected by severe land degradation. The issues that need to be addressed include what are the critical variables that influence the connection between dryland farming and land degradation, and what are the local people's resolutions. Answering these concerns will be critical for preserving a balance between environmentally sensitive drylands and regional economic growth, as well as for increasing awareness of the Human-land link in drylands.

Inland Tarim Basin in Xinjiang is one of the world's driest regions. The basin's glaciers, such as Tianshan and Kunlun Mountain, give birth to the Tarim River, China's longest interior river. The lower parts of the Tarim river are scattered with isolated oases. Cities in the lower Tarim river

valley, developed around oasis agriculture, are critical topics in Human-land relations in arid climates, since their locations starkly illustrate the interplay between dryland agriculture and local water supplies. The British and Russians had long desired Xinjiang during the late Qing Dynasty, creating a sense of territorial crisis among the Qing authorities. As a result, initiatives spearheaded by the Qing rulers, most notably migration and cultivated farmland, were implemented to safeguard the country's western boundaries. The late Qing saw a tremendous shift in human-environment connections, making it a critical age of development along the Tarim river. What has been explored by Chinese scholars on the opening-up of Tarim river during the Qing era mostly revolves around migratory pathways, the establishment of farming methods, and the Qing local governance[4-7]. Few studies have been conducted on the issue of environmental changes in the lower Tarim river during the Qing dynasty, and these studies have revealed that government-led exploitation in the upper and middle reaches of the Tarim river resulted in a decrease in water supply in the lower reaches and a gradual reduction in the Lop Nor's area [8]. Additional information are required to better understand the linkages between land degradation and water redistribution, as well as the interactions between dryland agriculture and regional administration. As a result, this study will examine migration and agricultural systems, land degradation, and regional urbanization in the lower Tarim river basin during the late Qing Dynasty, with the goal of elucidating the peculiarities of Human-land connections in dry regions.

2. Restoring the Exploitation Process during the Qing

The lower Tarim River region is located in the southern section of Xinjiang Uygur Autonomous Region and is comprised of four counties: Korla, Yuli, Ruoqiang, and Qiemo. It is located between 35°38' and 41°45' north latitude and 86°8' and 93°45' east longitude. This region is located on the eastern border of the Tarim Basin, with the Kumtag Mountains to the north, the Aljinshan Mountains to the south, and the lower Tarim alluvial plains in the center. Due to the area's high aridity, the area's alluvial plain is primarily covered by rolling sand dunes, separating it from the Taklamakan Desert and the Kumtag Desert.

The research region is characterized by a typical temperate-continental desert environment, with an average yearly temperature of around 11.5°C. The diurnal and seasonal temperature ranges, on the other hand, are rather broad, with the average daily temperature reaching as high as 14°C to 16°C. There is little precipitation, but a lot of evaporation, as the annual average precipitation is 17.44 to 22.0mm and the yearly evaporation is 2500 to 3000mm. Meanwhile, the dry and clear weather provides this region with an abundance of sunshine hours, totaling 3000h per year. Additionally, the long frost-free period there, which could reach 187 to 233 days annually, benefits regional agriculture. The yearly total temperature there is up to 4000-4500°C, and the temperature 5cm beneath the earth may be maintained consistently above 10°C from 10 to 15 April, which is beneficial for temperate crops.

In contrast to its dry climate, the study region has a rather large supply of surface water. The glaciers that originate in surrounding mountains pour into the rivers that snake across the desert and spring-overflow belts at the confluence of the mountains and plains. The Tarim River is fed by the Weigan River, Kuqia River, Kongque River, and other streams that rise in Tianshan. It passes through Aksu, Shaya, Kuqia, and Luntai, then meanders southeast through parts of Korla and Yuli. Finally, the Tarim river flows into Taitma Lake. Different from its current route, the Tarim river had various channels through history. As recorded, the Tarim, south Weigan, north Weigan, and Kongque rivers snaked across the desert and joint into a single stream near Arakan, a location in Korla's southeast section. From the southwest, the Cherchen river flew into Tarim river, and then the combined river went to Lob nor, a massive lake that swallowed all streams.

These contributed to the natural geographical basis for the Qing government's exploitation in Lop Nor.

2.1. Local Governance during the Qing Dynasty

At the early years of the Qing Dynasty, the lower Tarim river valley was a nomadic territory inhabited by Mongolian Junghar. The Qing government reunified Xinjiang in the 24th year of Emperor Qianlong's reign period (1759), and the Beg system, a traditional uighur grassroots administrative system, was implemented in Korla, Yanqi, and Bugul, which used to be controlled by the Junghar. All Begg were subject to Karasar Amban's authority, and Karasar Amban's seat was in Yanqi. Meanwhile, Kaklik (now Ruoqiang), a location in the study region's southern portion, was under the authority of Khotan Amban, whose governing purview included the Tarim Basin's southern frontier. The General of Yili was set to take responsibility of both the northern and southern sides of Tianshan in the 27th year of the Qianlong reign (1762).

Yakub Beg had ruled the territory from the 7th year of Emperor Tongzhi's reign (1868). Until the 3rd year of Emperor Guangxu's rule (1877), Liu Jintang, the Qing commander, reunified the territory. In 1884, a provincial government was established in Xinjiang to protect the Qing's western frontier's security, and people were recruited and reorganized along the Tarim river to solidify the Qing's rule there. Xinping County (now Yuli) was legally founded in 1898 in response to the growth in people and local affairs in the Lop nor, and the county was subordinate to the autonomous sub-prefecture of Kalashar. The autonomous sub-prefecture of Kalashar was elevated to Yanqi Prefecture in the 25th year of Guangxu era (1899). And a deputy county was established at Ruoqiang or Kaklik, the southern half of the autonomous sub-prefecture of Kalashar, for sharing the location of the famed Han Dynasty city of Loulan and serving as a vital transit hub for mining in the Qing. The year 1899 saw the comprehensive establishment of county system across the lower Tarim river. In the 28th year of Emperor Guangxu's reign (1902), the deputy county of Kaklik was elevated to Ruqiang County, retaining its administrative affiliation with Yanqi Prefecture. The year 1902 marks the completion of the county system along the lower Tarim river, which continues to operate to the present day.

Local government near the lower Tarim river, in general, remained unstable during the Qing. The Qing began exploring its management of southern Xinjiang in the 18th century, during the Yongzheng-Qianlong reign era. To adhere to the idea of nationality-based rule, the Qing central government simply established ambans and garrisons in major cities that were formerly administered by the Beg system, a system founded on serfdom institutions and manorial economics. By the middle of the nineteenth century, or during the Daoguang-Xianfeng reign period, the Qing government was forced to acknowledge the effectiveness of its policy of "ruling by customs" in southern Xinjiang due to the British-Russian competitions in Central Asia and the rebellion of descendants of former Khojas [9]. The Qing's General Na Yancheng was appointed in the 7th year of Daoguang reign period (1827) to deal with the aftermath of the Jahangir Khoja rebellion, and at the same time, the decision to convert the local Beg system to a County system was put on the agenda to bolster the Qing's control over southern Xinjiang. In the 8th year of Emperor Guangxu's reign (1882), the independent sub-prefecture of Kharshal and the independent prefecture absorbed the former sporadic local Ambans, which not only laid the groundwork for the establishment of a province in Xinjiang two years later, but also laid the foundation for the development of the lower Tarim River region.

2.2. Migration and Crops Cultivation

After the mid-Qing Dynasty, the oasis in the lower reaches of the Tarim river degraded and the scarce agriculture was abandoned as a result of battles such as the Zhangger revolt, the Agub rebellion, and the Hui army's arrival. During the early Guangxu era, the Qing decided to establish a new administrative mode in Xinjiang following its pacification in order to bolster the central government's grip. As a result, Xinjiang province was founded in the 10th year of

Guangxu-reign period (1884). Therefore, central government-led regional development and migration were vigorously fostered along the Tarim river's lower reaches, with the goal of preserving a stable grass-roots governance in Xinjiang.

During the Guangxu-reign period, the Lopliks were the indigenous habitats along the lower Tarim river. There were about 640 Loplik families or over 6000 Loplik people living in 26 scattered communities, and their way of life was defined by migration to areas with adequate water and grass, ignorance of farming, reliance on fish as a steady food source, and the construction of thatched homes.

However, the development of province upset the lopliks' unworldly existence. In the 14th year of Guangxu-reign period (1888), then-Xinjiang province Governor Wei Guangtao viewed the Lop nor area as a vital place with a large amount of fertile virgin land, and he was concerned that opposing claims to the Lop nor region by various forces might spark violence. After the Qing's approval of his recommendation, a bureau of farm and land reclamation was established in Ying ge ke li, a tiny oasis on the north side of a subsidiary stream of the Tarim river, with the responsibility of promoting immigration and reclamation in Lop nor. Meanwhile, three irrigated regions have been designated based on water availability. To be precise, the middle and the west part of Lop nor were irrigated by Tarim river, and the east area was irrigated by Cherchan river.

In the early years of the formation of the Lop nor reclamation region, the farmers were predominantly Uighurs, who fell into three categories: discharged Uighur soldiers, Loplik fishermen, and Uighur farmers from the remainder of the south Tianshan Mountain area. [7] With the encouragement of local officials, the lopliks progressively transitioned from fishing to farming, and the reorganization of immigrations proved exceedingly effective. In the 19th year of Guangxu's reign period(1893), there were over 1200 farmer households and over 200 commercial families in Lop nor, and bazaars and fairs began to flourish. Until the 24th year of Guangxu's era, the population of Lop nor exceeded 10 900.

Due to the expanded worker force, land reclamation in Lop nor developed rapidly. Lop nor had developed into a significant reclamation region in southern Xinjiang by the 24th year of Guangxu's reign, with good irrigation infrastructure and nearly 200 000 mu of reclaimed cropland. Barley, wheat, glutinous millet, beans, and other grains were the predominant crops. The scenery in Lop nor transformed into a vibrant one with a light green spring, a brilliant green summer, and a golden fall. Within a few years of growth, the reclamation and settlement on the lower parts of Tarim River had flourished.

2.3. Urbanization and Relocation of Regional Centre

As previously stated, a bureau dealing with migration and farming was established in Ying ge ke li in the 16th year of the Guangxu-reign period (1890). It was a temporary administrative center since it operated more like an official post office or transfer station. The Qing administrators established a new city in Du nali, 285 li east of Ying ge ke li, in the 19th year of the Guangxu-reign period (1893). Du nali's terrain was more level, and it was surrounded by abundant water supplies. The new city was named Puchang city, in memory of its historical place name, *Puchang sea*, during the Han era. Apart from city construction, the Qing governors established green-banner forces, a national army of primarily of Han people, in Puchang City to control Lop nor's settlement concerns. In the 21st year of Guangxu-reign period, a reclamation and defense office was established in Kaklik (now Ruoqiang), to recruit farmers and destitute people for mining and transshipment.

Considering the rapid population expansion and diverse demographic composition in Lop nor, the then-Xinjiang governor, Rao Yingqi, advised the central government that it would be impossible to maintain stable authority over Lop nor without the official installation of local governors. From his point of view, enduring stability could only be possible with the

construction of good civil and military systems, systems that have the features of the inland ones. The central government approved Rao Yingqi's idea, and in the 24th year of Guangxu's reign, the new county of Xinping was established. However, Xinping county did not have its seat in Puchang city. Indeed, it was erected at Ka lagong, an oasis located at the base of Kulutak Mountain and on the north bank of Qongque River. Due to the fertile soils of Ka lagong, it might take no more than two years to harvest.

The deputy county of Kaklik was renamed Ruoqiang county in the 24th year of the Guangxu-reign period (1902). In the following year, the green-banner troop in Puchang city was transferred to Xinping county's capital, while the military rank in Puchang city was reduced by two levels. In the 31st year of Guangxu era, the lower-leveled regiment in Puchang city was disbanded, thus eliminating the functions that defined it as a city. [6] In 1917, Xie Bin, a member of the Beiyang Government's Ministry of Finance, conducted an investigation to Lop nor. He discovered that Puchang city was still in ruins, with just three historic military offices in fair condition. Thus, the old city of Puchang had been abandoned. Xinping County was renamed Yuli County in 1914.

In general, the regional administrative centers in Lop nor was reorganized multiple times throughout the late Qing Dynasty due to the rise of farming and population growth. Yingge Keli, a location in the lower reaches of the Tarim river with great water and heat conditions, was not the intended location of Lop nor's regional headquarter. The regional center was therefore relocated to Du nali or Puchang City, which benefited from a reasonable geographical location. Finally, the administrative center in Lop nor settled down in Xinping county, a place at the spring outcropping region.

3. Discussions

3.1. Water Resources and Dryland Farming System

Due to the region's high aridity, its inhabitants rested on surface water to establish irrigated agriculture. And the surface water there, particularly the Tarim river system, was replenished by glaciers and groundwater in the region between mountains and plains. As a result of this hydrological characteristic, river runoff unevenly distributed across seasons, with summer runoff accounting for 60-70 percent of the yearly amount and spring runoff accounting for just 5-15 percent. Conversely, the crops require the greatest water in the spring, accounting for over 35% of yearly water usage. [10]

Additionally, large-scale immigration and reclamation in southern Xinjiang during the Qing Dynasty exacerbated the Tarim River's water loss, resulting in decreasing water volume in the river's lower reaches. Especially after the founding of Xinjiang province, towns along the upper and middle sections of the Tarim river, such as Aksu and Kuqia, constructed several new irrigation channels that absorbed a significant quantity of runoffs. As a result, surface water supplies were insufficient in Lop nor or the lower reach, particularly during the spring plowing season. Such a grave condition became apparent to Swedish explorer Sven Hedin during his 1900 journey to Lop nor. He emphasized that irrigation-related water loss would significantly limit the water supply in the lower end and have a long-lasting influence on the livelihoods there.

To supply sufficient irrigation water, an embankment was constructed on the north side of Lop nor. It is dammed on the Alatirim River, a tributary of Tarim River, and east to the Kongque River, in order to store river water. This dam remained operational until the early years of the Republic of China. At that time, the reservoir beneath the bank was deep and clean, and the pathways along the bank were lined with willows that waved in breeze. While the water conservancy projects mitigated the adverse effects that caused by excessive interannual and

seasonal variations in the water flow, it also created hidden dangers for the subsequent abandonment of farmland in this area.

Restricted by water resources, agricultural techniques in Lop nor had also changed. The majority of immigrants came from the Hehuang area in Gansu and Qinghai provinces, and they brought their unique dryland agricultural skills to Lop nor. *Pao Dong shui* was the term given to this skill, which entailed saving rain and water in fall, storing them as ice in the fields in winter, and thawing the frozen glaciers for sowing in the following spring. Thus, the problem of limited water during spring ploughing might be adequately addressed. This agricultural technique, also known as *Zhong Chuang Tian* (chasing the rain when cultivating), was widespread in the Loess Plateau, Hexi Corridor, Xinjiang, and other desert regions [11]. *Pao Dong shui*, characterized as a method ideal for water-scarce farming, has been practiced in the Tarim River Basin to this day.

3.2. Soil Degradation and Relocation of Regional Administrative Center

Between the 16th and 24th years of Guangxu's reign period, more than 200,000 mu of cropland in the Tarim River's lower reaches had been recovered. Simultaneously, land deterioration occurred in this environmentally sensitive area.

The soil conditions along the Tarim River were inherently deficient. Although water and grass were abundant, the soil was sandy and impoverished. Additionally, land salinization was facilitated by the dry environment, evaporation of surface water, and soil nutrient loss. With several river branches and abundant groundwater, Puchang city's seat was surrounded by sand dunes and muddy lakes, making it simple to create soil salinization. As a result, residents of Lop nor immediately noticed that the salinization caused by severe rains could differ crops growth. Additionally, the farming practice *Pao Dong Shui* exacerbated salinization in the lower reaches of Tarim river, owing to its inefficient agricultural drainage.

Desertification would also result from soil salinization and land degradation, creating a vicious spiral of "reclamation-abandonment-reclamation-re-abandonment." Rao Yingqi, the then-Governor of Xinjiang, abolished the policy of cultivating in Puchang city. Rather than that, he picked the Kulutag piedmont alluvial fan as the new agricultural reclamation area to address land salinization limitations. And the regional administrative headquarter was accordingly relocated to Kara Gong. Not only was it easier to drain waterlogged farmland, but the terrain in Kara Gong was also more plain and abundant in unclaimed land.

Kara Gong has progressively developed into a formal county-level administrative entity, or Xinping county, as the reclamation there progressed. The shift of the regional center to the lower reaches of the Tarim river in the late Qing Dynasty demonstrated a changing spacial tendency from the Tarim River's tributaries, the rivers' confluences to the piedmont alluvial fan's midsection."

3.3. Efforts of the Government and its Environmental Responses

Irrigation systems were critical and crucial for agriculture development in the highly sandy sections of Tarim River. This, however, necessitated a substantial investment of human and material resources. Tao Baolian, whose father was the then-governor of Xinjiang, was also aware of these issues during his field excursions to Lop nor. As he indicated, it was required to construct and maintain efficient irrigations in order to convert the fields into agriculture, while the expense would be far greater than its profits. This magnitude of investment could only be accomplished with the government's support.

Throughout the unstable late Qing Dynasty, Britain, Russia, and other nations increased their competition in Central Asia, affecting the Qing government's control and management over Xinjiang. As a result, reclamation in southern Xinjiang became a necessary tool for the Qing government to govern Xinjiang and ensure its frontier's security. To a certain extent, the Qing's

control of Xinjiang was more effective and legitimate than that of earlier dynasties. [12] Especially after the province's formation, immigration and reclamation became the focal points of the Qing's reforms in Xinjiang, propelling the development in the lower reaches of the Tarim river.

Agriculture growth in the harsh and isolated Lop nor requires significant government support in the form of human and financial resources, including substantial investment in agricultural tools, livestock, seeds, and water conservation infrastructures. Along with these essential agricultural demands, a significant portion of the budget was spent on resettlement. According to the proposed regulations, every man and woman above the age of 13 received a silver stipend of three taels, while men under the age of 12 received a silver allowance of two taels. Additionally, depending on the age of each male, each household received eight or four taels of silver for home construction and agricultural tool manufacture, respectively. It is calculated that 5647.3 taels of silver were required to relocate the refugees from Hehuang area to Lop nor. [7] The Qing government ever had a comprehensive assessment on this, indicating that the yearly financial assistance provided to support the tens of thousands of families in Lop nor was just a drop in the bucket.

With the expansion of reclaimed land, the investment in water conservation infrastructures increased proportionately. Due to the seasonal distribution of available water and the sandy soil over which the channels traverse, the yearly cost of irrigation dredging cannot be underestimated. The basic reason for Puhang city's abandonment might be attributed to soil degradation, with the immediate cause being siltation of the irrigation system due to floods. In turn, neither population reduction nor enhanced desertification had occurred in Lop nor. [13]

4. Conclusion

Previous research on the evolution of the Earth's surface system in arid and semi-arid regions has generally indicated that changes in production techniques are the result of human activities. Specifically, the transition from nomadic to intensive farming may result in environmental deterioration. However, such a simplistic logical link is incapable of capturing the immensely complicated interaction between human and land in arid regions. Although climatic fluctuations normally limit environmental change in arid places, the effect of human activities becomes increasingly pronounced as historical processes progress. This study demonstrates that before the Qing's Qianlong period, the primary factor determining the consumption of water resources in the Tarim Basin was the natural environment, while the primary element turned to human activity since the Qianlong-reign period.

Taking geopolitics and marginal security into account, the Qing governor actively introduced the county system in Xinjiang. This administrative system was congruent with that of the Qing's interior region and was centered on agricultural or labor-intensive agriculture. The imposition of farming in arid places by administrative edict ultimately disrupted the livelihoods that were previously adapted to local ecosystems. The newly imposed intensive farming required a large amount of water. As a result, the natural ecosystem around lower reaches of Tarim river had grown more vulnerable. And irresponsible agricultural practices would also contribute to salinization of cultivated lands. The main explanation for the geographical change in the development of the lower Tarim area during the late Qing Dynasty was the land use strategy dictated by Xinjiang's unique geopolitical conditions. This case study demonstrates the need of considering the structural function of the natural environment and social structure in order to ascertain the influence of human activities on the arid regions.

Acknowledgments

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Appendix: Cross-check List of Historical Documents with Original Titles in Chinese

Factual Records of Emperor Guangxu in Qing Dynasty. 德宗景皇帝实录

Memorials to Emperor Guangxu Collected in Palace Archives. 宫中档光绪朝奏折

Historical Documents about Xinjiang in the late Qing Dynasty that Collected in Gansu Archive. 甘肃省档案馆藏清末新疆档案

Military Archives and Palace Files. 军机及宫中档

Tao Mo's Memorials to the Throne. 陶模新疆奏稿

Textual Research and Annotation of Tao Mo's Posthumous Memorials to the Throne. 陶模奏议遗稿补证

Journey to the West in the Year of Xinmao. 辛卯侍行记

Travel Notes of Xinjiang. (Xie Xiaozhong)新疆游记

The Management and Governance over the West-frontiers. 西陲要略

Lop-nor, in Scientific Results of a Journey in Central Asia 1899-1902, vol. 2(Sven Hedin)