

Investment in China's Belt and Road Project in Kazakhstan and its Risk Assessment

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Abstract.

Oases agriculture is one of the most vulnerable primary industry to climate change and human activities. Central Asia is one of the arid regions highly vulnerable to water scarcity. Located in Central Asia, Kazakhstan is characterized as a semi-arid region which includes dry steppe land in the south. Agriculture carried out in this area is typically oasis farmland with water taken from local rivers used for irrigation. During the former Soviet Union, irrigation projects were widely carried out to expand agricultural land, and large-scale irrigation projects were created in several areas. Therefore, many irrigated farmlands were abandoned due to the collapse of the former Soviet Union. However, China's investment in Kazakhstan agriculture is cultivating once abandoned agricultural land and developing new oases agricultural land. China's "One Belt, One Road" project has led to urbanization along railroads and highways, reducing the area of agricultural land. Meanwhile, China is also developing new agricultural land in this region. These two are acts that contradict each other. Our study area of Zharkent (Panfilov) Region is located on the border between Kazakhstan and China, is a semi-arid area and has been cultivating corn by irrigation from the Ili River and the Usek River for many years. Therefore, there are many abandoned agricultural lands because of salinization. However, this area is the start point of the railway and highway of China's Belt and Road Initiative (BRI) project to Europe, and corn production and exports are expected to flourish. Therefore, we focus on the vulnerability of oasis agriculture and extract changes in agricultural land for about 30 years from 1989 to the present using Landsat series and Sentinel series and visualized them using RGB color combined techniques. The results show that agricultural land is disappeared or desertified at the Ili river basin and at the foot of the Zhongar-Alatau Mountain and that there are several years of fallow even in areas where agriculture is active. Using the Zharkent region in the irrigated alluvial fan of Zhongar-Alatau Mountain of eastern Kazakhstan as an example, we classify the farm field changing using Landsat TM and Sentinel-2 satellite imagery and identify of vulnerability to the disappearance of oases farmland. China's investment in agriculture could lead to the depletion of water resources in the region.

Keywords: Oases farmland changes, China's OBOR (BRI), Kazakhstan, Remote sensing, Risk assessment, water resources.

1. Introduction

This study forces to an evaluation of the appearance and disappearance of oasis farmland. An oasis is an area made fertile by a source of fresh water in an otherwise dry and arid region. The Usek River Oases are irrigated by natural snow meltwater from the Zhongar-Altai Mountains. Irrigated corn farmland is widespread in between Usek River and Ili River oasis. However, the fluctuations in oasis agriculture are so severe that farmland is being repeatedly discarded and re-cultivation, because soil salt accumulation or urbanization ([Thevs et al., 2017a](#); [Thevs et al., 2017b](#); [Pueppke et al., 2018](#)).

Downward infiltration of soil water is unlikely to occur in dry areas where precipitation exceeds evaporation. Also, when the soil is moistened, the transfer of soluble salts occurs. Evapotranspiration of the ground surface causes salts to move to the surface layer and remain in the soil layer, resulting in salt accumulation ([Matsumoto et al., 2012](#)). Large-scale irrigation on farmland with inadequate drainage facilities provides a constant supply of water within or on the soil surface ([Anna and Tatiana, 2007](#)). Also, in the same area, the degree of progress varies depending on the soil quality. Soil containing a large number of fine particles such as clay is said to have a water holding capacity, so salts are likely to accumulate. On the other hand, sandy soil is said to be less prone to salting due to its high water permeability ([Yoda et al., 2012](#)). Removal of soluble salts from salt soil is possible by leaching ([Nurtazin et al., 2019](#)).

In 2013, China proposed two economic initiatives that would form the basis of the "One Belt One Road (OBOR)". Stations and ports have been built throughout Asia and Africa, and infrastructure such as railways, highways, and gas / crude oil pipe-lines has been developed. It is unpredictable to what extent the changes in the natural and social environments due to rapid large-scale development will occur. In addition, OBOR is considered to be not only economically connected, but also politically and militarily. For that reason, it is attracting attention from various fields ([Teo et al., 2019](#); [Russell, 2019](#); [Foggin, 2018](#)), especially within the food-water-energy nexus. Central Asia, including Kazakhstan, has many arid and semi-arid areas, making it difficult to secure water and food. It has been pointed out that China may seek to take control of the region through food and water control funded for development ([Sternberg et al., 2017](#); [Sternberg et al., 2020](#)).

Vulnerable oasis agriculture is greatly affected not only by the natural environment but also by the social environment. In recent years, the changes in the environment that have occurred are not limited to those caused by climate change, but also include changes in the natural environment due to OBOR, changes in supply and demand due to the development of transportation networks, and changes in population and agricultural land area. China's "One Belt, One Road" project has led to urbanization along railroads and highways, reducing the area of agricultural land. Meanwhile, China is also developing new agricultural land in this region. These two are acts that contradict each other. In this study, satellite analysis, field surveys, and interviews are used to clarify the vulnerability of oasis agriculture and the rapid change caused by OBOR. The purpose was to predict what kind of impact the addition of environmental changes would have in the future ([Kazuki et al., 2021](#)).

2. Methods

2.1 The study area and field survey

The study area was the Zharkent region in the Panfilov district of the Republic of Kazakhstan. The Panfilov District is an administrative district located in the south-eastern part of Kazakhstan with an area of 1,058,252 ha and a population of about 130,000. The region shares a border with China and is the starting point of OBOR leading to Europe. The first field survey was conducted in September 2019, including irrigation water survey, river water quality survey, soil survey and agricultural land survey. A second field survey was conducted in September 2020 and November 2020. An interview survey of local farmers regarding the use of agricultural land and changes due to OBOR was also conducted. Twenty-five responses were received in the first round and 26 responses in the second round (see Fig. 1).

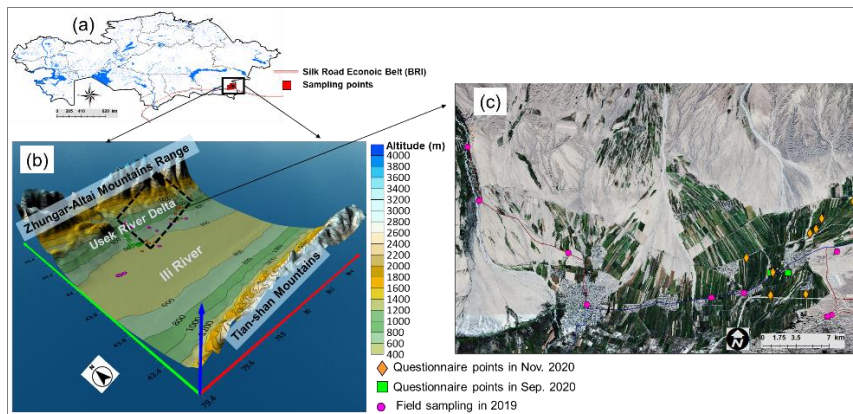


Fig. 1 The study area (where, (a) is Kazakhstan border; (b) is the study area located in Ukek River delta in the southeastern part of Kazakhstan; (c) is Sentinel 2 satellite image R-G-B=B4:B3:B2 10m resolution of study site)

2.2 Satellite image analysis

Land use change was determined using satellite data for 30 years from 1989 to 2019. The data used are as follows: Using Landsat TM (from USGS): August 22, 1989; August 11 and October 30, 1994; September 6 and October 31, 2006; August 10, 2008; September 11 and October 22, 2011. And used Landsat ETM+ (from USGS): August 26 and October 30, 1999. Landsat 8 (from USGS): September 6 and November 9, 2015; August 22 and October 19, 2019. Also used Dove (from Planet) September 13, 2020.

Calculation of time series NDVI (Normalized Difference Vegetation Index) based on time series Landsat and Sentinel 2 satellite data.

3. Results

3.1 Agricultural land extracted from time series Landsat satellite

Agricultural land extracted using NDVI from time series Landsat satellite analysis is as follows. The area of agricultural land was largest in 1989 (on Soviet Union era), with nearly 34% of agricultural land abandoned by 1994 shows in Fig. 2. After the collapse of the Soviet Union, the area of agricultural land has continued to decrease, and when the Belt and Road Initiative (BRI) in China begins, the area of agricultural land is expanding again. In addition, there was a difference between the change in the agricultural land area within Panfilov district and the change in the extracted analysis range. According to local government statistics, the area of agricultural land, which had been decreasing since 1990, increased sharply from 2001 and peaked in 2005. However, such a tendency was not seen in the range extracted during this time, but rather it was on a decreasing tendency. From this perspective, it is expected that a large amount of agricultural land was abandoned outside this area in the Panfilov district.

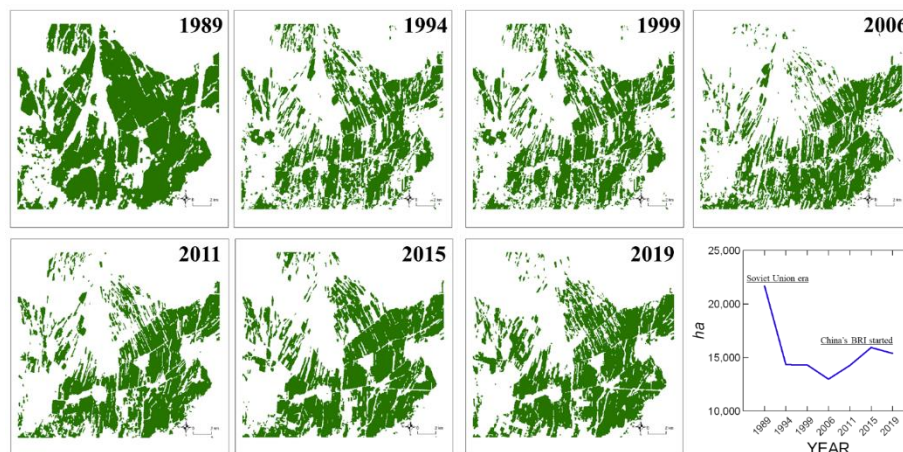


Fig. 2 Extracted and aggregation of agriculture farm land area based on Landsat time series data (where, left panel is shows satellite imagery of agriculture areas and the lower right panel shows 2D map of agriculture areas change)

3.2 Change detection of Oases farmland using RGB color combination method

Using RGB image color composite method for the detection of land use and land cover changes (Suriga et al., 2012; Pujiono et al., 2013). Fig. 3, below, shows visual changes in agriculture land from 1989, during the former Soviet era, 2006, when the area of the entire district increased, and in 2019; the colors were assigned to red (R), green (G), and blue (B), respectively. It can be seen that agricultural land in Khorgas, characterized in white, indicates that the land was primarily used as agricultural land in all three study years; in southern Zharkent and Akaral, some land is also being used continuously. Most of the area in the center of the image is farm-land that has been used again although at one time had stopped. On the other hand, in the northern part of Zharkent on the left side of the center of the image, land that has not been used since the collapse of the former Soviet Union stands out (blue color).

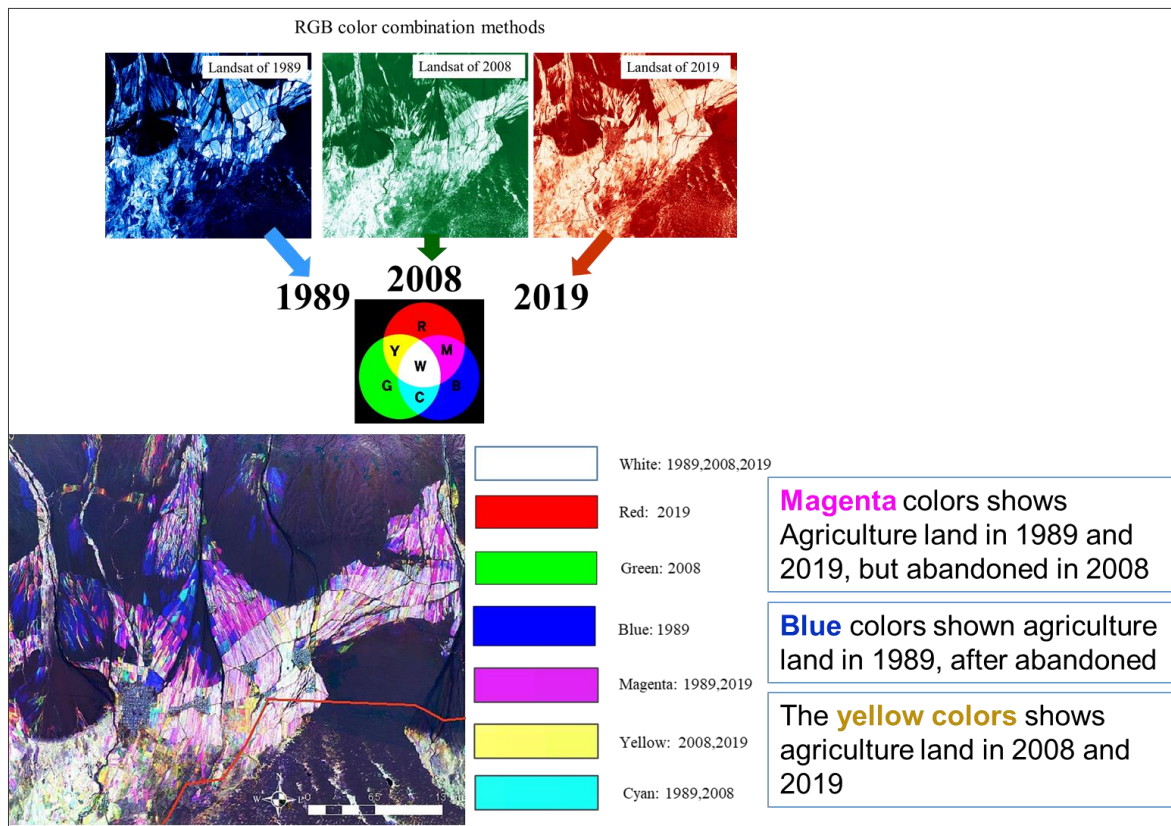


Fig. 3 Change detection of Oases farmland using RGB color combination method (where, magenta color is noticeable in the northern area. It shows that the farmland was once abandoned around 2008a)

3.3 China's BRI influence: problems and anxiety

Troy et al., (Troy et al., 2020) within a 10-km infrastructure buffer zone, various degrees of land cover change are observed along Kazakhstan's BRI transportation corridors (Table 1). We note that comparing 2008 to 2018, urban area had a 31% increase and irrigated agriculture was 1% increased along potential BRI roads and rails. However, water areas decreased in Kazakhstan 5%.

Table 1. Change in irrigated and rainfed agriculture, water resources and urbanization in Kazakhstan, 2008–2018 (Troy et al., 2020)

Total National Area (ha)				10 km Buffer (ha)					
	2008 (ha)	2018 (ha)	% Change	2008 (ha)	2008 (ha)	2018 (ha)	2018 (ha)	% Change	% Change
				Roads	Rail	Roads	Rail	Roads	Rail
Irrigated Agriculture	99,770	101,106	1%	28,473	22,434	28,380	22,470	0%	0%
Rain Fed Agriculture	431,520	430,529	0%	55,634	44,482	55,231	44,009	−1%	−1%
Water	95,921	90,864	−5%	7588	6501	7302	6465	−4%	−1%
Urban	4669	6110	31%	2910	2506	3829	3342	32%	33%

China's investment in agriculture could lead to the depletion of water resources in the region. Because, China's investment in Kazakhstan agriculture is cultivating once abandoned agricultural land and developing new oases agricultural land. Other hands, China's "One Belt, One Road" project has led to urbanization along railroads and highways, reducing the area of agricultural land. Meanwhile, China is also developing new agricultural land in this region. These two are acts that contradict each other.

We interviewed local farmers about the risks of OBOR investment. The first interview survey provided detailed answers regarding BRI. Positive opinions were that the opening of roads increased opportunities for communication with other regions and expanded the range of crop transportation. In addition, the opening of the railway has the advantages of expanding transportation opportunities and increasing the profits of the agricultural organization, such as simplifying the introduction of fertilizer. On the other hand, farmers in areas far from the major transportation lines did not notice any change. Farmers who have farmland around the highway reported negative effects such as flood damage due to poor drainage function and irrigation and groundwater division due to the division of farmland.

In the second interview survey, the answers focused mainly on agricultural land use. None of the farmers felt that the yield was reduced or the field was deteriorated due to salinization. Many farmers cited water and funding shortages as anxiety factors. Due to the lack of water resources, the number of irrigations is originally desirable to be three, but it can only be done twice. In addition, there is a waiting list for irrigation in early spring in order to share scarce resources among multiple farmers. The more time between sowing and irrigation, the lower the yield for the year. In addition, compost is mainly used in this area to ensure continuous use of agricultural land and yield. However, compost requires a large amount of fertilizer and is expensive. There were many farmers who wanted to use compost but could not due to a lack of funds (see [Table 2](#)).

Table 2. Problems and anxiety from questionnaire samples

Contents of problems and anxieties	Number of responses
Water shortage	6
Land degradation	2
Disadvantages of OBOR highways	6
Lack of funds	7

4. Discussion

Agriculture in Eastern Kazakhstan depends on climate change and soil conditions. Alluvial fan soil has a low capacity to retain water and nutrients. Most of the abandoned agricultural land is distributed in the alluvial fan soil area. Feed crops such as alfalfa were produced here. In northern Zharkent, there was a clear separation between land that was continuously used as agricultural land and land that was not. There may be some unsuitable conditions for farmland in the north. As an example, if the slope of the farmland is large, nutrients will flow off the farm and it will not be suitable for agriculture. One reason why there are many abandoned cultivated

farms in the northern part of Zharkent may be because of the mountain range to the north and the large sloping terrain. If that is the case, it can be used again as agricultural land by scraping the ground surface and flattening it. From our result, it can be said that the abandoned agricultural land has a slope of less than 1% and is rather flat. Another possible reason is the difference in soil quality. Mountain ranges extend to the north of the Panfilov region, and the area around Zharkent is an alluvial fan. The soil quality in this area was shifting sand. This type of soil is formed by the influx of large amounts of sand from floods that occur with the melting of snow in the mountains. The upper part is coarse and the soil is renewed quickly. It is difficult to run long-term agriculture because of the young soil that is not conducive to growing. This is thought to be the reason why continuous agricultural land use is not possible in the northern region of Zharkent ([Kazuki et al., 2021](#)).

Among the farmers who visited the site, there was a large difference in yield within the field. Many farmers wanted specialized knowledge in order to obtain as much yield as possible in a sustainable manner. We believe it is important for farmers to have an understanding of the factors influencing the quality of their farmland and identify this as an important area for improvement.

Contextual research identifies how Chinese policies may encourage agribusiness investment for food exports as possible disruptions to national and regional food supply. However, to date Central Asia provides <1% of Chinese agricultural imports. Evaluating infrastructure change is essential to understand BRI impacts on environments and societies, with the food-water nexus a particular concern in Central Asia including Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. Limited Chinese imports of Central Asian agriculture suggests the region's food security will not be significantly altered by the Belt and Road Initiative ([Sternberg et al., 2020](#)). Locals want to invest in China OBOR, but depletion of water resources could put the region in poverty again in the future.

5. Conclusions

It was found that agriculture in the area around Zharkent has been more influenced by the social environment than by the natural environment. OBOR has expanded its economic sphere more than ever before and is affecting the areas along the railway lines in various ways. Agricultural land abuse due to increased demand carries a high risk of making continuous use impossible in fragile oasis agriculture. In addition, the soil quality of fluid dunes, where the soil is renewed in a short period of time, hinders the prosperity of agriculture in the northern region located above the alluvial fan. Not only is there a problem with soil quality, but water resources are also limited, so the crops that can be cultivated are also limited. Understanding the conditions of farmland is essential to meet the ever-increasing demand in these circumstances. In addition, "lack of funds" and "water shortage" are very serious factors limiting agricultural production in this area. This could give China the opportunity to take control of the region through funding associated with OBOR. However, the lack of cooperation of local farmers and experts may prevent such a situation.

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