

Title: Thaddeus Overley World Food Prize Project

Kazakhstan faces a multitude of challenges in securing a sustainable agricultural future, encompassing climate change impacts, environmental degradation, and the ongoing Aral Sea crisis. This paper aims to explore the current state of agriculture in Kazakhstan, dissect the ramifications of climate change on the sector, analyze strategies for sustainable agricultural development, examine the multifaceted Aral Sea crisis, and ease the implications of population demographics on agricultural sustainability. Using various sources, including scientific research, governmental reports, organizations and expert analyses, this paper provides an in-depth examination of the interconnected factors shaping Kazakhstan's agricultural environment.

Following the dissolution of the USSR in December 1991, Central Asia has been divided into five different countries- Kazakhstan being the largest of them. The Kazakh people have ascended from an amalgamation of nomadic Turkic people as well as other migratory groups in the Central Asian Steppes. Due to this amalgamation, Kazakh people have an extraordinarily unique culture, ascending from countless other cultures. The majority of these people follow the Sunni Muslim faith, with minorities following Christianity and other religions. With diversity comes numerous distinctions between the rural and the urban Kazakh peoples. In 2019 the amount of urban people in Kazakhstan exceeded the rural population, at 58%. This is a substantial demographic change in Kazakhstan. The main differences between urban and rural Kazakhs are the types of jobs, the type of food they eat as well as the differences in infrastructure, education, and wealth. While urban Kazakhs might work in the service sector, more rural Kazakhs would prefer to work in the agricultural sector, albeit in farming or nomadic herding.

The dietary differences are substantial, with city dwellers having traditional food mixed with newer Western or Eastern cuisine. Traditional Kazakh food consists of horse meat, mutton, eastern rice, vegetables, and more Turkic foods such as Kebabs. They prefer this type of food as it would keep for a longer period without going bad. Perfect for the traditional nomadic lifestyle. But with the demographics of Kazakhstan changing, so does its diet. With the previous years of isolation that was enforced under the former communist government being lifted, a new generation of eager Kazakhs who have access to the internet (90.9% of the population has internet access) and outside political influence, a prime example of this cultural diffusion is the twenty-four McDonalds located in Kazakhstan.

Even with the influx of imported cuisine and the demographic changes in Kazakhstan, the agricultural sector in Kazakhstan still serves as a cornerstone of the nation's economy, employment, and food security. However, it grapples with an array of challenges, including inefficient farming practices, inadequate infrastructure, limited technological access, climate change-induced environmental stressors, and the devastating consequences of the Aral Sea crisis (the sea is shrinking). Moreover, the dynamics of population demographics, such as urbanization, migration patterns, and aging populations, exert significant influence on the agricultural sector's

sustainability. Thus, understanding the interlap among these factors is imperative for formulating effective strategies to ensure a resilient and sustainable agricultural future in Kazakhstan.

Population demographics exert an intense influence on the sustainability and viability of Kazakhstan's agricultural sector, encapsulating urbanization trends, migration dynamics, and demographic shifts. Rural depopulation and labor scarcity pose formidable challenges to agricultural production while burgeoning urbanization rates and evolving consumer preferences shape market demand and consumption patterns. This is creating an economic model where Kazakhstan has been importing larger quantities of agricultural products from other countries. These importations account for around 70-80% of Kazakhstan's total agricultural input.

According to the CIA World Factbook (2020), the nation's population predominantly resides in urban centers, with urbanization rates steadily ascending. Concurrently, rural-to-urban migration, particularly among younger demographics, engenders labor shortages in the agricultural sector, thereby impeding farm productivity and rural livelihoods. This is one of the reasons why the importation of agricultural products has been increasing.

The United Nations Development Programme (UNDP) (2019) highlights the imperative of formulating policies tailored to address the demographic imperatives impinging upon agricultural sustainability. Investing in rural infrastructure, providing requisite training and support to smallholder farmers, and nurture agribusiness development emerge as pivotal strategies to attract youth to agriculture and invigorate rural communities.

To support family-owned farming businesses in rural communities, one effective strategy could be using targeted tax incentives. Unlike large corporations, these small, family-run farms often struggle to stay afloat. A practical solution would be to introduce a progressive tax bracket

specifically for these businesses. This system would allow taxes to increase gradually as a farm's income rises, rather than facing a sudden, steep tax hike once a certain income threshold is surpassed. Such an approach would encourage growth and development without penalizing farms that move beyond a particular income level. However, implementing this new tax framework would also require addressing broader issues within the agricultural sector to provide comprehensive support for these businesses.

Kazakhstan's agricultural landscape is characterized by its vast expanse of arable land and its vital contribution to the nation's economy and livelihoods. However, despite its agricultural potential, the sector faces persistent challenges stemming from outdated farming techniques, inadequate infrastructure, and limited access to modern technologies. As a result, productivity and competitiveness are hindered, thereby impeding the sector's ability to fully capitalize on its agricultural resources (FAO, 2020).

According to the World Bank (2019), Kazakhstan's agricultural sector has demonstrated resilience in the face of adversities, owing to advancements in technology and management practices. Nonetheless, the sector remains vulnerable to the impacts of climate change, with erratic weather patterns, water scarcity, and soil degradation posing significant risks to agricultural sustainability.

Climate change poses a formidable threat to Kazakhstan's agricultural sector, manifesting through escalating temperatures, erratic precipitation patterns, and intensified frequency of extreme weather events. These climatic shifts exacerbate water stress, soil erosion, and crop failures, thereby undermining agricultural productivity and food security. Scientific studies

underscore the concerning trend of rising temperatures, with Kazakhstan experiencing an average temperature increase of approximately 1.5°C over the past century (IPCC, 2014), with projections indicating further escalation in the coming decades.

Kassenova (2018) emphasizes the vulnerability of Kazakhstan's agriculture to climate change, emphasizing the urgent need for adaptive strategies to mitigate risks and safeguard food security. Sustainable land management practices, water conservation measures, and crop diversification emerge as critical approaches to bolster agricultural resilience amidst climate variability and extreme weather events.

One adaptive solution for improving land use involves converting unused farmland back to its original state with native and non-native plants suited to the harsh central Asian climate. For instance, plants like the Perennial-jointed Glasswort, Tamarisk, saltbush, are halophytes, which means they thrive in salty conditions and help reduce soil salinity. By reintroducing these plants, we can aid in the recovery of natural habitats in areas where soil degradation has prevented other vegetation from growing.

Another important step is creating earth swales, which are shallow, gently sloping channels designed to capture and retain water. By building these swales, water accumulates between the slopes, allowing the local community to plant trees on top. Trees such as the Siberian elm or White poplar, known for their durability and ability to reduce soil erosion, can help with water storage and stabilize the soil. Like the halophyte plants, these trees also help lower soil salinity. Once the salinity levels are reduced, it becomes possible to plant other crops, such as apple or apricot trees. This shift from cotton farming to growing fruit trees offers a dual benefit: improving soil conditions and providing crops that can be sold or consumed locally. This

approach encourages local farmers to adopt sustainable practices and reduce dependence on imported food. A similar method has proven successful in Jordan's Dead Sea region through the Greening the Desert Project, which focuses on permaculture and environmental restoration. (GtDP).

The government of Kazakhstan is already funding this on a small scale. However, with the given circumstances there is a need for further funding and more volunteer work from the international community to help stop a climate collapse in central Asia. This unused farmland comes from the extreme water diversions of the Aral Sea, where crop managers watered soil that could not retain the moisture levels required for cotton farms. A reason for the soil lacking water retention was the destruction of the natural Steppes (swales) and native grass species such as Stipa. This left the soil dry and exacerbated the trend of desertification due to climate change.

Another part of this solution is education on climate change and ecology in rural Kazakhstan. Rural Kazakhs aren't able to receive the same level of education that someone in a city would receive. This has been an ongoing issue, as Kazakhstan is the world's ninth-largest country, by land mass. That's a lot of rural people (42%). By educating the rural population on how to convert poor land to be arable and encourage environmentally safe farming practices such as crop rotation, pollination, reducing deep soil tillage, as well as planting salt and chemical-resistant crops. This will help reduce climate degradation everywhere in Kazakhstan. A single Kazakh could have the potential to convert unused farmland into local plant life or small-scale farms.

Zhandos Moldagulov, a farmer in the city of Aralsk, in the Kyzylorda region, used these exact practices to make his 101 hectares of farmland arable again. He improved soil fertility, using crop rotation and intercropping techniques, and breeding the best-adapted varieties of bees, and salt-resistant White Poplar trees. UNDP Hold back the shifting sands (2022). This example shows how education, to even a single dedicated person, can be the difference between a desert or and a luscious garden.

To boost education in rural areas, agencies such as the Ministry of Agriculture and the Ministry of Education in Kazakhstan could take several steps. They could distribute books on ecology and farming, create pamphlets with simple instructions, and involve volunteers or government officials, like teachers, to provide direct education to families. Additionally, they could utilize the internet to share information, given that 90.9% of Kazakhs have online access.

The Aral Sea crisis stands as a poignant proof to the devastating consequences of unsustainable water management practices and human-induced environmental degradation. Historically one of the world's largest inland bodies of water, the Aral Sea has shrunk dramatically due to excessive water diversion for irrigation, primarily driven by cotton cultivation. This ecological catastrophe has precipitated the desiccation of the sea, ecological degradation, and deleterious health effects on local populations.

The World Bank (2021) emphasizes the urgency of addressing the Aral Sea crisis through concerted efforts, surrounding water management reforms, ecosystem restoration, and international collaboration. Investing in sustainable water utilization practices, promoting alternative livelihoods, and mobilizing political will are pivotal steps towards mitigating the socio-economic and environmental repercussions of the Aral Sea disaster.

Effectuating tangible solutions to salvage the Aral Sea necessitates a many sided approach involving water management, ecosystem restoration, and socio-economic development initiatives. Raising awareness about the environmental ramifications of the Aral Sea crisis and galvanizing political resolve are indispensable for strengthening regional cooperation and implementing sustainable solutions. These solutions need to be implemented as soon as possible to maximize the effect and minimize the damage to the region. As the Aral Sea is an Endorheic lake. With the Aral Sea being endorheic this means the lake has no outlet or inlet, making the lake exceptionally vulnerable to environmental pollution and overuse. This is because the lake is only fed through evaporation and rainfall, meaning pollutants that enter the lake often stay in the lake.

By replenishing and protecting the wetlands that surround the sea this will help filter and clean the water and pollutants out of the sea, as marshes and swamps have been used to filter Nitrogen out of water before. (Nitrogen is a common pollutant of fertilizer rich farms.) This process is known as Denitrification and is commonly used to treat water that has been used with large amounts of nitrogen-rich fertilizers. Denitrification is safe and sustainable environmentally and is supported by The Wetlands Initiative. Which is a non-profit aimed to protect wetlands and help supply the environment with clean water.

The World Bank (2021) stresses the imperative of investing in water-saving technologies, promoting efficient irrigation practices, and rehabilitating wetlands to replenish water reservoirs and reinvigorate ecosystems. Moreover, increasing community engagement in conservation (Such as wetland replenishing) efforts and encouraging alternative income avenues can mitigate

reliance on unsustainable agricultural practices, thereby contributing to the broader goal of revitalizing the Aral Sea region.

In summation, navigating the complex web of challenges confronting Kazakhstan's agricultural sector demands a significant understanding of the interplay among climate change impacts, environmental degradation, the Aral Sea crisis, and population demographics. By espousing adaptive strategies, stimulating ecosystem restoration, and contributing to inclusive development, Kazakhstan can bolster agricultural resilience and safeguard its natural resources for posterity.

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