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IDENTIFYING THE POTENTIAL LINKS BETWEEN INFRASTRUCTURE DEVELOPMENT AND FOOD SECURITY: EVIDENCE FROM LANDLOCKED CENTRAL ASIA

ВЫЯВЛЕНИЕ ПОТЕНЦИАЛЬНЫХ СВЯЗЕЙ МЕЖДУ РАЗВИТИЕМ ИНФРАСТРУКТУРЫ И ПРОДОВОЛЬСТВЕННОЙ БЕЗОПАСНОСТЬЮ: ДАННЫЕ ИЗ ЦЕНТРАЛЬНОЙ АЗИИ

Anna-Maria E. Chkoniya, PhD student Department of Applied Economics HSE University, Moscow, Russia (Russia, 101000, Moscow, str. Myasnitskaya, 20), e-mail: achkoniya@hse.ru

Чкония Анна-Мария Евгеньевна, аспирант Департамента прикладной экономики НИУ ВШЭ, Москва Россия (Россия, 101000, г. Москва, ул. Мясницкая, д. 20), e-mail: achkoniya@hse.ru

Abstract. While Central Asia has boasted one of the lowest subregional average hunger rates on the Asian continent for almost a decade, food security as a wider and more comprehensive concept remains a high priority for development. This study focuses on four Central Asian countries, namely Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan. It looks at the current state of food security in the region, as well as the key infrastructure-related measures

identified in current strategic documents to improve food security. This paper also analyses the role of infrastructure in inland freight, the relevance of infrastructure for the Central Asian food systems and its effect on food production and distribution enterprises.

Аннотация. В течение почти десятилетия в Центральной Азии наблюдается один из самых низких средних показателей голода на азиатском континенте, однако продовольственная безопасность как более широкая и всеобъемлющая концепция остается высоким приоритетом для развития в странах этого региона. В данном исследовании основное внимание уделяется четырем странам Центральной Азии, а именно Казахстану, Кыргызстану, Таджикистану и Узбекистану. В нем рассматривается текущее состояние продовольственной безопасности в регионе, а также ключевые меры, связанные с развитием инфраструктуры, определенные в текущих стратегических документах в целях повышения продовольственной безопасности. В данной статье анализируется роль инфраструктуры грузовых перевозках внутри страны, а также значимость инфраструктуры для продовольственных систем Центральной Азии и ее влияние на предприятия по производству и распределению продуктов питания.

Keywords: food security, infrastructure development, road networks, Central Asia.

Ключевые слова: продовольственная безопасность, развитие инфраструктуры, дорожные сети, Центральная Азия.

INTRODUCTION AND MOTIVATION

Central Asia has boasted one of the lowest subregional average hunger rates on the Asian continent for almost a decade [1]. Nevertheless, food security remains a high priority on the development agenda in Central Asia, as there are significant disparities in the economic accessibility of a healthy diet across the countries and their regions. For many in Central Asia, the lack of a nutritious diet affects the overall state of food security. This being said all of the Central Asian countries have identified the need to improve food security at an institutional level in their national strategies for development [2]. Efforts towards this

goal can also be seen at both a country level in terms of national initiatives aimed at improving agricultural productivity, irrigation systems and logistic distribution centres, as well as at an international level through the initiatives and projects of international organisations in Central Asia.

Despite the active global efforts to increase food security, the COVID-19 pandemic has hindered many efforts and pushed many developing countries even further back in their quest for improving food security [3]. The countries of Central Asia are no exception, with this regress taking place mainly for the accessibility of foodstuffs. Although the countries vary in terms of food security, the general trend has shown a decrease in the prevalence of undernourishment, on one hand, and an increase in obesity levels on the other. In addition, certain countries continue to struggle with improving the utilisation of diets because of the growing inaccessibility of a healthy diet, growing food prices and limited availability due to geographic conditions, which leads to growing deficiencies of important micronutrients and vitamins. Moreover, the rise in food prices seen in the region over the past years is expected to preservere in the upcoming years [4]. The combination of these trends can be considered the symptom of ineffective national food distribution systems and high vulnerability to external conditions.

This underlines the importance of creating better and more resilient food systems that will be able to stand the test of global and national shocks, as well as harsh weather conditions, that might otherwise impact the various dimensions of food security through uneven distribution. A means to building such food systems is the comprehensive development of infrastructure networks that hold the potential to change the distribution channels of foodstuffs within a country. While the development and construction of infrastructure itself does not directly solve such issues, it has an instrumental and conditional role to play in catalysing development objectives by creating the necessary conditions [5].

According to the United Nations, all five of the Central Asian countries (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) are classified as landlocked

developing countries (LLDCs), the economies of which are heavily reliant on low-value primary products with high sensitivity to transportation costs [6].

The aim of this article is to analyse the potential link between infrastructure development in Central Asian countries and food security, with a focus on infrastructure and transport. This article defines infrastructure as hard infrastructure, specifically roads, railroads, cold chain storage centres and electricity power lines, that can facilitate the distribution and storage of foodstuffs within a country. It will provide an overview of the current state of food security in Central Asia, highlighting the progress that has been made in recent years, as well as the remaining challenges. The research provides an overview of the role of transport in food systems in Central Asia. The article will also examine microdata from the World Bank Enterprise Survey conducted in the region to identify how transport affects food production and distribution [7].

THE STATE OF FOOD SECURITY IN CENTRAL ASIA

The general regional trend seen in Central Asia is an overall decline in the prevalence of undernourishment over the past two decades. As of 2021, all of the countries have managed to contain the prevalence of undernourishment within the 10% threshold. The regional leaders with the lowest prevalence levels are Kazakhstan and Uzbekistan with an indicator of less than 2,5% over the span of the past 10 years. The most drastic change has been seen in Tajikistan, where this indicator has decreased from almost half of the population being undernourished in the early 2000s to 10% as of 2020-2022.

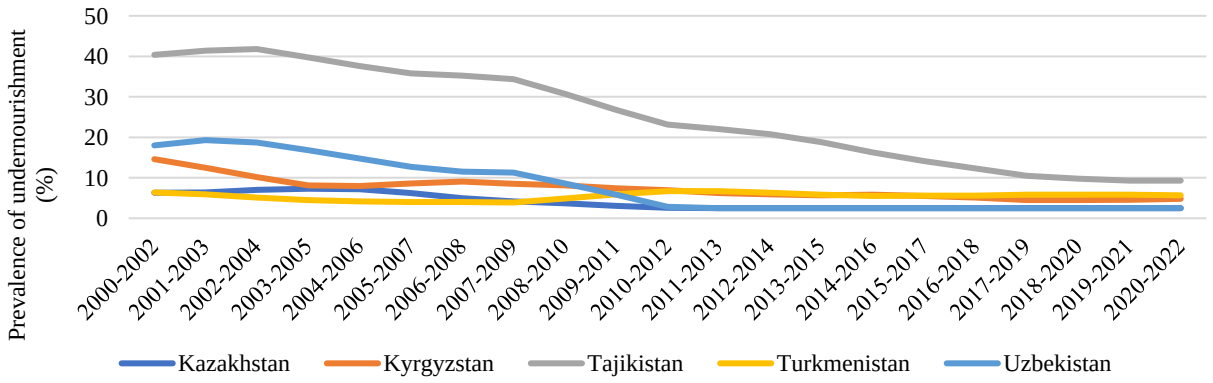

Figure 1. **Prevalence of undernourishment (%, 3-year average)**

Source: FAOSTAT (2023)

As per the concept of food security, formalised by the United Nations in the Report of the World Food Conference in 1974, there are four main dimensions of food security: availability, accessibility, utilisation and stability. According to the data of The Economist Intelligence Unit on the Global Food Security Index (GFSI) the Central Asian countries show very different levels of food security. The overall frontrunner is Kazakhstan, which leads in all the dimensions, with particularly high scores for affordability and food quality and safety. Food quality and security in Central Asian countries have traditionally been a challenge due to lower quality standards and the predominant role of small farmers, for whom quality standards are harder to adhere to [8].

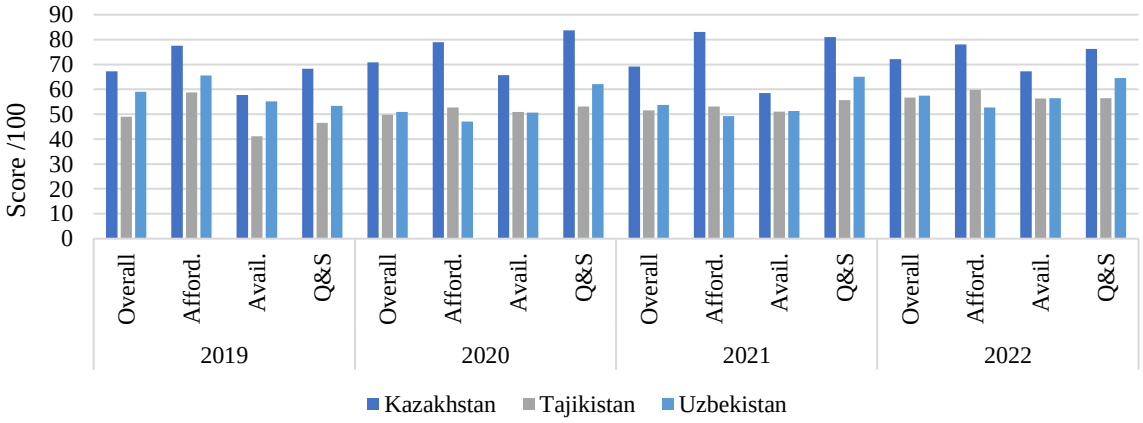

Figure 2. **The Global Food Security Index (GFSI) for Central Asian countries***

* Not available for Kyrgyzstan and Turkmenistan

Source: The Economist Intelligence Unit (2023)

The trend for obesity has been steadily growing over the past years in Central Asia (see Figure 3), which can be attributed to an increase in welfare combined with limited availability and access to a nutritious diet [9; 10].

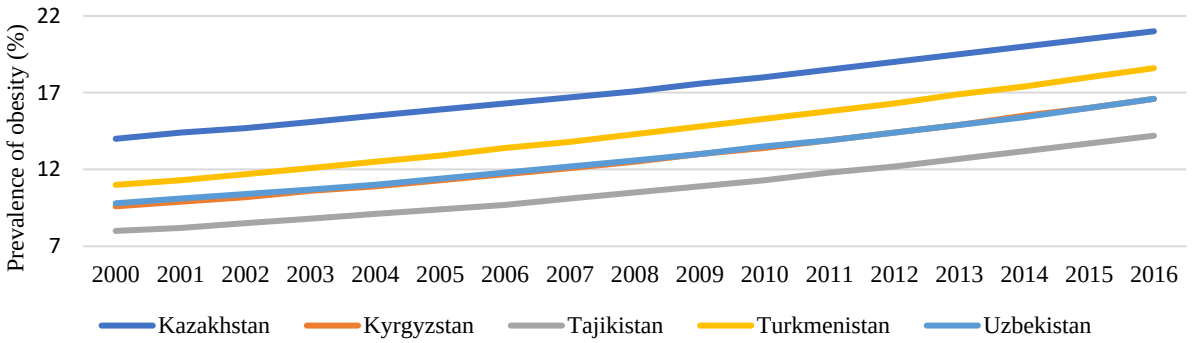

Figure 3. **Prevalence of obesity in the adult population (18 years and older) 2000-2016, %**

Source: FAOSTAT (2023)

In Tajikistan, for example, wheat is the key staple food and provides up to 70% of the caloric intake for parts of the population [11]. The danger in this is that such high consumption of "empty calorie food" with low nutritional value will lead to poor utilisation of consumed foodstuffs and a deficit of important vitamins and microelements. This can be seen in Tajikistan, where almost 30% of women and young children suffer from anaemia, according to WFP data in 2018.

Considering the different and even seemingly contradictory trends in undernutrition, obesity and micronutrient deficiencies, the Central Asian region, as well as the greater Eurasian region, is faced with a very diverse spectrum of food and nutrition challenges.

NATIONAL STRATEGIC APPROACHES TO USING INFRASTRUCTURE TO IMPROVE FOOD SECURITY

At large Central Asian countries similarly define food security in their respective official documents [12]. The definitions are based mainly on two dimensions of food security: availability and affordability of foodstuffs, while emphasizing the importance of national food independence. In general, the Central Asian countries are driving for a high degree of self-sufficiency (80–95%) for basic products of their agro-industrial complexes, the mass production of which is enabled in those countries by their agro-climatic conditions [13]. More production and self-sufficiency do not necessarily imply that there is equal distribution of foodstuffs at a national level. This means that the utilisation dimension may

remain relatively low in the region as well as the affordability of certain food groups. Lack of access to healthy, diversified, and affordable produce is the leading cause of food insecurity worldwide in both urban and rural areas [14].

The current official strategic documents and development plans were analysed to identify the measures Central Asian countries are currently implementing at the crossroads of food security and infrastructure development. The midterm development strategies of the Central Asian countries also underline food security as an important priority; however, analysis of these documents shows that hard infrastructure development is not regarded as an instrument to increase levels of food security in the country. Instead, in most of these countries, the development of infrastructure for storage, logistics and processing facilities is aimed at increasing their agricultural exports and, to a lesser extent, better national distribution patterns. The table below gives a summary of how infrastructure development is linked to the agricultural sector in current national strategic documents.

Table 1. **Types of Infrastructure Determined as Instruments to Improve Food Security in Current National Strategic Documents in Central Asian Countries**

	Roads and railroads	Irrigation and water management	Greenhouses	Cold chain, logistics and distribution	Agriculture laboratories and research
Kazakhstan	-	-	-	●	●
Kyrgyzstan	-	●	-	●	-
Tajikistan	-	●	●	●	●
Turkmenistan	-	-	-	-	-
Uzbekistan	-	-	-	●	-

Source: Compiled by author using FAOLEX Database (2023)

Kazakhstan identifies the need to develop infrastructure to provide storage, logistic and processing facilities with the aim of developing and increasing agricultural produce in both the Strategic Plan of the Ministry of Agriculture for the period of 2020-2024, as well as the Strategic Development Plan of the Republic of Kazakhstan until 2025. The Plan for Ensuring

Food Security of The Republic of Kazakhstan for 2022-2024 includes 2 specific measures aimed at conceptualizing and modernizing water management and research organization infrastructure. There is no mention of road and railroad infrastructure to increase food security.

The National Development Program of Kyrgyz Republic until 2026 identifies the necessity for the construction of wholesale distribution centres comprising the commodity distribution infrastructure in the country's agro-industrial complex, as well as modernized irrigation infrastructure. This strategic document mentions plans to develop a multimodal cargo hub that combines air, rail, and road transport. However, these plans are not linked to their possible effect on national food security. The Program also identifies the need to resolve organizational, legal and land issues for the construction of logistics centres for processing, storage and sale of agricultural products.

The Medium-term Development Program of the Republic of Tajikistan for 2021-2025 sets out measures to develop greenhouse and irrigation infrastructure aimed at increasing harvest volumes, as well as increasing cold-chain infrastructure and establishing agricultural clusters. The Program of Food Security in the Republic of Tajikistan for the Period of 2019-2023 identifies the need for the creation of mobile food safety laboratories and food security surveillance sites at border checkpoints to increase the effectiveness of supervision over the quality of food products for import and export.

The Program of Socio-economic Development of Turkmenistan for 2023, which is based on the document The Revival of a New Era of a Sovereign State: The National Program of Socio-Economic Development of Turkmenistan for 2022-2052 identifies the increase in cargo turnover and passenger traffic along international transport and transit corridors passing through the country as an important priority. It does not, however, link this plan to improving food security. Instead, the Program envisions complete independence from food imports as the path to achieving food security.

The Development Strategy of the New Uzbekistan for the period of 2022-2026 prioritizes the development of agro-logistic centres and an increase in the number of modern

laboratories for agricultural produce. The Agriculture Development Strategy of Uzbekistan for 2020-2030 sets out the goal to increase investment in trade infrastructure, agro-logistics centres, food safety laboratories, sanitary and phytosanitary systems, as well as for the necessary equipment and inventory to ensure cost minimization and overcome technical obstacles to enable uninterrupted supply of domestic agricultural goods.

The study of the key national strategic documents has shown that the Central Asian countries do not identify the development of hard infrastructure like roads and railroads as an instrument of increasing food security. Instead, the construction of modern irrigation systems, agro-logistic centres and sanitary laboratories are considered measures to improve food security and safety. While these measures are important, they may prove to be even more effective with a plan to develop the road and railroad networks to create better linkages. In the case of large-scale construction of agro-logistic centres, acting as "an arterial system", as planned across the region, a developed road network will be instrumental in allowing for a wider distribution of foodstuffs in harder-to-reach areas, as would a capillary system.

STATE OF INFRASTRUCTURE IN CENTRAL ASIA AND ITS ROLE IN FOOD DISTRIBUTION

It has been widely acknowledged that infrastructure has an instrumental role in the development agenda of any nation. To a large extent, the effects of infrastructure development and its correlation to pressing social and economic issues such as poverty and economic growth have been widely studied through a wide variety of methods. While the development and construction of infrastructure itself does not directly solve such issues, it has an instrumental and conditional role to play in catalysing development objectives by creating the necessary conditions.

FAO established that infrastructural limitations are a key cause of food waste and loss, especially in developing countries. However, the causality, if any, between the role of infrastructure in food security and its quantifiable effects remains largely undiscovered and unquantified. In Central Asia, as the Asian Pacific region as a whole, infrastructure, especially railroads, has been identified by the Economist Intelligence Unit as an important

contributing factor to the availability of food across the region as a whole [15]. Nevertheless, food transportation infrastructure lags in low- and lower-middle-income countries, such as Kyrgyzstan and Tajikistan.

An important challenge in the Central Asian countries is the topographical characteristic – in countries such as Kyrgyzstan and Tajikistan over 90% of the territory is mountainous. The roads in these regions usually become impassable in the winter, which means that certain areas are cut off from the national infrastructure networks. The mountainous surface can pose a challenge in trying to develop infrastructure. Planning and constructing infrastructure objects become more complex and capital-intensive in mountainous areas. This means that the development of such transportation infrastructure requires planning and larger investments. The development of more comprehensive infrastructure can be considered a viable coping mechanism for mountainous areas, where serious climatic and geographic stressors limit self-sufficiency in food production [17].

Statistics available for the modal split of freight in the period from 2000 to 2021 seen in Figure 4 show that there has been growth in the overall volume of transported freight. This is an indication that Central Asian countries are developing and realising more of their logistic potential. In the case of Kazakhstan, this growth has reached up around 700%, according to the author's calculations based on the data of the Interstate Statistical Committee of the CIS. The growth rate of the density of the hard surface road network in Kazakhstan calculated by the author using the statistics of the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan for the same period reached 11%. This may indicate that the increase in freight volume is driven by both an increase in road network density and thus better connectivity, an improvement in road quality, as well as an increase in traffic intensity on an existing road network.

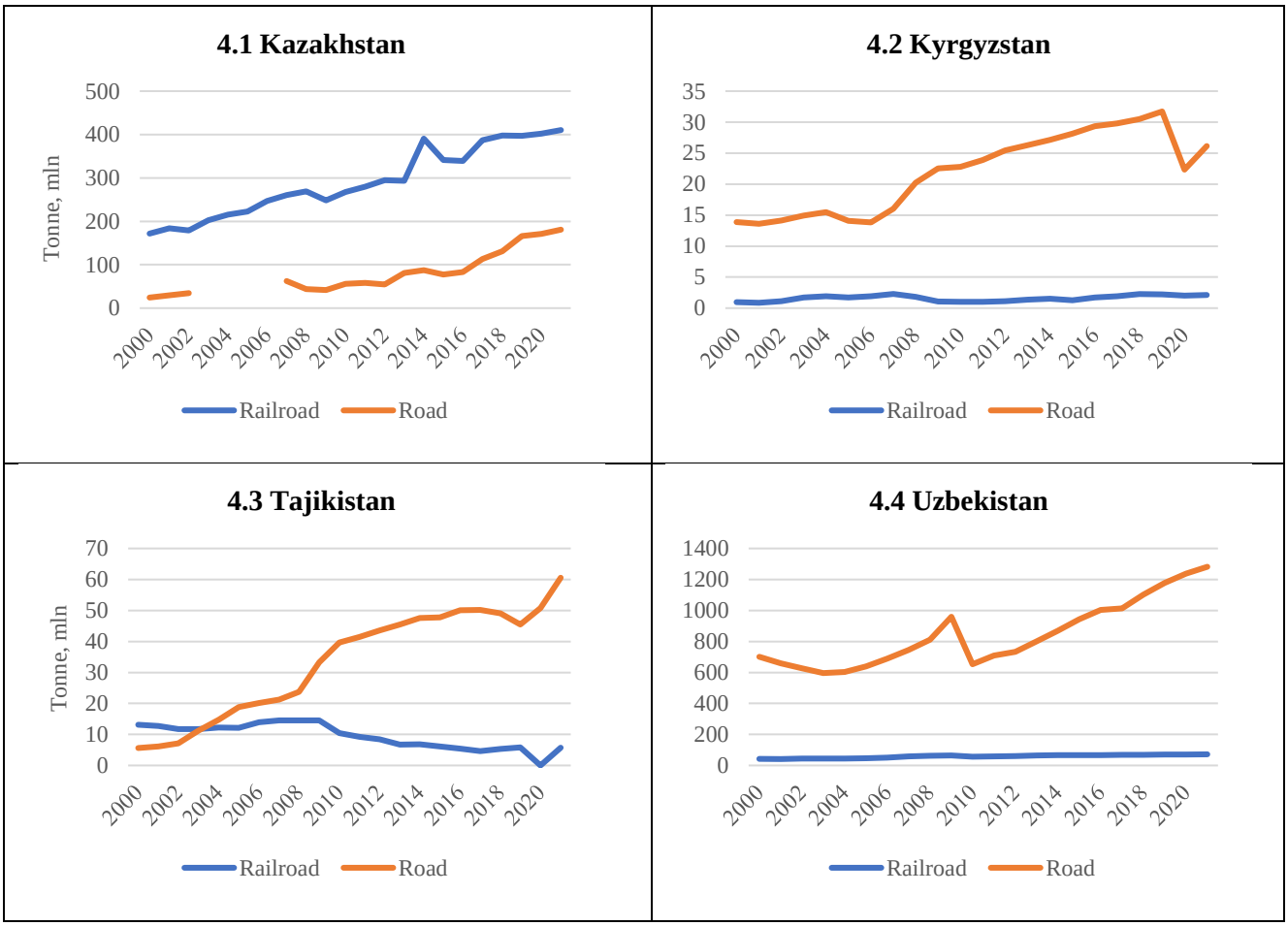

Figure 4. **Freight by mode for Central Asian countries 2000-2020**

Source: Interstate Statistical Committee of the CIS (2023)

For a more comprehensive understanding of the role of infrastructure, the growing freight volumes should be compared with the overall dynamic of railroad and road infrastructure development over the same period. This will give an indication as to whether the overall growth can be attributed to the increase of infrastructure network coverage, in the case that there is a positive trend.

The national railroad networks in Central Asian countries, measured as the density kilometre of railroad per 100 km^2 of land area in Figure 5, show that the railroad density remained largely unchanged over the past two decades. While the railroad networks were used actively prior to the dissolution of the USSR for the transportation of goods, the independent Central Asian states built their food logistic systems on automobile transportation. The key exception is Turkmenistan, which increased the density of railroads by 300%.

A slight increase was observed in Uzbekistan and Kazakhstan, however, in the case of the former, the periods of density growth do not coincide clearly with volume increases. This can be an indication of better and more active use of existing infrastructure. In the case of Kazakhstan, Figure 4 shows a 20% jump in railroad density in 2016 compared to 2015, which could possibly be one of the contributing factors to the growth in the national railroad freight volumes as of 2016.

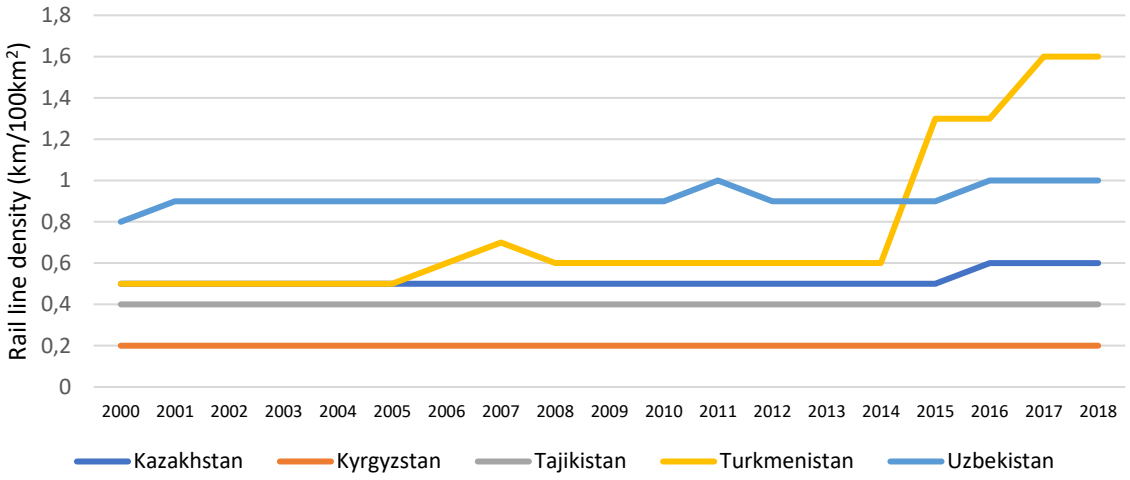

Figure 5. **Rail line density in Central Asian countries**

Source: FAOSTAT (2023)

The modal split of freight in Central Asian countries clearly demonstrates the key role of the road transport system for inland freight. The key exception is the case of Kazakhstan, where railroad freight comprised 60% of total freight tonne-km volume compared to 40% by road in 2018. Moreover, the freight volumes being moved by road have been growing in all Central Asian countries. This highlights the importance of proper road connection between regions and cities for distribution.

In the case of Kyrgyzstan, this growth seen in the last of the available years allowed the country to regain freight volumes seen pre-COVID-19 pandemic. More recently, according to the assessment of the National Institute of Strategic Studies of the Kyrgyz Republic, published in 2022, the national road system in the Kyrgyz Republic largely can ensure an uninterrupted supply of food to virtually any locality, given the absence of extreme weather conditions and catastrophes. This is due to the efforts to expand and reconstruct domestic

roads, which in turn increases the potential for improved physical accessibility of food in the Kyrgyz Republic.

When compared with the trends in freight modal split, the change in density of the national road networks in Kazakhstan and Uzbekistan suggests that the increase in freight volumes is not supported by an increase in the overall road density. Instead, the increase could stem from more active use of these networks (high movement intensity), as well as increased quality allowing for more efficient movement of goods. According to the data on Kazakhstan from CIS Statistics, the number of cargo cars between 2000 to 2021 grew by 35% from 13 537 to 18 287 in the respective years [18]. This can serve as an indication of higher intensity of use of existing transportation infrastructure.

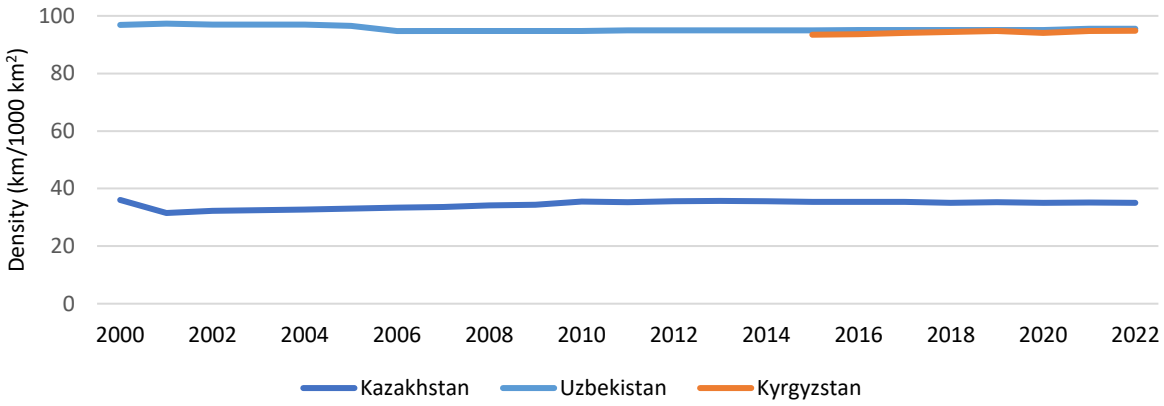

Figure 6. **Public road density in Kazakhstan, Kyrgyzstan and Uzbekistan (total route in km/1000 km^2)**

Source: Interstate Statistical Committee of the CIS (2023) and statistics from the Department of Roads of the Ministry of Transport and Communication of the Kyrgyz Republic

Nevertheless, the physical fact of a road does not necessarily imply the suitable physical road conditions that allow for effective and higher-speed freight. An important characteristic of the quality and potential of any road network is the type and category of roads. The speed regime, which is predetermined by the road surface as well as its category, can play a critical role in decreasing the time needed for cargo deliveries. In the case of Kyrgyzstan, the total public road density only increased by 2% from 2015 to 2022, however over the same period the length of hard-surfaced roads grew by 26%. In the case of the transportation of perishable

items better road quality and, thus, increasing freight speed and decreasing time costs means higher chances of reaching shelves and eventually consumers. In an article by Karymshakov, K. et al. [19] an empirical analysis of the impact of 6 largescale road construction projects spanning 6 regions in Kyrgyzstan showed that the infrastructure development had a positive effect on poverty reduction and retail trade growth in the country.

Another important component of food logistic networks includes storage services and food processing, which are largely underdeveloped in most Central Asian countries, where up to 25% of harvested fruits and vegetables are lost [20]. As previously mentioned, most Central Asian countries have identified the creation of such infrastructure as a strategic priority in their official documents (see Table 1.). In the case of Tajikistan, due to the implementation of the Program for the organization and repair of refrigeration equipment for the storage of agricultural products in the Republic of Tajikistan for 2015-2019, 188 warehouses with a capacity of 223 384 tons were built and put into operation in the country. Even though there was an increase in warehouse infrastructure, according to the World Bank, limited post-harvest capacity in Tajikistan is a driver of domestic price volatility [21].

The development of cold storage chains will improve the overall potential of foodstuffs distribution systems, especially for perishables, on a national level. This will, in turn, increase the availability and accessibility of certain food groups in harder-to-reach places. For an improvement in the utilization dimension of food security, there are three important prerequisites: the respective products for a healthy diet are available and accessible, and consumers have the chance to properly store and prepare the products for a healthy diet. Considering the last of the abovementioned prerequisites, a cold chain system needs to be properly connected for it to enable better distribution of foodstuffs around a country, and subsequently affect the accessibility.

A significant obstacle to dietary diversity and nutrition in Central Asia is costliness (accessibility). According to the statistics of the World Bank on the cost of a healthy diet, this way of eating is unaffordable for approximately half of the population in Kyrgyzstan and Tajikistan, where this indicator had been on the rise even before the economic shocks

caused by the COVID-19 pandemic. The healthy diet is defined by the World Bank as the least expensive locally-available foods for nutrient adequacy, in 2017 PPP$/person/day, for a representative person within upper and lower bounds for 23 macro- and micronutrients plus 2330 kcal/day energy balance.

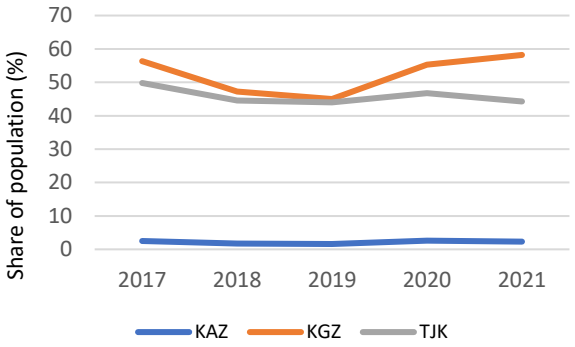

Figure 7. **Share of the population unable to afford a healthy diet (%)**

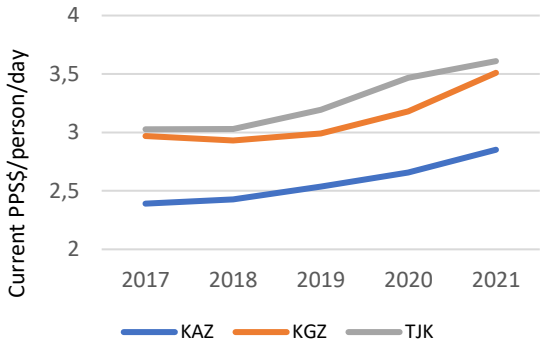

Figure 8. **The Cost of a healthy diet in 2017-2021, current PPP$/person/day**

Source: Compiled by author based on World Bank Food Prices for Nutrition (2023)

A specific case for which the data can be analysed in more detail at a national level is Kyrgyzstan. As per the WFP report Fill the Nutrient Gap 2022: Kyrgyz Republic [22], the average daily cost of a diet that only meets the energy needs of a five-person household was Kyrgyzstani Som (KGS) 107 (USD2 1.11). The average cost of a nutritious diet per day for the same household was nearly three times higher at KGS 296 (USD 3.07). These indicators are heterogeneous across the various Kyrgyzstani regions. The largest difference in a nutritious diet is seen in Djalal-Abad (204 KGS daily), while the Issyk-Kul region showed the least (176 KGS).

To understand if there is a possible correlation for future analysis, the cost of nutrition is compared to the degree of road network development, measured as the density of 1 kilometre of hard-surfaced roads per 1000 km of surface on a regional level for Kyrgyzstan (see Figure 9). Hard surface roads include asphalt and cement.

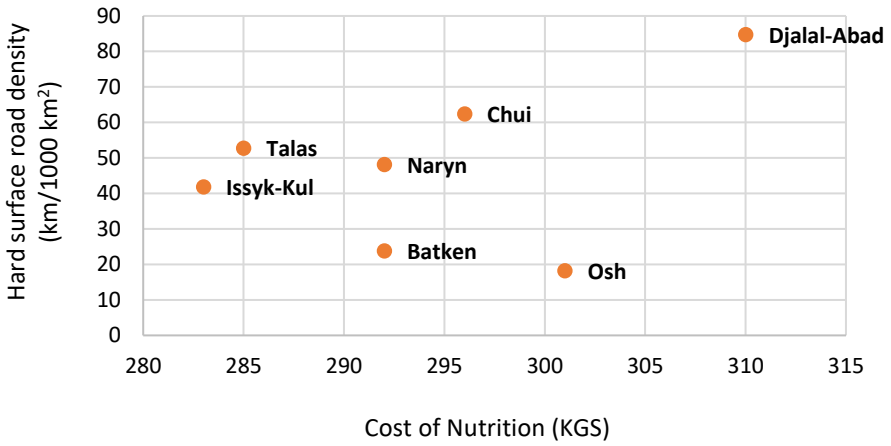

Figure 9. **Density of Hard Surface Roads (km per 1000km²) vs. Cost of Nutrition (KGS)**

Source: Compiled by author based on WFP data from Fill the Nutrient Gap 2022: Kyrgyz Republic and statistics from the National Statistic Committee of the Kyrgyz Republic

The construction of better-quality roads has been shown to decrease transport costs on produce in developing countries such as India, Bangladesh, Kenya, Tanzania and Uganda [23]. This difference can affect the economic affordability of the produce for goods already available, and even accessibility in cases when the transport cost is too high compared to the price, thus making it infeasible to transport long distances.

Empirical studies under the auspices of large-scale infrastructure projects in Kyrgyzstan, such as the Bishkek-Naryn-Torugart Highway (CAREC-1), have quantified the expected contribution to the economy of the country and the respective affected regions. The Ministry of Transport and Infrastructure estimated that the CAREC-1 Highway could, among others, significantly decrease the transport time for foodstuffs, which in the case of perishables would decrease losses by 8-20% [24]. According to the Asian Development Bank, the project has substantially improved the road conditions after construction. After completion, according to surveys conducted for the project's completion report, the vehicles on the respective route increased their average travel speed to 50–90 km/h, compared with 25–35 km/h before the project [25].

THE TRANSPORT CHALLENGE FOR FOOD PRODUCTION AND DISTRIBUTION ENTERPRISES IN CENTRAL ASIA

Considering that transport costs are an important factor that influences the economic accessibility of foodstuffs and thus contributes to food insecurity, it is important to consider the extent to which enterprises in the region consider it to be an obstacle to business. The data used for this analysis comes from the World Bank Enterprise Survey series (WB ES) for the years 2008-2009, 2012-2013 and most recently 2018-2019. The data was analysed over the span of these periods to give a better understanding of how the dynamic is changing over time. In addition, no data newer than 2019 was used to exclude the shocks caused by the COVID-19 pandemic. The WB ES are nationally representative surveys of enterprises in the non-agricultural and non-financial private economy. A common sampling methodology – stratified random sampling – is followed in all the surveys along with a common questionnaire. The sample for each country is stratified by industry, firm size and location within the country.

To verify whether transport presents an obstacle to business in Central Asia (excluding Turkmenistan due to the lack of data) the author used the responses of firms to the question of whether transport represents an obstacle to business. Firms were asked to choose whether transport constituted no obstacle, a minor obstacle, a moderate obstacle, a major obstacle or a very severe obstacle to business. In the results presented in this paper, the responses have been reclassified to a binary scale of no obstacle and obstacle (which corresponds to minor, moderate, major, and severe obstacle). This binary scale was used to calculate the share of interviewed enterprises for whom transport is an obstacle at the national level. This was done by dividing the overall number of enterprises for whom transport is an obstacle to any degree by the total number of all the enterprises that answered the question with a clear position (not responses “do not know” or “does not apply”).

Secondly, a second indicator was calculated for enterprises working in the industry of food production. Lastly, a third indicator was computed to calculate the share of enterprises in retail and wholesale for which transport represents an obstacle. These industries were specifically chosen because many of the enterprises interviewed have identified foodstuffs as their main product for sale, as shown in the WB ES databases. This was verified using the

ES data variable "d1a1x" providing corresponding answers to the question on the Establishment's main product/service last fiscal year. The results of these computations are presented in Table 2 below.

Table 2. **Enterprise perception of transport in Central Asia**

Country	Number and **share (%)** of enterprises for which transport is an obstacle			Number and **share (%)** of enterprises in food production for which transport is an obstacle			Number and **share (%)** of enterprises in wholesale and retail for which transport is an obstacle		
Year	**2009**	**2013**	**2019**	**2009**	**2013**	**2019**	**2009**	**2013**	**2019**
Kazakhstan	355 **(65%)**	304 **(51%)**	641 **(46%)**	50 **(60%)**	24 **(63%)**	112 **(51%)**	166 **(71%)**	140 **(50%)**	126 **(41%)**
Kyrgyz Republic	130 **(55%)**	117 **(43%)**	123 **(34%)**	22 **(67%)**	11 **(39%)**	20 **(41%)**	37 **(55%)**	42 **(53%)**	45 **(36%)**
Tajikistan	147 **(41%)**	138 **(38%)**	96 **(27%)**	13 **(33%)**	23 **(51%)**	16 **(34%)**	55 **(41%)**	67 **(50%)**	35 **(33%)**
Uzbekistan	170 **(46%)**	40 **(10%)**	259 **(21%)**	18 **(62%)**	2 **(7%)**	34 **(22%)**	60 **(43%)**	13 **(8%)**	49 **(25%)**
Weighted average share (%) for Central Asia	**53%**	**37%**	**33%**	**55%**	**43%**	**39%**	**55%**	**40%**	**35%**

Source: Author's calculations using World Bank Enterprise Survey data

The data in the table shows several important trends throughout the period from 2008-2019. Overall, there is a general trend of transport becoming less of an obstacle to business. Generally, in Central Asia the weighted average (as per the number of respondents to the respective question) of the share of enterprises that encounter transport-related obstacles has decreased by 20 p.p. over 10 years. This improvement could be an indication of several factors, including an overall increase in the coverage of road network, the possible improvement in the quality of hard infrastructure in the region (road surface and category), cheaper transportation costs driven by changes in oil and gas prices, a larger transport fleet which allows for larger freight fleet.

Taking the national level indicators as the benchmark level across all industries, the second indicator in Table 2. shows that overall, the business of food production is even more

prone to suffering from transport-related obstacles. The final indicator for the respective years also allows us to understand the extent to which transport-related obstacles affect businesses in wholesale and retail. Compared to the benchmark indicator across industries, wholesale and retail are impacted to more of a degree.

The importance of this analysis as such is in the fact that the enterprises in Central Asia that are directly integrated into the national food systems are more likely to be affected by transport. This is an important insight. The basis of the data is comprised of survey responses, which may, at first glance, seem like subjective data. However, the way that business perceives reality, obstacles and potential risks often lay the foundation for the strategies they choose to pursue, including pricing strategies. Therefore, enterprises in Central Asia could be factoring difficult or limited infrastructure conditions in the region into their pricing strategies, which is then transferred onto the buyers, thus making foodstuffs less economically viable, than had the transport systems been less of an obstacle.

Moreover, the indicators calculated for the food production and wholesale and retail industries demonstrate that there potentially may be a double or even triple effect of poor or inadequate transport conditions on the price of foodstuffs. Firstly, at the production stage transportation costs can affect the price of inputs. Secondly, at the post-production stage transportation obstacles are faced for distribution. Thirdly, if the distribution of the produced foodstuffs is realized through wholesale and retail, the transport obstacle is faced again. Therefore, the overall improvement of transport conditions for business could mean a multiplicative effect on the price of foodstuffs at several stages in the value chain.

In an attempt to identify how transport hinders business for food production companies, the WB ES data was analysed according to the destination market of the goods produced by the enterprises in this respective industry across the countries of Central Asia. According to the WB ES, three possible destination markets were identified: local, where the main product is sold mostly in the same municipality where the enterprise is located; national, where the main product is sold mostly across the country where the enterprise is located; international, where the main product is sold abroad.

The next step consists of identifying whether transport is an obstacle for food production enterprises depending on their main destination market. This could show the extent to which transport hinders better distribution of foodstuffs across the respective country. The analysis in Table 3 indicates that the majority share of enterprises, depending on their market destination, consider transport to be an obstacle. This was verified using the variable “e1” providing answers to the question “Establishment's main destination market over the last fiscal year where it sold its main product or service?”

Table 3. **Share of enterprises in food production for which transport is an obstacle in 2019 as per destination market**

	Kazakhstan	Kyrgyzstan	Tajikistan	Uzbekistan	Central Asia average
Local	50%	36%	29%	19%	**37%**
National	49%	40%	40%	24%	**39%**
International	80%	60%	0%	38%	**58%**

Source: Author’s calculations using World Bank Enterprise Survey data

The outlier in the analysis is Kazakhstan, for which transport to reach local markets is a more significant obstacle for enterprises in the food production industry compared to nationwide sales. This could possibly be explained by the difference in road quality of the republican network, of which the share of roads in the standard condition is 89%, and the local network, which is almost three times larger, but of which the share of roads in standard condition is 75% [26].

LIMITATIONS

One of the key limitations of the article is the availability of statistical data for all the Central Asian countries. This limits the analysis of the potential links between road infrastructure and the cost of healthy diets for the regions of respective countries. Consistent data on transportation costs in the region was not available, which is why the author chose to use the World Bank Survey Data to identify if transport and infrastructure present more of a challenge to the food production industry and firms in wholesale and retail compared to the national average across industries.

CONCLUSION

Although Central Asia has shown progress in decreasing the prevalence of hunger in the region, food security remains a complex challenge faced by these countries. This is largely because even with diminishing undernourishment, the region is demonstrating rising levels of obesity and vitamin and micronutrient deficiencies. This is primarily due to the inaccessibility of healthy diets in the region, which can be rooted in uneven distribution systems based on insufficient food transportation systems.

For most of the region, the modal freight split underscores the crucial role of the road network, the coverage (density) of which overall remains significantly unchanged over the past 20 years. Nevertheless, like in the case of Kyrgyzstan, there has been an improvement in the road network quality that allows for faster and more efficient transportation of perishables. In the Central Asian countries, which are all landlocked developing countries, this is particularly important as their economies are reliant on low-value primary products with a high sensitivity to transportation costs. This means that improvements in the transportation infrastructure can decrease transportation costs, thus decreasing the price of foodstuffs.

The article has shown that while there is a widespread consensus on the role of infrastructure and how it can affect development issues including food security, the Central Asian countries do not set out road and railroad development in their current national strategies as a measure to improve food security in the region. This is further discussed in the context of whether Central Asian enterprises perceive transport as an obstacle to business. In a nationwide comparison of all Central Asian countries, the analysis of enterprise survey responses has shown that over the period from 2009 to 2019, there has been an overall improvement in the perception of transport by enterprises. In an industry-wide comparison, firms in the food production business, as well as wholesale and retail show a higher dissatisfaction with infrastructure, which could have implications for their pricing strategies, and through this, affect national food security. Finally, the study has also shown that according to the enterprise survey data of 2018-2019, food production companies in

Central Asia are relatively most affected by transport when they are oriented on export and realizing their produce on a national level. Except for Kazakhstan, Central Asian food production enterprises face more obstacles when selling goods between regions of their respective countries than when they trade only within their locality. This can be an indication of poor connectivity between localities within a country, which exacerbates unequal food distribution, leading to disparities in the costliness of healthy diets and nutrient deficiencies.

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