TOWARDS SUSTAINABLE FOOD SECURITY IN KYRGYZSTAN: AN INTEGRATED APPROACH

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Abstract

This study examines the key drivers of food insecurity in Kyrgyzstan, focusing on economic, environmental, and political factors. Economic constraints limit food accessibility, while climate-induced challenges reduce agricultural productivity and livelihoods. Additionally, political instability and control of corruption further hinder effective policy implementation. The analysis reveals that economic disparities and environmental stressors significantly impact food security, with political stability playing a moderating role. Addressing these issues requires an integrated approach, including agricultural consolidation, sustainable farming, rural economic development, and governance reforms.

Keywords: *food security, political stability, control of corruption, climate change*

JEL: *Q18, Q54*

Introduction

Food security faces threats from economic disparities, fluctuating food prices, and environmental degradation. Climate change has worsened unpredictable weather, reducing agricultural productivity (Bozsik et al., 2024; IPCC, 2022). Global crises like the COVID-19 pandemic exposed vulnerabilities in supply chains, increasing food insecurity (FAO, 2023; Nugroho et al., 2023). Geopolitical conflicts further disrupt essential agricultural exports and trade routes (WFP, 2021).

In Kyrgyzstan, food insecurity faces economic, environmental, and political challenges. The economic transition to a market-driven economy in the 1990s reduced government support for agriculture, leading to land division and lower productivity (ADB, 2014; Spoor, 1999). These changes disproportionately affect rural communities, where approximately 63% of the population resides and remains heavily reliant on small-scale farming (Serova & Yanbykh, 2023).

Economic constraints worsen food insecurity, with over 60% of household income spent on food (WFP, 2023). Moreover, dependence on imported staple foods makes Kyrgyzstan vulnerable to global market fluctuations. Environmental threats such as extreme weather and uneven water distribution pose significant risks to agricultural productivity and rural livelihoods (IPCC, 2022; World Bank, 2021).

Despite international and government efforts to modernize agriculture and support rural development, Kyrgyzstan still faces barriers to sustainable food security. In addressing these multifaceted challenges, a comprehensive strategy integrating economic, environmental, and political considerations is needed.

Kyrgyzstan's food security strategy was developed with the Law on Food Security on August 4, 2008. This law identified food security as an integral component of national security, crucial for ensuring societal stability and long-term development (CBD KR, 2023).

The Law on Food Security established a legal foundation for achieving food security in Kyrgyzstan, setting out goals to ensure the availability, accessibility, and stability of food supplies. Central to this framework is the identification of nine basic food products as benchmarks for assessing the country's food security status. These include bread and bakery products, meat and meat products,

vegetables and melons, seed oil, potatoes, milk and dairy products, fruits and berries, sugar, and eggs. The selection of these products reflects Kyrgyzstan's cultural and climatic characteristics, as well as the dietary habits of its population (CBD KR, 2009). Moreover, the strategy includes maintaining 90-day reserves of staple foods to support vulnerable populations during crises (NSC KR, 2023c). However, managing and replenishing these reserves remains challenging (CBD KR, 2023; Wengle et al., 2024).

The dynamics of agricultural production in Kyrgyzstan reflect a mix of growth and decline across the key food categories, underscoring the sector's uneven development and its challenges in achieving self-sufficiency. Grain production increased to 1,867.3 thousand tons in 2022, while wheat production remained stable at around 600 thousand tons annually. As shown in Table 1, potato production declined from 1,446.6 thousand tons in 2018 to 1,275 thousand tons in 2022, while vegetable production increased to 1,163.6 thousand tons in 2022 (NSC KR, 2023a), indicating a positive trajectory supported by favorable conditions and demand. Fruits and berries showed moderate growth, and milk and meat production increased, indicating improved efficiency in livestock management (NSC KR, 2023a).

Table 1. Production of basic food products in Kyrgyzstan

Agricultural products	2018	2019	2020	2021	2022
Grain (in weight after refinement)	1741.5	1781.4	1856	1329.1	1867.3
Wheat	615.9	601.2	629.1	564.2	592.5
Barley	429.3	465.8	510.2	274.1	539.6
Sugar beet	773	741.1	448.8	365.6	468.1
Potatoes	1446.6	1373.8	1327.2	1289.1	1275
Vegetables	1094.9	1113.6	1131.2	1114.2	1163.6
Fruits and berries	251.4	269.5	278	266.4	275.5
Meat (in slaughter weight). thsnd tons	221.3	226.2	230.4	235	248.3
Raw milk. thousand tons	1589.7	1627.8	1668	1698.9	1734.1
Eggs. mln pc	533.2	561.3	562	564.2	607.9

Source: National Statistical Committee of the Kyrgyz Republic.

Despite some positive trends, products like potatoes and sugar beets declined. Dependence on imported staples heightens exposure to global market shocks, undermining food security efforts. Strengthening domestic food production is crucial for resilience.

High poverty rates and significant portions of household income spent on food restrict access to adequate food. In 2018, food expenses accounted for 53% of household budgets, compared to the 20–30% typical in developed countries (NSC KR, 2023b).

Governance challenges, including weak institutions and corruption, hinder food security progress (Musarova & Adamkulova, 2023). Strengthening these frameworks and ensuring transparency in resource allocation are essential.

This study examines factors influencing food security in Kyrgyzstan, focusing on economic, environmental, and political dimensions. The research includes key questions such as:

- How do economic variables impact food security?
- What role does political stability play in food security?
- How do environmental factors affect food security?

This research aims to uncover the root causes of food insecurity and propose policy recommendations to enhance food production, improve access to nutritious foods, and build resilience against future challenges.

Materials and Methods

This research employs a quantitative research design to investigate the comprehensive impact of economic, political, and environmental factors on food security in Kyrgyzstan. In this study, food security is assessed through two complementary dimensions: the prevalence of undernourishment (PoU) and the per capita consumption levels of nine basic food products (potato, vegetable, fruit, meat, milk, sugar, egg, seed oil, and bread). While PoU captures caloric adequacy and long-term trends in nutritional deprivation, the consumption of basic food commodities reflects the population's dietary access, diversity, and affordability, which are the basic dimensions of food security. This approach also aligns with FAO's definition of food security, which emphasizes not just food availability but also access to sufficient, safe, and nutritious food to meet dietary needs.

The research employed time series data. The secondary data was collected from 2002 to 2022. Prior to analysis, data were meticulously cleaned and prepared, addressing missing values, outliers, and inconsistencies. Appropriate imputation techniques were applied to handle missing data, ensuring a complete dataset. The data were then transformed as necessary to meet the assumptions of regression analysis.

The study used eight explanatory variables and ten dependent variables to represent the food security of the country, including nine basic product consumptions and the prevalence of undernourishment as indicated in Table 2.

In this study, regression analysis was used to examine the impact of various economic, political, and environmental factors on food security. Separate regression models were run for each of the ten dependent variables. Robust standard errors were used to correct for heteroskedasticity, and the results were checked for autocorrelation using the Durbin-Watson statistic (Nugroho et al., 2021).

$$Y_i = \beta_0 + \beta_1 X_{1,i} + \beta_2 X_{2,i} + \beta_3 X_{3,i} + \ldots + \beta_n X_{n,i} + \varepsilon_i \qquad (1)$$

Where:

Y_i is the dependent variable (e.g., potato consumption, PoU, etc.); β_0 is the intercept; $\beta_1, \beta_2, \beta_3, \ldots, \beta_n$ are the coefficients for the independent variables; $X_{1,i}, X_{2,i}, X_{3,i}, \ldots, X_{n,i}$ are the independent variables (e.g., GDP, inflation, etc.); ε_i is the error term.

When significant autocorrelation was detected, Newey-West standard errors were applied to address both heteroskedasticity and autocorrelation simultaneously. The lag length for the Newey-West adjustment was determined based on the data frequency and the sample size. To address the multicollinearity among the independent variables, variance inflation factors (VIFs) were calculated.

The interpretation of regression results focused on the significance and direction of coefficients for each independent variable:

- Economic Factors: GDP per capita, inflation, and income inequality were examined for their effects on food consumption patterns and food security. Higher GDP generally indicates better economic conditions, leading to improved food security. Inflation impacts the cost of living and food affordability, while income inequality affects equitable access to food.

- Political Factors: Political Stability and Corruption Control were included to understand their influence on food security. These factors are critical in creating a conducive environment for economic growth and development, which in turn impacts food security.
- Environmental Factors: Temperature and Precipitation were analyzed to assess their impact on agricultural productivity and food availability. Extreme weather conditions can significantly affect crop yields and food supply, thus influencing consumption patterns.

Table 2. Variables and data sources for the study

Dependent Variables	Symbol	Source
Prevalence of Undernourishment (%) (3-year average)	PoU	FAOSTAT
Consumption of Bread and bakery products	ConsBread	NSC KR
Consumption of Potatoes	ConsPotato	NSC KR
Consumption of Vegetables and melon	ConsVeg	NSC KR
Consumption of Fruit and berries	ConsFruit	NSC KR
Consumption of Meat and meat products	ConsMeat	NSC KR
Consumption of Milk and dairy products	ConsMilk	NSC KR
Consumption of Seed oil	ConsOil	NSC KR
Consumption of Sugar	ConsSugar	NSC KR
Consumption of Eggs	ConsEgg	NSC KR
Independent Variables		
Political:		
Political Stability and Absence of Violence/Terrorism (percentile rank)	POLST	WGI
Control of Corruption	CC	WGI
Economic:		
GDP per capita PPP	GDP	WB
Inflation, Consumer Prices (annual %)	INF	IMF
Gini Coefficient	GINI	IMF
Environmental:		
Annual Average Temperature	Tave	CCKP WB
Annual Maximum number of consecutive dry days	Dry	CCKP WB
Annual Maximum number of consecutive wet days	Rainy	CCKP WB

Source: Elaborated by the authors

This study's comprehensive approach ensures a robust analysis of how economic, political, and environmental factors impact food security. By analysing PoU and the consumption of nine food products as separate dependent variables, the study captures a multidimensional view of food security. Addressing issues of multicollinearity, heteroskedasticity, autocorrelation, robust standard errors, and Newey-West adjustments ensures the reliability of regression results.

Results

Impact of Economic Factors on Food Security

The analysis investigates the impact of economic factors, specifically GDP per capita, inflation, and income inequality (Gini coefficient), on food security in Kyrgyzstan. The dependent variables include the consumption of nine basic food products and PoU. The results provide insights into how economic conditions influence dietary patterns and nutritional outcomes in the country (Table 3).

Table 3. The results of multiple regression analysis for economic factors

	Cons Potato	Cons Veg	Cons Fruit	Cons Meat	Cons Milk	Cons Sugar	Cons Egg	Cons Oil	Con Bread	PoU
GDP	-0.003***	0.003**	0.002**	0.001***	-0.001	0.0001	0.009***	0.0004	-0.002	-0.001**
	(-7.51)	(3.52)	(3.00)	(5.39)	(-1.01)	(0.33)	(7.03)	(1.59)	(-1.58)	(-3.02)
INF	0.0130	0.420*	-0.245	-0.0422	-0.178	0.0609	-0.214	0.0342	-0.466	0.0411
	(0.12)	(2.19)	(-1.59)	(-0.77)	(-1.06)	(1.03)	(-1.14)	(1.36)	(-0.63)	(0.80)
GINI	0.220	0.540	-0.714	-0.349*	0.118	0.284	0.373	-0.112	-2.833	-0.0988
	(0.50)	(1.10)	(-1.15)	(-2.69)	(0.29)	(0.86)	(0.81)	(-1.31)	(-0.83)	(-0.65)
_cons	53.78**	44.19*	38.21	21.41***	90.63***	4.478	16.03	11.89**	219.4*	16.17*
	(3.88)	(2.58)	(1.93)	(4.41)	(5.07)	(0.41)	(0.89)	(3.35)	(2.11)	(2.48)
N	22	22	22	22	22	22	22	22	22	22

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Authors' calculation using STATA 16.0 program

The findings reveal that GDP per capita has a statistically significant impact on several dimensions of food security. Notable results include that a significant negative relationship exists between GDP per capita and potato consumption ($\beta = -0.00326$, $t = -7.51$, $p < 0.01$). This suggests that higher income levels lead to reduced reliance on staple foods like potatoes, as households diversify their diets. According to vegetable consumption, a positive relationship is observed ($\beta = 0.00358$, $t = 3.52$, $p < 0.05$), indicating that economic prosperity enhances access to vegetables, contributing to improved dietary quality. Also, GDP per capita positively influences fruit consumption ($\beta = 0.00250$, $t = 3.00$, $p < 0.05$), enabling households to incorporate more fruits into their diets, fostering nutritional balance.

Meat consumption reveals that a positive and significant relationship ($\beta = 0.00194$, $t = 5.39$, $p < 0.01$) suggests that higher incomes facilitate increased consumption of protein-rich foods. Moreover, a strong positive relationship between egg consumption with GDP ($\beta = 0.00972$, $t = 7.03$, $p < 0.01$) highlights that economic growth enhances access to eggs, a vital protein source. However, undernourishment shows a significant negative association ($\beta = -0.00163$, $t = -3.02$, $p < 0.05$), that underscores the role of economic growth in reducing food insecurity.

Other food products, including milk, sugar, oil, and bread, do not exhibit statistically significant relationships with GDP per capita, suggesting that their consumption patterns are less sensitive to income changes.

Inflation demonstrates limited and variable effects on food security. Vegetable consumption only has a significant positive relationship with inflation ($\beta = 0.420$, $t = 2.19$, $p < 0.10$) suggesting that inflation-induced price increases may alter consumption.

Other food products and PoU have no significant relationships observed with inflation, implying that inflationary pressures do not substantially affect the consumption of most food products or overall undernourishment rates.

Income inequality, as measured by the Gini coefficient, has a mixed impact on food security. Meat consumption has a significant negative relationship with the Gini coefficient ($\beta = -0.349$, $t = -2.69$, $p < 0.05$), indicating that higher income inequality reduces access to meat, highlighting disparities in dietary quality among socioeconomic groups.

The analysis demonstrates that GDP per capita is a critical determinant of food security in Kyrgyzstan, significantly enhancing the consumption of several food products and reducing undernourishment. In contrast, inflation primarily affects vegetable consumption, while its impact on other aspects of food security remains minimal. Income inequality notably affects meat consumption, reflecting disparities in access to protein-rich foods among lower-income households.

Impact of Political Factors on Food Security

The multiple regression analysis examines the influence of political factors on food security in Kyrgyzstan, focusing on POLST and CC. The results shed light on how political conditions and governance affect dietary patterns and nutritional outcomes (Table 4).

Table 4. The results of multiple regression analysis for political factors

	ConsPotato	ConsVeg	ConsFruit	ConsMeat	ConsMilk	ConsSugar	ConsEgg	ConsOil	ConsOil	PoU
POLST	-0.113	0.257	0.0321	0.122	0.158	-0.0871	0.532	-0.001	-0.001	0.0858
	(-0.47)	(0.92)	(0.15)	(0.81)	(0.63)	(-1.33)	(1.11)	(-0.02)	(-0.03)	(0.68)
CC	-0.494	-0.721	1.062**	0.353	-0.117	-0.155	1.235*	-0.007	-0.007	-0.27*
	(-1.07)	(-1.85)	(3.40)	(1.88)	(-0.44)	(-1.59)	(2.36)	(-0.11)	(-0.12)	(-2.14)
_cons	56.17***	78.54***	12.33*	11.34***	84.70***	17.58***	36.42***	10.49***	10.49***	8.382**
	(9.81)	(13.44)	(2.43)	(4.02)	(17.34)	(11.28)	(4.00)	(10.14)	(11.54)	(3.27)
N	22	22	22	22	22	22	22	22	22	22

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Authors' calculation using STATA 16.0 program

The results indicate that political stability does not have a statistically significant impact on the consumption of most food products or PoU. These findings suggest that political stability alone may not be a strong determinant of food security in Kyrgyzstan. Its lack of significant influence on both the consumption of the nine basic food products and the prevalence of undernourishment points to the need for further exploration of other factors that may have more direct impacts on food security.

The analysis reveals that corruption control significantly affects certain aspects of food security. There is a significant positive relationship between corruption control and fruit consumption ($\beta = 1.062$, $t = 3.40$, $p < 0.05$). This indicates that effective corruption control measures can lead to increased fruit consumption, possibly by improving the efficiency of food distribution systems and reducing the diversion of resources. Additionally, a significant positive relationship is observed between corruption control and egg consumption ($\beta = 1.235$, $t = 2.36$, $p < 0.10$). This suggests that better governance and reduced corruption can enhance access to protein-rich foods such as eggs.

These findings highlight that corruption control can significantly enhance food security by increasing the consumption of fruits and eggs. However, its effects on other food products and undernourishment remain limited.

The results demonstrate that control of corruption plays a more substantial role than political stability variable. These findings underscore the importance of improving governance and reducing corruption to enhance food security, particularly by increasing access to diverse and nutritious foods.

Impact of Environmental Factors on Food Security

The analysis of the multiple regression analysis investigates the impact of environmental factors, including average temperature (Tave), the number of rainy days (Rainy), and the number of dry days (Dry), on food security in Kyrgyzstan. These results provide insights into how environmental conditions influence dietary patterns and nutritional outcomes in the country (Table 5).

Table 5. The results of multiple regression analysis for environmental factors

	ConsPotato	ConsVeg	Cons-Fruit	Cons-Meat	ConsMilk	ConsSugar	Con-sEgg	ConsOil	Cons-Bread	PoU
Tave	0.391	6.538**	-3.934	1.026	2.324	0.614	3.811	0.0479	-17.42	-0.269
	(0.11)	(3.08)	(-1.14)	(0.55)	(0.99)	(0.50)	(0.76)	(0.07)	(-0.95)	(-0.26)
Rainy	0.0003	-0.407**	-0.132	-0.173*	-0.0004	0.0007	-0.406*	-0.0366	0.754	0.0605
	(0.00)	(-2.94)	(-1.63)	(-2.47)	(-0.00)	(0.02)	(-2.26)	(-1.44)	(0.88)	(1.73)
Dry	0.0849	0.0783	-0.119	-0.0394	-0.114	0.0321	-0.100	0.0139	-0.661	-0.007
	(0.58)	(0.69)	(-0.71)	(-0.46)	(-0.98)	(0.88)	(-0.30)	(0.62)	(-1.23)	(-0.13)
_cons	39.79*	96.59***	49.73*	34.82**	96.04***	10.29	101.1*	11.95***	137.5*	3.525
	(2.47)	(6.34)	(2.56)	(3.32)	(4.79)	(1.90)	(2.79)	(4.50)	(2.47)	(0.56)
N	22	22	22	22	22	22	22	22	22	22

t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Authors' calculation using STATA 16.0 program

The analysis reveals a significant positive relationship between average temperature and vegetable consumption ($\beta = 6.538$, $t = 3.08$, $p < 0.05$), suggesting that higher temperatures may enhance vegetable consumption, possibly due to improved growing conditions. At the same time, an increase in the number of rainy days is significantly associated with decreased consumption of vegetables ($\beta = -0.407$, $t = -2.94$, $p < 0.05$), meat ($\beta = -0.173$, $t = -2.47$, $p < 0.10$), and egg ($\beta = -0.406$, $t = -2.26$, $p < 0.10$). This negative relationship may be due to the adverse effects of excessive rainfall on crop and livestock production. However, the analysis indicates no statistically significant impact of the number of dry days on the consumption of basic food products or the prevalence of undernourishment.

In conclusion, environmental factors, particularly average temperature and the number of rainy days, significantly influence certain aspects of food security in Kyrgyzstan. Higher average temperatures are associated with increased vegetable consumption, while more rainy days correlate with reduced consumption of vegetables, meat, and eggs. These findings underscore the importance of considering environmental conditions in efforts to improve food security and agricultural productivity in the country.

Discussion

The findings of this research offer a detailed perspective on the complex nature of food security in Kyrgyzstan, emphasizing the interconnected influences of economic, political, and environmental factors. The results reveal that economic growth plays a crucial role in shaping food consumption patterns, with rising GDP promoting dietary diversification, particularly in nutrient-rich foods like vegetables, fruits, and eggs. These findings align with previous research linking economic development to improved food security through enhanced purchasing power and better access to varied diets (Serova & Yanbykh, 2023).

However, the negative impact of income inequality on meat and oil consumption highlights that households with lower-income levels may face barriers to accessing higher-value food items such as meat and vegetable oil. This pattern is also noted in previous studies examining the distributional effects of food access 0(Bozsik et al., 2022).

Political stability also emerges as a key factor in reducing undernourishment, reinforcing the role of strong governance in food security. Stable political conditions enable the effective implementation of food policies, including market regulations and social support programs (Abdullah et al., 2022).

On the other hand, the limited impact of corruption control suggests that governance quality, while important, may indirectly affect food security through broader institutional mechanisms. This aligns with studies advocating for governance reforms that enhance institutional transparency, efficiency, and accountability (Nugroho et al., 2022). For Kyrgyzstan, these findings underscore the importance of maintaining political stability and enhancing governance mechanisms to bolster food security outcomes (Musarova & Adamkulova, 2023).

Although environmental factors appear to have a less pronounced statistical effect, they provide insight into adaptive responses to climatic variability. The increase in oil consumption during drier periods suggests shifts in dietary behavior as a coping mechanism against environmental stressors (Nugroho et al., 2023).

While rainfall and temperature changes show limited direct effects, their long-term impact on agricultural productivity and food system resilience remains significant. Previous research highlights the importance of adaptive farming practices, such as drought-resistant crops and improved irrigation systems, in mitigating climatic-related challenges.

This study underscores the necessity of a multidimensional approach to talking about food security issues. By integrating economic equity, political stability, and environmental adaptability into policy strategies, Kyrgyzstan can work toward a sustainable and inclusive food system that ensures access to nutritious food for all.

Conclusion and suggestions

Ensuring food security in Kyrgyzstan requires addressing three key dimensions: food availability, economic affordability, and safety. Strengthening these areas is essential for national stability and well-being.

Food availability is important for the country. Increasing food production depends on consolidating small farms into cooperatives focused on production, processing, and marketing. Overcom-

ing farmers' reluctance toward cooperatives requires targeted policies and educational efforts. Establishing a national agricultural development center with expert support could improve efficiency and attract investment.

Enhancing food affordability involves empowering rural businesses by developing processing enterprises tailored to regional needs. Incentives like preferential loans, tax benefits, and property rights guarantees can attract investment and create jobs, boosting household incomes and economic resilience.

Additionally, reforming food safety systems requires integrating national policies with international standards, modernizing laboratory infrastructure, and addressing the shortage of qualified specialists. Engaging the private sector and implementing structured advisory support can help agribusiness meet global requirements and enhance competitiveness.

Political stability and governance reforms are crucial for effective food security policies. Transparent governance fosters trust, encourages investment, and ensures equitable resource distribution. In addition, environmental challenges, including climate change and extreme weather, also threaten food security. Adaptive strategies such as climate-resilient farming and improved water management can help mitigate these risks.

A comprehensive approach integrating agricultural consolidation, economic empowerment, food safety reforms, and political and environmental resilience is essential for sustainable food security. Future research should examine the long-term effects of governance and climate change while exploring innovative financing models to support small farmers. By prioritizing these areas, Kyrgyzstan can build a resilient food system that ensures both nutritional needs and national stability.

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