ISRG Journal of Economics, Business & Management (ISRGJEBM)

ISRG PUBLISHERS
Abbreviated Key Title: Isrg J Econ Bus Manag
ISSN: 2584-0916 (Online)
Journal homepage: https://isrgpublishers.com/isrgjebm/
Volume – II Issue - V (September - October) 2024
Frequency: Bimonthly

Food Security in D8 Countries: Comparative Challenges and Sustainable Strategies

Fazlullah Ihza Qaseem[1*], Melani Sukma Yuridis[2]

[1, 2] Indonesian International Islamic University

| **Received:** 05.09.2024 | **Accepted:** 11.09.2024 | **Published:** 12.09.2024

***Corresponding author:** Fazlullah Ihza Qaseem
Indonesian International Islamic University

Abstract

Food security is a critical global issue, and the D8 countries (Bangladesh, Egypt, Indonesia, Iran, Malaysia, Nigeria, Pakistan, and Turkey) represent a significant group of emerging economies with diverse agricultural systems and challenges. The purpose of this paper is to investigate the determinants of food security in the D8 countries using panel data regression analysis. The study utilizes a panel dataset covering a time period of 9 years (2012-2020) for the eight members of D8 countries, except Iran, with variables representing the proportion of agriculture's added value to GDP, the value of agricultural production per capita, the share of agricultural exports to total exports, and land productivity. The panel data regression analysis employs appropriate econometric techniques, which is random effects model, to account for cross-country and time-series variations. The result of the study shows that the value of agricultural production per capita has a positive relationship with Food Security variable. While the variables of the share of the added value of agriculture in GDP and the share of export of agricultural products in total export have a negative correlation with Food Security. There is also no correlation between land productivity and food security. The results of this paper will provide valuable information for policymakers and stakeholders to formulate effective strategies and interventions to improve food security in the region. The results of this research will also provide implications for other developing countries facing similar challenges in ensuring food security for their populations.

Keywords: *Food security, D8 countries, Random Effect Model, Agricultural production, Agricultural export.*

1. Introduction

Food security, which pertains to the availability, accessibility, utilization, and stability of food supply, is a critical global issue that has significant implications for human well-being, social stability, and economic development. Among various regions, the D8 countries (except Iran), consisting of Bangladesh, Egypt, Indonesia, Malaysia, Nigeria, Pakistan, and Turkey, face unique challenges and opportunities in achieving food security due to their diverse geographical, economic, and social contexts. These

DOI: 10.5281/zenodo.13754392

countries, representing a diverse group of developing and emerging economies, are characterized by rapidly growing populations, increasing urbanization, changing dietary patterns, and evolving agricultural and food systems.

Despite the potential for agricultural production and trade in these countries, food security remains a persistent concern. Challenges such as inadequate infrastructure, limited access to markets, low agricultural productivity, climate change impacts, and social inequalities pose significant threats to food security in the region. At the same time, these countries also employ various strategies and policies to enhance food security, including investments in agricultural research and development, market-oriented reforms, social protection programs, and food trade agreements.

Given the complex and dynamic nature of food security in the D8 countries, there is a need for a comparative study to evaluate the status, challenges, and strategies for achieving sustainable food systems in the region. This research aims to fill this gap by conducting a comprehensive analysis of the food security situation in D8 countries, with a particular focus on the key determinants and factors influencing food security outcomes. By employing panel data regression, this study seeks to provide empirical evidence on the relationships between key variables, including value-added in agriculture, agricultural production, export of agricultural products, and land productivity, and their impacts on food security outcomes in D8 countries.

The findings of this research are expected to contribute to the existing literature on food security, agriculture, and development in D8 countries, and provide valuable insights for policymakers, researchers, and practitioners working in the field of food security and sustainable agriculture. Understanding the challenges and strategies for achieving food security in D8 countries is crucial for formulating effective policies and interventions that can improve food access, availability, and utilization, and ultimately enhance the well-being and livelihoods of vulnerable populations in the region.

2. Literature Review

2.1. Food Security

In 1974, at the Rome World Meeting on Food Problems, the formal definition of the term "food security" emerged in the scientific community. In 1996, at a similar conference, the concept was elaborated upon and made more precise. In this context, "food security" typically refers to the point at which it is physically and economically feasible to utilize it. In terms of physical food availability, it is normal to consider the number and variety of food products that satisfy the effective demand in their areas of demand. It refers to the sustenance supply of a region or country (Djurayeva et al., 2022).

In accordance with the FAO's (1996) definitions, food security is achieved while "all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life". Consequently, Four elements make up the idea of food security: food availability, economic and physical accessibility, utilization, and stability. Thus, it is not enough to produce enough food to meet global requirements; everyone must also be able to obtain this food in a timely manner and have access to sufficient quantities and quality (Fusco G, 2022).

Food availability is the availability of appropriate food in sufficient amounts, whether it is imported or produced domestically (including food aid). Food access is people's ability to obtain sufficient means to buy wholesome food and maintain a balanced diet. Food utilization is the biological utilization of food to reach a state of nutritional well-being in which all physiological needs are met through enough nourishment, drinking water, sanitation, and medical care, a.k.a. "nutritional well-being". In this manner, Stability is defined as both the presence and the ease of access to reliable food sources. Consequently, not only must enough food be produced globally, but everyone must also have access to this food, in the appropriate quantity and quality, in a timely manner (Walaa M, 2019). People should not be prevented from obtaining food as a result of sudden problems such as economic or climate crises or seasonal food inaccessibility (Mahrous W, 2019).

2.2. Agriculture and Food

Governments support food and agriculture through numerous policies, including trade and market interventions (e.g., border measures and market price control) that generate price incentives or disincentives, fiscal subsidies to producers and consumers, and support for general services. These policies have an effect on all stakeholders, as they are a component of the food environment and can influence the availability and affordability of healthful diets (FAO, 2022).

Policy assistance for sustenance and agriculture varies over time and across income categories in different nations. In general, price incentive measures and fiscal subsidies are most prevalent in high-income nations, and they are gaining popularity in some middle-income nations, particularly those with the highest income levels. Historically, low-income countries have established policies that create price disincentives for producers so that consumers can gain access to food at a lower cost. These nations have limited financial means to provide fiscal subsidies to producers and consumers and to finance general services that benefit the entire food and agricultural sectors. In middle-income countries, fiscal subsidies to agricultural producers accounted for only 5% of total production value, compared to 13% in high-income nations. As a percentage of the value of production, general services support is lower in low-income countries (2 %) than in high-income countries (4 %).

Two-thirds of the global fiscal subsidies to consumers (either final or intermediary, such as processors) were distributed in high-income nations. Policy support for food categories and commodities varies. Countries with higher income levels support all food groups, but especially staple foods such as cereals, tubers, and roots, followed by dairy and other protein-rich foods. In countries with a high income, producers of these three food categories receive equal amounts of price incentives and fiscal subsidies. In contrast, during 2013–2018, fiscal subsidies for fruits, vegetables, and lipids and oils (representing approximately 11% of the value of production) were significantly greater than price incentives on average. Lower-middle-income countries consistently penalized the production of most products through policies that depress farm gate prices, but they provided fiscal subsidies to farmers, particularly for staple foods, fruits and vegetables, and lipids and oils. In low-income countries, price incentives were negative for the majority of food categories, ranging from -7% for staple foods (primarily cereals) to 1% for other crops (such as sugar, tea, and coffee).

DOI: 10.5281/zenodo.13754392

2.3. D-8 Countries in Facing Food Security

An intergovernmental group known as D-8 is made up of eight developing nations. Eight developing countries make up the D-8: Bangladesh, Egypt, Indonesia, Iran, Malaysia, Nigeria, Pakistan, and Turkey. The D-8 has grown in both scope and operations since its founding in 1997, thanks to the dynamism and vitality of the private sector, which has formed various alliances and collaborations. Moreover, interpersonal interaction has improved, generating a feeling of community and building trust in the D-8 (Developing8.org, 2020).

The 9th D-8 Summit, held on October 20, 2017, in Istanbul, Turkey, decided that the D-8 Decennial Roadmap should be created to guide cooperation between 2020 and 2030 in order to encourage a practical and results-driven approach to cooperation. One of the organization's most important publications, the D-8 Decennial Plan 2020–2030, will pave the path for a more robust and developed D-8 community. The present procedures should be reviewed, updated, and expanded upon in light of the evolving nature of the global economic environment. Also, it will bring all of the organization's essential parts together in an effort to promote intra-trade and achieve successful economic cooperation. As D-8 moves into its second stage of development, the Decennial Roadmap will assist Member States in realizing their unique potential and fostering synergy via teamwork and collaboration.

The Agriculture and Food Security Program within the D-8 Roadmap encompasses a wide range of initiatives aimed at promoting cooperation among member states in the areas of agriculture and food security. These initiatives include finalizing the D-8 Programme for Food Security, developing a comprehensive cooperation framework to achieve self-sufficiency in food, and inaugurating the D-8 Research Center for Agriculture and Food Security in Pakistan. The program also involves reviewing trade barriers, establishing collaborative linkages between scientific institutions and the industry, conducting research and development to reduce input costs, and strengthening technology transfer and extension services to increase productivity.

Furthermore, the Agriculture and Food Security Program includes exchanging information and best practices on various aspects such as Halal food production, climate change impact on crop degradation, quality and safety standards, and regulations for food, agriculture, fisheries, livestock, and forestry products. It also emphasizes promoting trade, investment, and services related to agriculture and forestry, strengthening cooperation in the marine and fisheries sector, and exchanging food safety regulatory systems and comprehensive food and nutrition security monitoring systems. Additionally, the program aims to facilitate research, studies, and publications on food security, agriculture, and nutrition, and establish a comprehensive food security online database/information system.

Overall, the Agriculture and Food Security Program under the D-8 Roadmap is focused on enhancing cooperation among member states in various areas related to agriculture and food security. It encompasses initiatives aimed at improving self-sufficiency in food production, strengthening resilience and adaptive capacity of food systems, promoting technology development and innovation, reducing trade barriers, and sharing knowledge and best practices. Through these efforts, the program aims to foster sustainable agricultural practices, increase food security, and promote economic growth and development among the D-8 member states.

2.4. Previous Studies

Many authors have looked at the levels of food security in various regions using food security dimensions. Determining Food Security under Crisis Conditions: A Comparative Study of the Western Balkans and the EU is the title of research by Makovski et al. (2020). The main goal of this research is to identify the variables that affect food security and its level in the Western Balkans throughout the EU integration process. In order to do this, the four FAO dimensions of food security—stability, availability, access, and utilization—are looked at. The Western Balkan and European Union countries are then ranked according to their levels of food security using the Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE) technique.

The findings show a large gap in the levels of food security between these countries due to the Western Balkan countries' huge economic development lag relative to the EU. While being less secure than in the EU, food security in the Western Balkans is not in danger. But, at times of crisis, it may become in danger (such as the COVID-19 pandemic). The main reasons for this discrepancy are that these nations have a lower Gross Domestic Product (GDP) per capita than the EU, a high degree of fluctuation in their food supplies, and a reliance on imported cereals.

Viana et al (2022) conducted research that systematically reviewed the contributions of the different agricultural research studies by systematizing the main research fields and presenting a synthesis of the diversity and scope of research and knowledge. The study's findings demonstrate that agriculture provides the largest proportion of the world's food sources and maintains a significant number of ecosystem services (e.g., food provisioning). As a result, agriculture is essential for ensuring food security and advancing SDG 2 (Zero Hunger) and other SDGs.

Zen et al. (2021) also examine the topic of food security. Since 2015, global food insecurity has become more severe and has historically been a problem for developing nations, including those in Central Asia. This study empirically estimates the impact of trade openness and other factors on food security based on the four pillars of food security (availability, access, stability, and utilization) and uses a panel data fixed effect model as the baseline model to trace a U-shaped (or inverted U-shaped) relationship between trade openness and food security. The least-squares (LS) approach on the aggregated data and the dynamic panel data (DPD) analysis with the generalized method of moments (GMM) strategy were then used to simultaneously run the robustness test.

The results show that (1) there is a U-shaped relationship between trade openness and the four pillars of food security, indicating that food security in Central Asian countries tends to improve beyond a certain threshold of trade openness; and (2) GDP per capita, GDP growth, and agricultural productivity have all contributed to the improvement of food security. Food security is negatively impacted by employment in agriculture, arable land, freshwater withdrawals from agriculture, population growth, natural disasters, and inflation rates; (3) this study demonstrates that trade policy reforms can finally lead to an improvement in food security in Central Asian countries.

Nevertheless, it is still essential for Central Asian countries to achieve food security by reaching adequate levels of food self-sufficiency due to the effects of other factors, the possible drawbacks of trade openness, and the vulnerability of the global

DOI: 10.5281/zenodo.13754392

food trade network. This study can offer scientific justification for food system sustainability plans in Central Asian countries.

3. Methodology

3.1. Data and Sample

Quantitative data, or data quantified on a numerical scale by secondary data, are the type of data employed in this research. This study utilizes panel data from D8 countries, which include Bangladesh, Egypt, Indonesia, Malaysia, Nigeria, Pakistan, and Turkey, but not with the country of Iran because Iran data has not been updated by data center from various sources. This limitation may impact the comprehensiveness and generalizability of the research findings.

The panel data covers a period of 9 years from 2012 to 2020, which allows for a comprehensive analysis of food security trends over time. The data for the key variables, including value added in agriculture (% of GDP), agricultural production, export of agricultural products in total export, and land productivity, are obtained from reputable sources such as the World Bank, FAOs, GFSI and national statistical agencies.

3.2. Panel Data

Panel Data is a type of data that consists of observations on multiple entities (such as individuals, firms, or countries) over multiple time periods. It combines both cross-sectional data (observations on multiple entities at a single point in time) and time-series data (observations on a single entity over multiple time periods). This data analysis is widely used in various fields, such as economics, finance, and social sciences, for studying the impacts of policies, individual behaviors, and other factors on different outcomes.

Panel data allows researchers to capture changes in food security outcomes over time. Food security is a dynamic issue that can be influenced by various factors such as climate change, economic conditions, and policy interventions. Panel data enables researchers to track these changes and understand how food security evolves over time in D8 countries (except Iran), which are Bangladesh, Egypt, Indonesia, Malaysia, Nigeria, Pakistan, and Turkey. It offers a powerful analytical tool for evaluating food security in D8 countries by allowing researchers to account for both country-specific factors and temporal dynamics, as well as facilitating comparisons across countries and the assessment of the impact of various interventions.

3.3. Econometric Model

To evaluate the determinants of food security in D8 countries, panel data analysis will be employed. The Random Effect Model is particularly suitable for this study as it allows for the examination of both cross-sectional and time-series variations in the data, and accounts for individual country-specific effects. The following econometric equation regression model will be estimated:

$$Y = \beta_0 + \beta_1 GDP + \beta_2 APR + \beta_3 EXPR + \beta_4 LAND + \varepsilon$$

Annotation:

- Y is Food Security, which is the dependent variable, measured using a composite index of food availability, access, utilization, and stability indicators.
- GDP, APR, EXPR, and LAND are the independent variables, representing the key factors related to agriculture and trade that are expected to influence food security outcomes.
- β_1, β_2, β_3, and β_4 are the estimated coefficients of the respective variables, representing the strength and direction of the relationship between the variables and food security.
- GDP_i represents the country's GDP's share of agriculture's added value.
- APR_i represents the value of agricultural production per capita in the country i.
- $EXPR_i$ represents the proportion of agricultural exports to total export in the country i.
- $LAND_i$ represents land productivity in the country i.
- ε represents the error term, capturing other factors or influences that may affect food security but are not included in the model.

3.4. Estimation Technique

The panel data regression model will be estimated using appropriate panel data regression techniques, such as fixed effect or random effect models, depending on the results of panel data diagnostics tests. These techniques account for country-specific effects and provide robust estimates of the coefficients.

To find out which model is appropriate for processing this panel data, it was tested with the Chow Test, Hausman Test and Langrage Multiplier Test, and the results are as follows:

Table 1 Chow-test Result

Cross-section F	33.986088	(6,52)	0.0000
Cross-section Chi-square	100.397279	6	0.0000

Source: the authors' calculations on Eviews

Table 2 Hausman-test result

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	8.983546	4	0.0615

Source: the authors' calculations on Eviews

Table 3 Lagrange Multiplier test result

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	111.8255	0.746793	112.5723
	(0.0000)	(0.3875)	(0.0000)

Source: the authors' calculations on Eviews

Based on the results of the Chow Test, Hausman Test, and Lagrange Multiplier Test, we can interpret the most appropriate model for processing the given panel data as follows:

- Chow Test: The probability value is 0.0000, which is less than 0.05. This indicates that the Fixed Effects Model (FEM) is more appropriate than the Common Effects Model (CEM).
- Hausman Test: The probability value is 0.0615, which is more than 0.05. This suggests that the Random Effects Model (REM) is more appropriate than the Fixed Effects Model (FEM).

DOI: 10.5281/zenodo.13754392

- Lagrange Multiplier Test: The probability value is 0.0000, which is less than 0.05. This indicates that the Random Effects Model (REM) is more appropriate than the Common Effects Model (CEM).

Considering the results of all three tests, we can conclude that the Random Effects Model (REM) is the most appropriate choice for analyzing this panel data. The REM takes into account both within-entity variations and between-entity variations, making it a suitable model for capturing unobserved entity-specific effects and time-invariant factors.

3.5. Classical Assumption Test

To find out whether a regression model is good or not when used for estimation, it is necessary to test the classical assumptions. The classic assumption test is a series of tests carried out to find out whether there are significant disturbances in the existing data. To obtain the overall relationship between the dependent variable and a set of independent variables and identify factors that influence the dependent variable, this research applies Random Effect Model regression. Since the research employed Random Effect Model, the tests that will be run are only multicollinearity test and heteroscedasticity test.

a. Multicollinearity Test

A statistical method called the Multicollinearity Test can be used to determine whether a regression model contains multicollinearity. When two or more independent variables in a multiple regression model have a high degree of correlation, this phenomenon is known as multicollinearity, which makes it challenging to isolate the individual effects of each independent variable on the dependent variable. Multicollinearity can result in inflated regression coefficient standard errors, unstable estimations of the regression coefficients, and therefore less interpretable models.

Table 4 Multicollinearity test result

	GDP	APR	EXPR	LAND
GDP	1	-0.1647	0.0184	0.4569
APR	-0.1647	1	0.1633	0.1708
EXPR	0.0184	0.1633	1	0.2521
LAND	0.4569	0.1708	0.2521	1

Source: the authors' calculations on Eviews

Multicollinearity is not a concern when the correlation coefficients between the independent variables are low (typically, below 0.8). In this case, all the correlation coefficients between the independent variables are below 0.8:

- APR and EXPR : 0.1633
- APR and LAND : 0.1708
- EXPR and LAND : 0.2521

Since all the correlations between the independent variables are relatively low, it is safe to assume that multicollinearity does not occur in this data result.

b. Heteroscedasticity Test

Heteroscedasticity test which is carried out by carrying out residual regression (U_t^2) with the squared independent variables and the multiplication of the independent variables. If the probability of each variable is greater than 0.05, then the data is free from the heteroscedasticity test.

Table 5 Heteroscedasticity test result

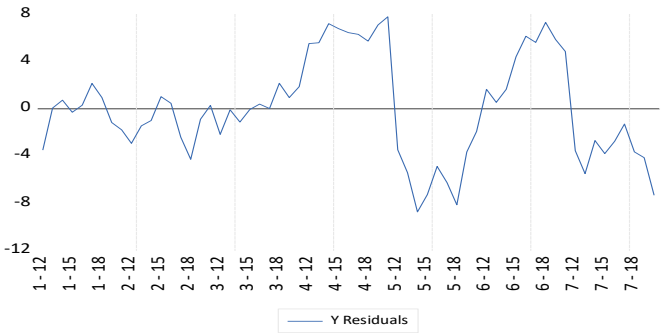
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.404193	5.334739	0.263217	0.7933
GDP	-0.259188	0.162310	-1.596865	0.1157
APR	0.000526	0.000439	1.197546	0.2360
EXPR	-0.436891	0.189463	-2.305941	0.0247
LAND	3.77E-05	4.80E-05	0.784371	0.4360

Source: the authors' calculations on Eviews

The result obtained above shows that heteroscedasticity only occurs in EXPR variable because the probability of EXPR variable is 0.0247 and it is below 0.05.

Because of it, the test continues to the next stage, and here is the result:

Picture 1 Heteroscedasticity next stage test result



Source: the authors' calculations on Eviews

From the residual graph (blue) above, it can be seen that the values do not cross the limits (500 and -500). This means that the residual variance is the same. Therefore, there are no symptoms of Heteroscedasticity, and it does not occur (Napitupulu el al., 2021).

3.6. Data Analysis

Panel data regression results will be analyzed to evaluate the statistical significance and direction of the coefficients for the key variables of interest. The magnitude and significance of the coefficients will provide insights into the relative importance of each variable in explaining food security outcomes in D8 countries. However, it is important to acknowledge that data for Iran, one of the members of the D8 countries, was not available for the analysis.

The absence of Iran's data in the analysis may result in incomplete and potentially biased results, as Iran represents a significant country within the D8 group with its unique agricultural systems and challenges. The exclusion of Iran's data may limit the ability to fully capture the nuances and trends of food security in the D8 countries, and caution should be exercised in interpreting the results without considering Iran's data.

Efforts were made to obtain data for Iran; however, due to data unavailability or other reasons, it was not included in the analysis. Despite the efforts to collect comprehensive data, the missing data for Iran represents a limitation of this study. It is important to acknowledge this limitation and highlight the potential implications on the research findings and conclusions.

The methodology employed in this study will allow for a comprehensive analysis of the determinants of food security in D8 countries, providing valuable insights into the challenges and strategies for achieving sustainable food systems in the region. The findings of this study can contribute to the existing literature on food security and inform policymakers and stakeholders in D8

DOI: 10.5281/zenodo.13754392

countries on evidence-based strategies to improve food security outcomes.

4. Result

4.1. Hypothesis Test Results

The result is as follows:

Table 6 Heteroscedasticity test result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	56.98539	6.959590	8.188039	0.0000
GDP	-1.275899	0.233143	-5.472599	0.0000
APR	0.001433	0.000525	2.732836	0.0083
EXPR	-0.605207	0.226985	-2.666282	0.0099
LAND	0.000118	8.27E-05	1.420983	0.1607

Source: the authors' calculations on Eviews

Based on the table provided, we can perform hypothesis tests for each variable using their coefficients, standard errors, and t-statistics. The null hypothesis (H_0) states that the variable has no significant effect on the dependent variable, meaning the coefficient is equal to zero. The alternative hypothesis (H_1) is that the variable has a significant effect on the dependent variable, meaning the coefficient is not equal to zero. Here are the hypothesis test results for each variable:

1. C (Constant)
   - Coefficient: 56.98539
   - t-Statistic : 8.188039
   - p-value : 0.0000
   - Result : Reject H_0. The constant term is significantly different from zero.
2. GDP
   - Coefficient : -1.275899
   - t-Statistic : -5.472599
   - p-value : 0.0000
   - Result : Reject H_0. The GDP variable has a significant effect on the dependent variable.
3. APR
   - Coefficient: 0.001433
   - t-Statistic : 2.732836
   - p-value : 0.0083
   - Result : Reject H_0. The APR variable has a significant effect on the dependent variable.
4. EXPR
   - Coefficient : -0.605207
   - t-Statistic : -2.666282
   - p-value : 0.0099
   - Result : Reject H_0. The EXPR variable has a significant effect on the dependent variable.
5. LAND
   - Coefficient : 0.000118
   - t-Statistic : 1.420983
   - p-value : 0.1607
   - Result : Fail to reject H_0. The LAND variable does not have a significant effect on the dependent variable at the usual significance levels (0.05 or 0.1).

4.2. Panel Data Regression Equation

The given regression equation represents a multiple linear regression model that estimates the dependent variable Y based on independent variables: GDP, APR, EXPR, and LAND. Here's an interpretation of the results:

$$Y = 56.985 - 1.28*GDP + 0.01*APR - 0.61*EXPR + 0.01*LAND + \varepsilon$$

The results of the regression equation obtained above can be interpreted as follows:

a. Constant (56.985): When all independent variables, which are GDP, APR, EXPR, and LAND, are set to zero, the predicted value of Y (Food Security) is 56.985.
b. GDP (-1.28): Holding all other variables constant, a one-unit increase in GDP is associated with a 1.28-unit decrease in the value of Y. This indicates a negative relationship between the share of the added value of agriculture in GDP and food security.
c. APR (0.01): Holding all other variables constant, a one-unit increase in APR is associated with a 0.01-unit increase in the value of Y. This indicates a positive, but weak, relationship between the value of agricultural production per capita and food security.
d. EXPR (-0.61): Holding all other variables constant, a one-unit increase in EXPR is associated with a 0.61-unit decrease in the value of Y. This indicates a negative relationship between the share of export of agricultural products in total export and food security.
e. LAND (0.01): Because the regression results get a probability that does not have a significant effect and fails to reject H0, it implies that there is no relationship between land productivity and food security.
f. ε represents the error term or residual, which captures the unexplained variation in Y that is not accounted for by the included independent variables.

5. Discussion

The findings of this study shed light on the determinants of food security in the D8 countries (except Iran), namely Bangladesh, Egypt, Indonesia, Malaysia, Nigeria, Pakistan, and Turkey. The results revealed that agricultural production per capita have a positive relationship with food security, indicating that higher agricultural production is associated with better food security outcomes in these countries. This underscores the importance of investing in agricultural production as strategies for enhancing food security in the D8 countries.

On the other hand, the study also found that the share of the added value of agriculture in GDP and the share of export of agricultural products in total export have a negative relationship with food security. This implies that a lower share of agriculture in GDP and a lower share of agricultural exports in total exports are associated with better food security outcomes. This finding may suggest that a narrow focus on agriculture as a driver of economic growth, without considering the broader food security implications, may not necessarily result in improved food security in these countries.

The results of this study have important implications for policymakers and stakeholders involved in addressing food security challenges in the D8 countries. Firstly, there is a need to prioritize investments in agricultural production to enhance food security. This may involve measures such as improving access to agricultural inputs, modernizing agricultural practices, and

DOI: 10.5281/zenodo.13754392

promoting sustainable land management techniques. Additionally, policymakers should take into consideration the broader implications of agricultural policies on food security, beyond just economic growth. Policies should be designed to promote not only agricultural production, but also access to food, affordability, and nutrition.

Furthermore, the negative relationship between the share of export of agricultural products in total export and food security suggests that relying heavily on agricultural exports may not necessarily translate into improved food security outcomes. Policymakers should diversify their export strategies and not solely rely on agricultural exports as a means of promoting economic growth and development. Diversification of the economy can help reduce vulnerability to external shocks and ensure a stable food supply for domestic consumption.

This study also has implications for other developing countries facing similar challenges in ensuring food security for their populations. The findings highlight the need for a holistic approach to food security, taking into consideration not only agricultural production but also access to food, affordability, and nutrition. It emphasizes the importance of balancing economic growth with the need to ensure food security for all, particularly vulnerable populations. Policymakers in other developing countries can draw on the findings of this study to design effective strategies and interventions to improve food security outcomes in their respective countries.

It is important to note that this study has some limitations. The use of panel data regression analysis, specifically the random effects model, has its assumptions and limitations. The results should be interpreted with caution, and further research using different methods and data sources is needed to validate the findings. Additionally, the study relies on secondary data, and the quality and reliability of the data may vary across the D8 countries, which could potentially impact the results. Future research could also explore the role of other factors such as climate change, policy interventions, and social factors in influencing food security in the D8 countries.

Table 7 Ranking of D-8 Countries (*except Iran*) according to food security

Rank	Country	Afford-ability	Avail-ability	Quality & Safety	Sustain-ability	Food Security	Total Average
1	Malaysia	84.7	54.6	74.1	49.2	66.8	66.8
2	Turkiye	68.4	57.9	74.9	53.6	63.9	63.9
3	Indonesia	74.6	51.4	60.7	46.1	59.2	59.2
4	Egypt	60.4	55.1	56.6	43.9	54.5	54.5
5	Bangladesh	53.2	62.8	54.6	42.5	53.5	53.5
6	Pakistan	61.6	48.6	49.7	34.2	49.5	49.5
7	Nigeria	43.8	39.8	52.1	47.4	45.5	45.5

Source: the authors' calculations

Based on the rank table provided, which shows the total average scores for food security in D8 countries (except Iran), the countries are ranked as follows:

1. Malaysia, Turkey, and Indonesia are the top three countries in terms of food security, with higher total average scores compared to the other D8 countries. This may indicate that these countries have relatively better food security situations compared to the others, potentially due to effective strategies and interventions in place to address food security challenges.
2. Egypt, Bangladesh, Pakistan, and Nigeria are ranked lower in terms of food security compared to Malaysia, Turkey, and Indonesia, with lower total average scores. This suggests that these countries may face greater challenges in ensuring food security for their populations, potentially due to factors such as limited agricultural productivity, inadequate infrastructure, or economic constraints.
3. The rank table provides a comparative perspective on the food security performance of D8 countries, indicating variations in food security situations among these countries. This can highlight the need for tailored strategies and interventions to address specific challenges faced by each country, taking into account their unique agricultural systems, economic conditions, and social contexts.

6. Conclusion

This study provides valuable insights into the determinants of food security in the D8 countries, highlighting the importance of agricultural production. The findings contribute to the existing literature on food security and provide important implications for policymakers and stakeholders in formulating strategies and interventions for sustainable food systems in the D8 countries and other developing countries facing similar challenges.

Based on the findings of this research, the following advice and suggestions can be provided to policymakers in D8 countries and each individual country:

- Investments in agriculture, such as expanding access to agricultural supplies, updating agricultural methods, and supporting sustainable land management techniques, should be prioritized by policymakers. This can help increase agricultural production, which is found to have a positive relationship with food security. Policies and programs should be designed to support smallholder farmers, promote sustainable farming practices, and enhance agricultural infrastructure and technology.
- As a means of fostering economic growth and development, policymakers should refrain from placing an undue reliance on agricultural exports. The negative

DOI: 10.5281/zenodo.13754392

relationship between the share of export of agricultural products in total export and food security suggests that diversifying export strategies can reduce vulnerability to external shocks and ensure a stable food supply for domestic consumption. Policymakers should explore and promote non-agricultural sectors, such as manufacturing and services, to diversify the economy and reduce dependency on agricultural exports.

- In food security policies and initiatives, policymakers should give priority to vulnerable groups, such as smallholder farmers, women, children, and disadvantaged communities. Targeted measures, such as social protection programs, nutrition education, and access to health services, should be designed to address the specific needs and vulnerabilities of these populations.
- To evaluate the effectiveness of policies and initiatives relating to food security, policymakers should set up effective monitoring and evaluation systems. Regular data collection and analysis can help policymakers understand the effectiveness of their interventions and identify areas for improvement. Evidence-based policymaking can contribute to more informed and targeted interventions to improve food security outcomes.

These recommendations can contribute to the development of effective strategies and interventions to achieve sustainable food systems and improve food security outcomes in the D8 countries, except Iran. The absence of Iran's data represents a limitation that should be taken into consideration when interpreting the findings. Further research with complete data for all D8 countries, including Iran, is warranted to obtain a more comprehensive understanding of food security in the region. Further research in this area can help advance our understanding of food security dynamics in diverse contexts and inform evidence-based policy decisions to achieve sustainable and inclusive food systems.

References

1. Developing8.org. (2020). D-8 Decennial Roadmap for 2020-2030 : Association of Southeast Asian Nations : Black Sea Economic Cooperation.
2. FAO. Declaration on World Food Security and World Food Summit Plan of Action. In Proceedings of the World Food Summit, Rome, Italy, 13–17 November 1996.
3. FAO. Trade Reforms and Food Security. 2003. Available online: http://www.fao.org/3/y4671e/y4671e00.htm#Contents (accessed on 14 May 2021). 12. Anderson, J.R.
4. Gujarati, D.N. (2004) Basic Econometrics. 4th Edition, McGraw-Hill Companies.
5. Mahrous, W. (2019). Climate change and food security in EAC region: a panel data analysis. Review of Economics and Political Science, 4(4), 270–284. https://doi.org/10.1108/REPS-12-2018-0039
6. Fusco, G. (2022). Climate Change and Food Security in the Northern and Eastern African Regions: A Panel Data Analysis. Sustainability (Switzerland), 14(19). https://doi.org/10.3390/su141912664
7. Matkovski, B., Đokić, D., Zekić, S., & Jurjević, Ž. (2020). Determining food security in crisis conditions: A comparative analysis of the Western Balkans and the EU. Sustainability (Switzerland), 12(23), 1–16. https://doi.org/10.3390/su12239924
8. Sun, Z., & Zhang, D. (2021). Impact of trade openness on food security: Evidence from panel data for central asian countries. Foods, 10(12). https://doi.org/10.3390/foods10123012
9. Viana, C. M., Freire, D., Abrantes, P., Rocha, J., & Pereira, P. (2022). Agricultural land systems importance for supporting food security and sustainable development goals: A systematic review. Science of the Total Environment, 806. https://doi.org/10.1016/j.scitotenv.2021.150718
10. Djuraeva D; Yoqutxon Y G. (2022). Challenges Of Food Security. International Conference on Research in Humanities, Applied Sciences and Education. Available online: https://conferencea.org

DOI: 10.5281/zenodo.13754392