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**THE REGIONAL ASPECTS OF FOOD SECURITY:  
THE CASE OF GANJA-GAZAKH REGION OF  
AZERBAIJAN**

**Theses of the Ph.D. dissertation**

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# **1. INTRODUCTION**

## **1.1. The Study Problem**

In Azerbaijan, food insecurity a major issue facing the country is the problem of climate change, rapid urbanization, limited productivity, and natural resource degradation. Increase in urban population requires increase in food supply in order to achieve a stable food security status requires more food to achieve food security. Azerbaijan has been facing food insecurity in various parts of the country every year (IFRC, 2008). The physical and social access to food is faced with challenges or poor infrastructural development such as poor storage and processing facilities, poor transportation means and road networks for timely transportation of the farm produce from rural to urban markets especially perishable farm produce (FAO,2003). The study of Murgai et al. (2001), showed that in Azerbaijan, factors such as low rural income level relative to increasing cost of living, household dependent ratio, and extensive unemployment contribute to household food insecurity. Therefore, individuals need to a satisfactory level of income or other modes to be able to purchase goods and services. Further low-income earnings in addition to unemployment has been associated to Azerbaijan's rural household's food insecurity status. (FAO, 2003) highlighted that since independence, achieving food security has been admitted as an imperative priority in Azerbaijan.

## **1.2. The Research Scope**

The agricultural sector has been considered as one of the key sectors which has a massive potential to develop and boost Azerbaijan economy significantly (ROA, 2008) and there are more prospects for achieving a significant reduction in household income and resource inequality and poverty. The agricultural sector plays a pivotal role in the economy of Azerbaijan. The major area of the country is used for agricultural activities. About 58% area of Azerbaijan was used for growing the different crops and farming of different animals. The major crops which are grown in 2010 were wheat and tomatoes. These two crops provide the maximum amount of production which was the highest value of the ever production. The peoples of Azerbaijan also take interest in cattle breeding, fishing, and forestry. They earn a lot of money by adopting such type of profession which directly affects the economy of the country. The country made progress through an

investment of money in the field of Agriculture. Poultry farming and buffalo breeding are also done for obtaining the highest monetary return. These two fields play a great role in developing the economy of the country. Meat is used by people and indirectly provides great money to the country and in return boosting the country's economy (GOA,2016). This study can then be used to understand the comprehensive phenomenon of multi-dimensional food security and to guide policy at regional, national and household level.

### **1.3. The Study Importance**

This research study will be useful for policy making, investors and non-governmental organizations to implement a significant and sustainable role to achieve food security at regional, national and household levels in Azerbaijan. It will also support and contribute to empirical evidence and the existing body of literature in the area of food security and open up further avenues for future research in the allied fields. This study aims to expand the understanding of the most critical issue of food security to support and improve the policy targeting marginal and food insecure segments of Azerbaijan population.

### **1.4. Background of the Study**

Agriculture is very sensitive to climate because when climate changes there is a great effect on the production of crops because specific crops grow with specific temperature, specific day length, specific photoperiod, and specific water requirements. When any one of these factors changes then the crops are automatically affected and finally the production of such crops is decreased. If crops are grown under favourable conditions, there tends to be a spontaneous increment in their growth with an increase in the overall production. With the incidence of climate change, the climate in Azerbaijan is also changing and the sector of agriculture is being affected. The agriculture facing drought, water scarcity, salinity and soil degradation in Azerbaijan (Chaaban, et al., 2018). About 47% of the population of Azerbaijan is currently living in rural areas and they depend on agriculture, so their lifestyle is affected due to changes in climate. Around 39% of employers are working in the agriculture sector so their living habits and living styles are also affected. Currently, the peoples of Azerbaijan are working to address climate change. Many other environmental issues in Azerbaijan are pollution if water resources with wastewater including transboundary pollution, insufficient quality of water and the soil of

Azerbaijan are degraded due to soil erosion and salinity, etc. It is stated that 39km water is present in Azerbaijan and out of it, 29.3 km is surface water and 8.8 km of water is underground. Experience of Azerbaijan. This study main purpose is to conduct an objective examination into the factors that affect the regional, national and household food security in Azerbaijan.

### **1.5. The Study Objectives**

This study aims to examine the determinants of household's and national food security in Azerbaijan generally and household food security in the Ganja-Gazakh region of Azerbaijan particularly. Besides, this study seeks to assess the link between the agriculture sector and food security in the light of various challenges.

The specific objectives of the study are given as:

1. What is the impact of food determinants on participants?
2. How do the participants perceive the different food security programs in the Ganja-Gazakh region of Azerbaijan?
3. Perceptions of participants about on their food security?
4. To examine the multi-dimensional determinants of food security in Azerbaijan.
5. What are the implications of the perceptions of the participants for policy and practice?

### **1.6. The Study Hypothesis**

The study hypothesises are given as follow:

- H1:** Does the food security determinant have a significant influence on the Ganja-Gazakh region or not?
- H2:** Does the Azerbaijan food security program have a significant impact on the participant or not?
- H3:** Does regional food have significance impact on regional economics or not?
- H4:** Do multi-dimensional determinants have a significant impact on the dynamics of national food security in Azerbaijan or not?

## **2. LITERATURE REVIEW**

This chapter is organized as follow: Section 2.1 describes the mapping the food security studies in Azerbaijan and reviewing the research priorities and gaps, and section 2.2 unfolding the food security studies in other countries. The section 2.3 reviews the present challenges of food insecurity in Azerbaijan. In the last section 2.4 explores the sustainable food security approach in Azerbaijan.

### **2.1. Exploring the sustainable household food security approach in Azerbaijan**

This short review paper aims at briefly highlight the research gaps and the right policy options for attaining the Azerbaijan household food security considering existing household food security studies of Azerbaijan and some regional countries to learn the experiences of regional economies.

#### **2.1.1. Protocols of Systematic Review Analysis**

To find the relevant studies, the researchers explored the electronic sources and reviewed the abstracts that previously synthesized food security analyses. Afterwards, criterion of the year of publication (2000 to 2018) was used for review analysis which was not applied by Villar-Compte *et al.* (2017).

##### **2.1.1.1. Synthesis of Azerbaijan household's food security studies**

Mammadov, (2017) highlighted the problems related to agriculture systems like irrigation, soil, water. A solution to these problems in Azerbaijan. The quantitative study was designed which indirectly targeted food security. Primary data was collected from 380 respondents. To attain food security, there is a need to explore and utilize the underground mineral of soil, surface, and ecosystem. Another research of Polat, (2015) explored the relationship between farming and agricultural education, farmer's income and level of production. The quantitative study was designed by employing secondary data from the year 1991 to 2013. The major findings from this research were that positive impact of farming education training on agriculture production. A recent study by Humbatova and Hajiyevev, (2016) analysed the impact of microfinancing and loan on agriculture and food

production. For this purpose, this study employed a secondary dataset from 2001 to 2015. Major findings from this research were that microfinancing and loan have positive impacts on the food and nutritional security of Azerbaijan. On the other side Tyczewska et al., (2018) examined the impact of population and climate change on agriculture production and productivity. In this research, they directly targeted food security problems. Secondary data was used from 1960 to 2015. Major findings from this research were that the used of agro-biotechnology in agriculture was a solution to the food security problem. Similarly, Oglu, (2018) explored that issues related to climate change, irrigation system and the problem of soil and salinity. Major findings from this research were that situations or problems in agriculture directly link with food security and development of the country. Achieving sustainable food security at the national level remains a great challenge not only for less developed countries but also for developed nations (Barrett, 1996). Although the Azerbaijan government has introduced many programs and policy interventions aimed at attaining national food security, all these efforts have not produced the required objectives (Chaaban, et al.,2018. In this research, they directly focused on food security by using secondary data from 2010 to 2016. Major findings from this research were that active restrictive policy ought to be enforced in several sectors of the economy in Azerbaijan at the macro and micro levels.

#### **2.1.1.2. Synthesis of global economies household's food security studies**

The study of Becquey *et al.*, (2012) analysed the seasonality of the dietary dimension of unit food security in Ouagadougou. For this purpose, the quantitative study was designed and directly targeted the issue of household food security. Primary data was used and collected from 1056 respondents. Results showed that intakes of energy and 10 micronutrients were considerably lower throughout the lean season than during the post-harvest season. Likewise, Frongillo and Nanama, (2006) studied the agencies measure household food insecurity for application layout, planning, concentrated on, implementation, tracking, and assessment, however current measures frequently are insufficient. A quantitative study was designed and directly targeted household food security. Primary data was used and collected from 126 respondents. Findings from this research were that the outcomes supplied sturdy evidence that the meals insecurity score, calculated from experience-primarily based questionnaire items, became valid for figuring

out seasonal variations in household meals insecurity, variations among families in food lack of confidence at a given time, and modifications in family food insecurity over the years in northern rural Burkina Faso. Another study of Da Silva Guerra et al. (2013) explored the household's food availability in the Brazilian Amazon. A quantitative study was designed and directly targeted household food security. Primary data was used and collected from 363 respondents. The results showed that 23.1% prevalence of mild to intense meals lacks confidence, suggesting affiliation with the following: low earnings, negative sanitation.

This study underlined the research gaps and the right policy options for achieving the Azerbaijan household food security considering existing household food security studies of Azerbaijan and some other countries to learn the experiences of regional economies. We found that household and individual food security is vulnerable due to climate change and exchange rate and international price volatility which requires urgent attention from both domestic as well as international. The synthesis of food security studies suggests a different factor that may influence the state of household food security. The best-performing nations in terms of household food security are those with high research and development. It will improve the potential of domestic agriculture food supply for meeting national household and individual's needs. At the household level, every nation, including Azerbaijan, need a database of cross-sectional, time series and panel datasets to study the food availability, accessibility, affordability, utilization, hunger and malnutrition that will provide early warning assistance to policymakers. The structure of social safety nets can mitigate the impact of food inflation on most vulnerable populations. In Azerbaijan at the household level, there is a need for inclusive household food security policy in order to achieve sustainable developmental plans that consider Azerbaijan's household characteristics and specificities and address both food accessibility and utilization dimensions of the country's food security. Household food security strategies should include short- and long-term policies that decrease food inflation and benefiting for both demand and supply side sectors. Instead of openly overruling in the agro market system to control the domestic prices, many nations adopt policies that offset the adverse impact of food inflation on common masses.

### **3. MATERIALS AND METHODS**

This chapter is organized as follows: the section 3.1 presents the methodology of the objective-1 and adds relevant information about food security dimensions, study design, and empirical strategy. The section 3.2 presents the methodological setup of the objective-2 of the dissertation. Similarly, section 3.3 presents the empirical methodology of objective 3.

#### **3.1. Multidimensional determinants of national food security in Azerbaijan**

The present study helps fill this gap by incorporating the multidimensional determinants of food security at the national level. The prime objective of this study is to examine the determinants of the national food security situation in Azerbaijan. The specific objectives of the study are to analyze the short-term and long-term dynamics of these determinants on food security status.

##### **3.1.1. Theoretical Background**

Food insecurity generally happens when people don't have physical, economic or social access to safe and healthy food, and chronic food insecurity occurs whenever they are incapable of diminishing or absorbing the adverse impact of food price shocks (FAO,2003). Food insecurity is interrelated yet separate from other social issues such as malnutrition and poverty. Primarily, the failure of efforts to control food insecurity is possibly the result of overemphasis on ensuring food availability at the national and household level (IFAD,2010). While a sustainable food security situation hangs on total food production and agricultural performance, it also is contingent on food access, utilization and stability (Jafarova, 2016). Therefore, looking only at the food availability component is a weak estimator of food security, as such analysis only conveys one aspect of the entire population (FAO,2015a). Most of the existing literature empirically observes the food availability component for national food security. However, food availability and accessibility cannot be explicitly distinguished at the national level, where constraints of data availability fail to disclose the extent to which food is physically and economically available in the domestic market. In addition, people's attitudes towards food acquisition don't always reflect food accessibility (Khalilov, et al, 2015). So, the food availability

approach to food security might not relate to its latent benefits, consequences, and causes.

This study gives a marginally different framework to explain how food security dynamics are examined and managed at the national level. The paper asserts there to be three main components of national food security analysis: food availability; food accessibility; and food utilization. This framework is very suitable for our analysis, subject to data and time constraints. While a reliable approximation of food security dynamics is a prerequisite for well-targeted policies and effective program implementations, there is no unique procedure for food security measurement. And despite the FAO's strong theoretical foundation, there exists no uniform tool that apprehends all dimensions of food security (FAO, 2003). The unattainability of such a gold standard makes it ineffective to employ a single benchmark as an accurate assessment of food security. Due to its multidimensional nature, it is typically agreed that a group of indicators is required for the accurate study of food security (IFAD,2010). This study employs the quantitative approach to explore how multidimensional deterrents affect the food security dynamics in Azerbaijan at the national level. This analysis will be useful for food security policymaking and monitoring analysis.

### 3.1.2. Methodological Setup

It is a precondition to test the stationarity and order to the integration of each variable in a model before employing the short and long run econometric technique. For this purpose, this study used the ADF test (Dickey and Fuller, 1981) for analyzing the order of stationarity of each time series. Unit root analysis was used for both conditions, with and without trend at 5 percent level of significance. The general equation of the augmented Dickey-Fuller (ADF) is bellow (Eq.1).

$$\Delta Y_t = \alpha + \beta_1 t + \delta Y_{t-i} + \sum_{i=1}^m \lambda_i \nabla Y_{t-i} + \varepsilon_t \quad (1)$$

Where  $\varepsilon_t$  is error-term (white noise).

### 3.1.3. Specification of Co-Integration Model

There are numerous models proposed to estimate cointegration such as Enger-Granger (1987), Johansen and Juselius test (1990), and ML-based Johansen model (1992). It is a criterion for the applications of these cointegration approaches that time series variables be stationary or integrated at the same time; otherwise they produce spurious results (Kim *et al.*, 2004). ARDL bounds testing approach or Autoregressive Distributive Lag Model to estimate long-run cointegration as developed by Pesaran *et al.* (2001), which is appropriate to small samples (Haug, 2002). This model can also be relevant, regardless of stationary level e.g. I (1) or I (0) (Pesaran *et al.*, 2001). In ARDL test, if estimated F-statistics value exceeds the upper critical bound value, then the time series is said to be cointegrated and vice versa. If the estimated F-statistics fall between the lower and upper bound values, then the series is said to be inconclusive cointegration. After establishing the long-run cointegration, the error correction method (ECM) used to examine the short-run relationships take the form defined in Eq (3) below:

$$\begin{aligned} \Delta FS = a + \sum_{i=1}^m \phi_1 FIM_{t-i} + \sum_{i=1}^m \phi_2 TGDP_{t-i} + \sum_{i=1}^m \phi_3 ER_{t-i} + \sum_{i=1}^m \phi_4 CPI \\ + \sum_{i=1}^m \phi_5 CC + \sum_{i=1}^m \phi_6 UPG + \sum_{i=1}^m \phi_7 FS + \\ \in \text{----- Eq2} \end{aligned}$$

$$\begin{aligned} \Delta FS = \sum_{i=1}^m \phi_1 \Delta FIM_{t-i} + \sum_{i=1}^m \phi_2 \Delta TGDP_{t-i} + \sum_{i=1}^m \phi_3 \Delta ER_{t-i} + \sum_{i=1}^m \phi_4 \Delta CPI \\ + \sum_{i=1}^m \phi_5 \Delta CC + \sum_{i=1}^m \phi_6 \Delta UPG + \sum_{i=1}^m \phi_7 \Delta FS + \in \text{----- Eq3} \end{aligned}$$

F test of the null that:  $\phi_1 = \phi_2 = \phi_3 = \phi_4 = \phi_5 = \phi_6 = 0$

### 3.2. Determinants of Regional Food Security

The main research objective is to identify the determinants of food security in Azerbaijan, Singapore, Austria, Georgia and Hungary. These counties have small

population size and had quite comparable socioeconomic situations and demographical profile. So, we selected them for examining the food security dynamics. Moreover, a specific objective is to investigate the short- and long-term impacts of both endogenous and exogenous shocks on the food security of the selected countries.

### 3.2.1. Econometric Modelling Framework

This study assessed the dynamics of food security of five selected regional economies by employing the Panel GMM estimation approach as proposed by Arellano and Bover (1995) and Blundell and Bond (1998). In order to study the empirical dynamics, we will estimate the moment conditions for  $f(FPI, \lambda)$  that is used as proxy of the food security (Eq.1):

$$m(\lambda_0) \cong E[f(FPI, \lambda_0)] = 0, \quad (1)$$

where FPI is the proxy of food security dynamics in each moment condition  $\lambda \neq \lambda_0$ .

The estimation of moment condition represents the simple average function (Eq.2):

$$\hat{m}(\lambda) \cong \frac{1}{n} \sum_{n=1}^n f(FPI, \lambda) \quad (2)$$

Let us minimise the  $f(FPI, \lambda)$  with respect to the  $\lambda$ , using the Eq.2. The estimator results will depend on the choice of the norm function as given (Eq.3):

$$\|\hat{m}(\lambda)\|_W^2 = \hat{m}(\lambda)' W \hat{m}(\lambda), \quad (3)$$

Here W represents the weight norm function bases of the given data set.

The Eq.4 represents the final equation of the GMM, based on all properties of GMM (consistent, efficient, and asymptotically normal):

$$\hat{\lambda} = \arg \min_{\lambda \in \Theta} \left( \frac{1}{n} \sum_{n=1}^n f(FPI, \lambda) \right)^n \hat{W} \left( \frac{1}{n} \sum_{n=1}^n f(FPI, \lambda) \right). \quad (4)$$

$$\ln FPI_{ij} = \beta_{ij,1} FPI_{t-1} + \beta_{ij,2} CPI + \beta_{ij,3} FII + \beta_{ij,4} FEI + \beta_{ij,5} PCGDP + \beta_{ij,6} FDIGDP + \beta_{ij,7} HDI + \varepsilon_{ij} \quad (5)$$

Where “I” represents cross section (number of countries) and j represents data span (1992-2019).

### 3.2.2. Data Description

Panel data were used to examine the regional dynamics of food security of selected five economies (Azerbaijan, Singapore, Austria, Georgia, Hungary). The annual data were taken from the World Development Indicators (WDI) published by World Bank for the period 1992 to 2019. Table 1 represents the detailed description and the unit of all variables used to estimate the dynamics of food security of selected countries.

**Table 3-1 Variable Description**

Sr.	Variables	Unit	Description
1	Food Production Index	Index	FS
2	Per capita GDP	Dollar	PCGDP
3	Consumer Price Index	Index	CPI
4	Food Import Index	Percentage (%)	FII
5	Food Export Index	Percentage (%)	FEI
6	Human Development Index	Index	HDI
7	Foreign Direct Investment to GDP Ratio	Percentage (%)	FDIGDP

Source: Authors’ own table

### **3.3. Estimation of food and nutritional security in Azerbaijan**

To our knowledge, none of the recent studies on food security have seek to estimate household food security situation and factors affecting the food and nutritional security. Therefore, this study aims to examine the food and nutritional security situation at the household level by the primary data.

#### **3.3.1. Materials, methods and experimental design**

##### **3.3.1.1. Location of Data collection**

The primary data was collected from the Ganja-Gazakh economic region of Azerbaijan that consists of Deshkesen, Goygol, Samukh, Agstafa, Gadabay, Gazakh, Garanboy, Tovuz, Shamkir districts and cities such as Naftalan and Ganja. The most developed city is Ganja city in Ganja-Gazakh economic region. This region represents 14% of the country's total population. In Ganja-Gazakh economic region, 53 percent population lives in rural areas and 47 percent live in urban areas (ROA, 2016).

##### **3.3.1.2. Household food security (Dietary Intake Approach)**

This study applied the dietary intake approach (DIA) as used by Bashir et al., (2013) for estimating the household food security status. Seven (7) days recall approach was used, household and per capita food intake were estimated. Thus, the adult equivalence units were used concerning gender and age groups. The mathematical expression of the DIA approach is given as:

$$FS_i = \sum cal'_i - L \geq 0$$

Where  $FS_i$  represents the status of Azerbaijan's food security at the  $i$ th household. ( $i = 1, 2, \dots, n$ ). The expression of  $Cal_i$  is exhibited total food intake in the form of calories. The 2450 kcal/per person/ per day criteria is used as a threshold for food security individuals. Azerbaijan household is said to be food secure household if the  $FS_i$  of a given household is greater than 0

## 4. RESULTS

### 4.1. Results of National Food Security in Azerbaijan

To estimate the long-term food security dynamics, the cointegration test is used to attain the equilibrium between multidimensional determinants and the food security situation in Azerbaijan. Table 2 below gives the results of the ARDL bounds test. Empirical evidence shows that the value of F-statistics (5.020) drives beyond the upper bound critical values at 5% level of significance, confirming the long term cointegration between multidimensional determinants and food security dynamics, explaining the long-term relationship. The coefficients of long term cointegration estimated following the empirical finding of the ARDL model are given in Table 4.1.

**Table 4-1 ARDL Bound Test**

<b>ARDL Bounds Test</b>		
Null Hypothesis: No long-run relationships exist		
<b>Test Statistic</b>	<b>Value</b>	<b>K</b>
<b>F-statistic</b>	5.020390	6
<b>Critical Value Bounds</b>		
<b>Significance Level</b>	<b>Lower Bound</b>	<b>Upper Bound</b>
10%	2.24	3.25
5%	2.76	3.60
2.50%	2.88	4.20
1%	3.35	4.58

Source: Author's calculations

The empirical findings of long-term estimates show that food import has a negative and statistically significant impact on the domestic food supply of Azerbaijan. The coefficient of food imports suggests that a 1% increase in food import will lead to a decrease of 0.38% in the domestic per capita food supply in Azerbaijan. The existing evidence supports this long-term negative relationship (Mary, S. 2019). Empirical evidence suggests that if Azerbaijan adopts more in-ward looking policies to develop the agriculture sector, it will improve the sustainable food supply and security as well as economic growth and trade

terms. However, the long-term estimates show trade to GDP ratio has a positive and significant impact on access to food security. The estimated coefficient of trade to GDP ratio suggests that a 1% increase in trade to GDP ratio leads to an improvement of 0.13% for the access to food security in the long term in Azerbaijan. In Table 3, empirical results show that depreciation in the exchange rate has a negative and significant impact on the food security situation because Azerbaijan's national food security largely depends on import of food products. Depreciation in domestic currency against the foreign currency leads to an adverse impact on food access and availability in Azerbaijan.

The exchange rate coefficient is interpreted as 1% depreciation in the local currency against the foreign currency which leads to a 0.19% negative impact on the food security situation in the long term for Azerbaijan. There are a number of papers that confirm this adverse dynamic of exchange rate depreciation on food security of developing countries (Ilyasov, J. (2016). Similarly, CPI, a proxy of inflation rate, also has negative costs and significant impact on long term food security dynamics of Azerbaijan. The coefficient of inflation in Azerbaijan interprets as a 1% increase in inflationary phenomena leading to a decrease of 0.41% in national food security in the long term. Inflation is a determinant of food accessibility at the national level; more inflationary pressure in the domestic market leads to more possibility for suppressing the food demand and accessibility in Azerbaijan.

#### **4.2. Determinants of Food Security in Regional Economies**

The results of descriptive statistics explain the dynamics of the food security of the selected economies. The value of average food production value is 70.27, while 339.02 was the maximum and 3.17 was the minimum value, respectively (Table 4.5). The average ratio of foreign direct investment to GDP was 9.62 percent between 1992 and 2019. The maximum and minimum values of foreign direct investment to GDP were 55.08 to -15.98 percent, respectively, where 55.08 was the maximum foreign direct investment to GDP in the selected countries during 2003. The lowest foreign direct investment to GDP ratio was observed during 2010. Similarly, the average human development index value was around 0.79, while 0.94 was the maximum and 0.61 was the minimum value of HDI, respectively. The average value of CPI was 89.63 between 1992 and 2019, the maximum and minimum CPI values were 155.22 and 48.02. The average food import index value was about 9.22, while the average food export index value was 3.60. (see Table 4.1)

**Table 4-2 Descriptive Statistics**

	<b>FDIGDP</b>	<b>HDI</b>	<b>CPI</b>	<b>FII</b>	<b>FEI</b>	<b>PCGDP</b>	<b>FPI</b>
<b>Mean</b>	9.62	0.79	89.63	9.22	3.60	25556.85	70.27
<b>Median</b>	7.03	0.79	86.05	5.70	3.48	30413.93	89.68
<b>Maximum</b>	55.08	0.94	155.22	39.10	8.34	59754.99	339.02
<b>Minimum</b>	-15.98	0.61	48.02	2.26	1.11	1238.48	3.17
<b>Std. Dev.</b>	13.15	0.09	25.58	7.18	1.59	19524.17	57.46
<b>Skewness</b>	0.50	-0.12	0.43	1.48	0.98	0.06	0.82
<b>Kurtosis</b>	8.21	2.17	3.08	6.11	3.79	1.54	4.87

Source: Authors' own calculations

The above Table 4.2 reports the results of Sargan test post-estimation for examining the reliability of the model. The Sargan test examines the over identification restrictions of the model. The results show that there was no problem of over identification restrictions in the model and that instrumental variables were uncorrelated with the error term and were correctly specified. The estimated value of the chi square was greater than the critical value of 1,5, while the level of significance was 10 percent.

### **4.3. Results of Household Food and Nutritional Security in Azerbaijan**

Similarly, this study also examined nutritional food security in terms of fat intakes. At the 80gm/adult equivalents/day threshold level, in terms of fat intakes nutritional security about 51 percent Ganja-Gazakh region households were food secure while the remaining 49 percent of households were found intakes of fats insecure. On the other hand, we have also studied the intakes of carbohydrates' nutritional security. According to 180gm/adult equivalents/day threshold level, about 60 percent of households were found 60 percent while reaming 40 percent were found to be carbohydrates insecure. In terms of iron security, 56 percent of households were found iron deficient. The iron deficiencies were the main cause of anaemia among women and kids under 5 years. Same in the case of zinc security level, almost all the population were suffering from zinc deficiency.

**Table 4-3 Household food security status in Azerbaijan**

Household Food security Status	Frequency @ 2350kcal/day/person	Frequency @ 2450kcal/day/person
HH food secure	243 (81%)	231 (77%)
HH food insecure	57 (19%)	69 (23%)
<b>Nutritional Security of Household (Proteins Intake Level)</b>		
	FS Status 70Gm in Proteins	Percentage %
HH food secure	165 (300)	55%
HH food insecure	135(300)	45%
<b>Nutritional Security of Household (Fats Intake Level)</b>		
	FS 80Gm FATS	Percentage %
HH food secure	153(300)	51%
HH food insecure	147(300)	49%
<b>Nutritional Security of Household (Carbohydrates (CH) Intake Level)</b>		
	FS 180Gm CH	Percentage %
HH food secure	180(300)	60%
HH food insecure	120(300)	40%
<b>Nutritional Security of Household (Iron Intake Level)</b>		
	FS 180Gm Iron	Percentage %
HH food secure	138(300)	46%
HH food insecure	162(300)	54%
<b>Nutritional Security of Household (Zinc Intake Level)</b>		
	FS 15mg in Zinc	Percentage %
HH food secure	159(300)	53%
HH food insecure	141(300)	47%
<b>Nutritional Security of Household (Calcium Intake Level)</b>		
	FS 1000mg in Calcium	Percentage %
HH food secure	204(300)	68%
HH food insecure	96(300)	32%
<b>Nutritional Security of Household (Phosphorus Intake Level)</b>		
	FS 1000mg in PHP	Percentage %
HH food secure	216(300)	72%
HH food insecure	84(300)	28%

Source: Author's calculations

Therefore, it is essential to ensure the micronutrient balance among the households to attain sustainable food and nutritional security in Azerbaijan. According to the nutritional security of calcium by using the 1000mg/adult equivalents/day threshold level, about 32

percent of households were found insecure in calcium intake. Same in the case of phosphorus security by using 1000mg/adult equivalents/day threshold level, about 28% of households were found insecure in a selected region of Azerbaijan.

**Table 4-4 Results of Multidimensional Food Security in Azerbaijan**

AZERBAIJAN	Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	MFSI Ranking 2018	GFSI Ranking 2018	
	MFSI Ranking	-	-	-	-	-	-	-	-0.9	-	-	59 <sup>th</sup>	54 <sup>th</sup>
	Year	2002	2003	2004	2005	2006	2007	2008	2009	2010			
	MFSI Ranking	0.74	0.73	0.77	0.77	0.81	0.85	0.91	0.96	0.99			
	Year	2011	2012	2013	2014	2015	2016	2017	2018				
	MFSI Ranking	0.94	0.96	0.95	0.94	0.96	0.96	0.93	0.96	0.99			
	Year												
	MFSI Ranking		1.03	1.02	1.04	1.06	1.06	1.06	1.05	1.07			

Data from the Global Food Security Index (GFSI) indicated that Azerbaijan food security has received significant improvement over time as shown in 2017-18. But the ranking of Azerbaijan as per multidimensional food security in 2017-18 obtained in present study does not correspond with ranking given by Global Food Security Index (GFSI). The differences in the ranking of Azerbaijan in both indexes was because we used more diverse and broad-spectrum indicators. It gave us deeper insights about food utilization and stability dimensions.

## 5. CONCLUSIONS AND RECOMMENDATIONS

### 5.1. Conclusion

. The ARDL model suggested that food import, exchange rate, inflation, climate change, and urban population growth have a negative impact on national food security dynamics of Azerbaijan. On the other hand, trade to GDP ratio has a positive impact on food security. This study finding is quite comparable to (Sutton, et al, 2013) because his paper also focused on food security dynamics and examined its linkages with socioeconomic determinants and climate change. Our findings suggest studies should be conducted in order to investigate the health and nutritional characteristics of individual countries looking at food security at regional, national and household levels. Also, food export was found to have had a negative impact on food availability and access.

A country can achieve sustainable development in many ways. Household food security is a multidimensional and complex issue. At present times, when household and individual food security is vulnerable due to climate change and exchange rates for currencies and international price volatility. There is a need for both domestic as well as global responses. Based on the findings of this study, there is a need for inclusive household food security policy for sustainable development plans that consider Azerbaijan's household characteristics and specificities and address both food accessibility and utilization dimensions of food security. Household food security strategies which should include short- and long-term policies. Research and development are critical for social and economic development of a country. Nations that are doing better in terms of household food security are those with high budget for intensive and continuous research and development that is economy driven in terms of implementation and sustainability. This forth objective explores the size of the dynamics of multidimensional factors on food security status, which gives deep understandings to decision and policymakers. This study provides a rational choice for food security policymaking for any country. The basic and foremost step to address with food insecurity issue is to examine its performance and to appraise the available policy choices. The multidimensional food security index was constructed by using diverse indicators based on food security pillars (availability, access, utilization, stability). The PCA analysis was used to construct multi-dimensional food security by using the 16 diverse indicators. They come up with results that a simple food security index shows improvement over time as shown Global Food Security Index (GFSI) in 2017-18. But the ranking of Azerbaijan based on multidimensional food security in 2017-18 obtained in the present study does not correspond with ranking given by the Global Food Security Index (GFSI). The difference in the ranking of Azerbaijan in both indexes was because we used more diverse and broad-spectrum indicators. It offered us deeper insights into food utilization and stability dimensions.

The demonstrated hypothesis in the thesis.

**H1:** confirmed that food security determinant has a significant influence on the Ganja-Gazakh region. The following hypothesis come up with the conclusion that food insecurity situation was the outcome of various factors, such as food price shocks, low agricultural production, and deprecation of domestic currency, climate change and rise in oil prices.

**H2:** confirmed that Azerbaijan's food security program has a significant impact on the participant. At present times, when household and individual food security is vulnerable due to climate change and exchange rates for currencies and international price volatility. There is a need for both domestic as well as global responses. Based on the findings of this study, there is a need for inclusive household food security policy for sustainable development plans and address both food accessibility and utilization dimensions of food security.

**H3:** confirmed that regional food supplies have significance impact on regional economics and their food security. The analysis of regional and national food security determinants and their status is, therefore, useful for not only policymaking but implementation as well. Hence, its suggested that there is need to look at some key areas and several factors to be examined empirically that directly or indirectly impacted food security in some regions.

**H4:** confirmed that multi-dimensional determinants have a significant impact on the dynamics of national food security in Azerbaijan. The empirical findings of long-term estimates show that food import has a negative and statistically significant impact on the domestic food supply of Azerbaijan. The coefficient of food imports suggests that a 1% increase in food import will lead to a decrease of 0.38% in the domestic per capita food supply in Azerbaijan. Empirical evidence suggests that if Azerbaijan adopts more in-ward looking policies to develop the agriculture sector, it will improve the sustainable food supply and security as well as economic growth and trade terms. However, the long-term estimates show trade to GDP ratio has a positive and significant impact on access to food security. The estimated coefficient of trade to GDP ratio suggests that a 1% increase in trade to GDP ratio leads to an improvement of 0.13% for the access to food security in the long term in Azerbaijan. The depreciation in the exchange rate has a negative and significant impact on the food security situation because Azerbaijan's national food security largely depends on import of food products. Depreciation in domestic currency against the foreign currency leads to an adverse impact on food access and availability in Azerbaijan.

## 5.2. Recommendations

Considering this, the present thesis also advocates broadening the frontiers of knowledge for policymakers to help overcome the problem of food insecurity, including the potential

impact of climate change phenomena on national food security in Azerbaijan. Policymakers should develop a set of policies to mitigate climate change and food insecurity concurrently. This study suggests that there is a very strong requirement to develop effective institutional structures if the Azerbaijan government genuinely hopes to attain sustainable food security. Finally, governments of the selected countries and developmental organisations, could channel efforts towards achieving national food security through indigenous agricultural inventions and interventions targeted toward a national support for local food producers in order to achieve sustainability and long-term effect to problems associated with food insecurity. This will improve the potential of domestic agriculture food supply for meeting national household and individual's needs. At the household level, every nation, including Azerbaijan, need a database and cross-sectional, time series and penal datasets to examine the food availability, accessibility, affordability, utilization, hunger, and malnutrition that will provide early warning assistance effectively. The structure of social safety nets can mitigate the impact of food inflation on most vulnerable populations. Our study findings have important implications for Azerbaijan government and policy makers for achieving household food security outcome. Food access, utilization and stability should put in place in term of policy and planning that will enhance the long-term development and sustainability of a country like Azerbaijan. This could be attained by investment in infrastructure, education, health, and food safety, giving importance to rural areas socioeconomic development. In Azerbaijan, such up and down in the food insecurity situation was the outcome of various factors, such as food price shocks, low agricultural production, and deprecation of domestic currency, climate change and rise in oil prices. Hence this study suggests that the Azerbaijan government should develop a comprehensive and broad-spectrum food security policy. This study advocates a well-targeted policy could overcome the food insecurity gap caused by multidimensional factors.

### 5.3. New Scientific findings from Thesis

This thesis has made following scientific and academic contributions to Azerbaijan's food security literature.

1	The debate to describe the food insecurity started in 1993 but this issue was assessed on household, national and regional level. In some studies, the causes of food insecurity and hunger are estimated through the food availability dimension. But, to the best of my knowledge, none has measured the partial as well as combined dimensions of food security (availability, access, utilization, stability) of Azerbaijan.
2	This thesis examined the broad concept of food security to review the existing food security studies for mapping the way in which food security is estimated and identified research priorities and gaps. This research also examined the usefulness of various food security dimensions for policy making and suggested possible modifications to food security research priorities related Azerbaijan.
3	This thesis used a cross-disciplinary method to estimate the multidimensional and complex nature of food security. To our best knowledge, this research was the pioneer study to conduct a multi- sectoral intervention together to explore a sustainable approach.
4	Existing studies that is national or regional in scale and estimates the concept food security using multidimensional approach is rare in Azerbaijan. To fill this gap, this research uses a multidimensional approach. In our best knowledge, this research is the pioneering research and ties all dimensions of food security together.
5	This thesis observed all the possible novel channels to understand the problem of food security of Azerbaijan. The findings of study opened several new research themes and evidences on food security in Azerbaijan.

## 6. RELATED PUBLICATIONS

### Papers published in scientific conference proceedings

1. **Ragif Huseynov** (2018): The role of agriculture in economic growth and insuring food security: case study of Azerbaijan. Conference proceedings ISBN 978-963-269-730-7, Pages 365-373, 3 RD INTERNATIONAL YOUNG RESEARCHER SCIENTIFIC CONFERENCE on “Sustainable Regional Development - Challenges of Space & Society in the 21st Century” Godollo, Hungary 2018 [http://rtdi.gtk.szie.hu/sites/default/files/files/2018\\_SRD-Conference-Proceedings\\_April-26%20k%C3%B6nyv.pdf](http://rtdi.gtk.szie.hu/sites/default/files/files/2018_SRD-Conference-Proceedings_April-26%20k%C3%B6nyv.pdf)
2. **Ragif Huseynov** (2019): Towards Food Security of Azerbaijan: Review Of Current Issues And Prospects Of Agriculture Sustainability. Conference proceedings ISBN 978-605-80128-1-3, Pages 155-168, 2 nd INTERNATIONAL AGRICULTURE Congress , Ankara, Turkey 2019 <https://utak2019.files.wordpress.com/2020/01/utak-2019-tam-metc4b0n-kc4b0tabi-8-ocak11.pdf>
3. **Ragif Huseynov** (2019): Unfolding of Food Security Studies in Singapore, Georgia and Austria: a critical review of empirical evidence. Conference proceedings ISBN 978-625-7029-51-3, Pages 106-114. INTERNATIONAL EUROASIA Congress on Scientific Researches and Recent Trends-V, Baku, Azerbaijan 2019 [https://f749d2de-b9db-4cec-b6d0-ee07a424febf.filesusr.com/ugd/614b1f\\_fe0e3631bf784313a30ed24d5a2c2ae7.pdf](https://f749d2de-b9db-4cec-b6d0-ee07a424febf.filesusr.com/ugd/614b1f_fe0e3631bf784313a30ed24d5a2c2ae7.pdf)
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## Articles in Scientific Journals

1. Boratyńska, Katarzyna T.; **Tofiq Huseynov, Raqif** (2017): An innovative approach to food security policy in developing countries. Journal of Innovation & Knowledge (JIK), ISSN 2444-569X, Elsevier, Amsterdam, Vol. 2, Iss. 1, pp. 39-44, <http://dx.doi.org/10.1016/j.jik.2016.01.007>  
<https://www.sciencedirect.com/science/article/pii/S2444569X16000093>
2. **Raqif Huseynov**, Michal Wojtaszek (2016): Economic issues of food production development in Azerbaijan against the backdrop of government action. Journal of Challenges of Modern Economy. ISSN: 978-83-62815-28-9, Pages 41-50, Warsaw, Poland 2016
3. **Ragif Huseynov** (2019): Multidimensional Determinants of National Food Security in Azerbaijan: an Application of the ARDL Approach. Problems of World Agriculture, ISSN 2081-6960, eISSN 2544-0659 Pages 58-68, Warsaw, Poland 2019, <https://ageconsearch.umn.edu/record/300088/>
4. **Ragif Huseynov** (2020): Dynamics of Multidimensional Food Security in Azerbaijan. Academic Journal of Economic Studies, Vol. 6, No. 1, March 2020, pp. 44–50 ISSN 2393-4913, ISSN On-line 2457-5836, Romania,  
[http://www.ajes.ro/wp-content/uploads/AJES\\_article\\_1\\_312.pdf](http://www.ajes.ro/wp-content/uploads/AJES_article_1_312.pdf)
5. **Ragif Huseynov** (2020): Estimation of food and nutritional security in Azerbaijan: A case study of the Ganja-Gazakh Region. Studia Mundi-Economica, ISSN 2415-9395, 2020 Volume 7, No.1, 2020-03-04, Pages 59-68, Godollo, Hungary, [http://studia.mundi.gtk.szie.hu/sites/default/files/upload/studia/2020-vol7-no1/studia\\_mundi\\_vol\\_7\\_no\\_1\\_7.pdf](http://studia.mundi.gtk.szie.hu/sites/default/files/upload/studia/2020-vol7-no1/studia_mundi_vol_7_no_1_7.pdf)