



## Research Article

# Impact of Macroeconomic Variables on Food Security in Saudi Arabia: Case Study of Poultry Meat

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**Abstract** | Recently the food meat gap was increased in Saudi Arabia, due to population growth. Accordingly, the country became food import dependent, putting a burden on the government import bills. The purpose of this research was to analyze the performance of food security indicators of poultry meat during the period 2005-2020 in Saudi Arabia. In addition, it assessed the relationship between poultry meat consumption and macroeconomic indicators during the period 1980-2020. The Autoregressive Distributed Lag model was employed to estimate the short-run and long-run relationships between domestic consumption of poultry meat and Gross Domestic Products (GDP), consumer price index, meat price index and population. The results revealed that self-sufficiency of poultry meat was declining by 0.11% and the food gap increased by 24 thousand tons annually. The model results showed a statistically significant positive association between domestic consumption of poultry meat and GDP, and a negative significant statistically relationship with meat price index in the long run. Furthermore, the results depicted a positive significant relationship in the short run between domestic consumption of poultry meat and GDP. The study recommended improvement of poultry sector productivity and encouragement of foreign agricultural investment to ensure sustainable food supply and to fill the domestic production gap.

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**Keywords** | Autoregressive distributed lag model, Food security, Poultry meat consumption



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## Introduction

Food security is an important issue at global level where more than two billion people, nearly one quarter of the world population are food insecure (Ministry of Foreign and European Affairs, 2019). Food and Agriculture Organization of the

United Nations (2015) stated that Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious foods to meet their dietary needs and food preferences for an active and healthy life. Food security is composed of four pillars, including food availability, accessibility, utilization, and stability of

the three pillars. The food availability pillar focuses on the supply side which is measured by the ability of society to provide adequate food to its population. This could be achieved from domestic production and imports. Domestic consumption is considered as one of the main indicators of food availability ([Arab Organization for Agricultural Development, 2018](#)).

The Kingdom of Saudi Arabia (KSA) has given great attention to the agriculture sector in order to support agricultural development and food security. The Kingdom's food security strategy aims to achieve sustainable local food production system for necessary goods, diversify external food sources, maintain stable food prices, and ensure safe and nutritious food ([Ministry of Environment Agriculture and Water, 2017](#)).

Food from animal sources is considered as a high nutritive food that provides the body with the necessary protein, in addition it contains macro and micronutrients such as iron, zinc and phosphorus, which is rich with energy and fatty acids ([Aweida, 2012](#)).

The livestock sector is one of the main KSA economy sectors that contributes significantly to food security. The Kingdom is keen to improve livestock production based on comparative advantage of different regions, to preserve and develop local breeds to meet the population food requirements ([Ministry of Environment Agriculture and Water, 2017](#)). The Kingdom is one of the highest consumer of poultry meat in the world, with an average per capita consumption of about 43 kg per year ([Mousa, 2022](#)). Poultry meat production and domestic consumption were estimated at about 900 and 1500 thousand tons respectively in 2020, yet the net import was amounted to about 2400 thousand tons ([Ministry of Environment Agriculture and Water, 2020](#)), which put a burden on the trade balance and the Kingdom has become vulnerable to external market shocks and fluctuations in global food prices.

In vision 2030, Saudi government encourages overseas investors to enter Saudi market, particularly in poultry industry. The government provides full ownership and direct production subsidy to local poultry producers ([Poultry World, 2022](#)).

Poultry sector in KSA faces many challenges such

as climate change, diseases, as well as an increasingly demand for animal products. This leads to sector deterioration and extinction of some animal breeds. In recent years, the meat food gap has widened as a result of the growing population and food demand, thus the Kingdom became food import dependent putting a burden on the government import bills. Moreover, the Kingdom has become vulnerable to external market shocks and fluctuations in world food prices. The purpose of this research is to analyze the performance of food security indicators of poultry meat during the period 2005-2020 in Saudi Arabia. In addition, it assesses the relationship between poultry meat consumption and macroeconomic indicators during the period 1980-2020. The macroeconomic variables include population, Gross Domestic Product (GDP), meat price index and consumer price index (CPI).

[Bielik and Hupkova \(2011\)](#) studied the economic factors affecting poultry meat consumption in Slovakia from 1993 to 2009 using the general fixed effects panel data model. The results revealed a significant relationship between consumption of poultry meat and the price of pork meat, the poultry meat price and the incidence of the BSE disease. [Sibai and Mansour \(2016\)](#) estimated and predict meat food gap in Saudi Arabia during the period (2000-2014). The results showed that there was a food gap in the Kingdom in fish, red and poultry meat estimated at about 104, 119 and 489 thousand tons respectively. [Elbogghi et al. \(2016\)](#) assessed the determinants of the increasing food gap and the declining self-sufficiency rates of some food commodities in the Arab countries using trend equations covering the period 2000-2013. The study showed that Arab countries are significantly subjected to food nutrition security risks, caused by weak trade within the Arab countries and high rates of unemployment and population growth. [Erdogdu and Cicek \(2017\)](#) used the Autoregressive distributed lag approach (ARDL) to estimate the link between beef consumption and its own prices, prices of chicken meat, and income per capita in Turkey during the period 1994-2014. The bounds test result reveals a long-term relationship between beef consumption and its determinants. Moreover, results showed a positive relationship between consumption of beef and chicken meat price and per capita income. [Rehman et al. \(2019\)](#) adopted an ARDL approach to analyze the relationship between agricultural GDP and beef, mutton and poultry meat production during the period 1982-2018 in Pakistan. The results

depicted a positive long-run relationship between beef production and GDP and a non-significant relationship between GDP and mutton and poultry meat production. [Applanaidu et al. \(2014\)](#) adopted VAR approach to measure the dynamic relationship between food security and some macroeconomic indicators in Malaysia during the period 1980-2012. These variables include population, GDP, biodiesel production, food price index, government expenditure on rural development and exchange rate. The variance decomposition results indicated that, year ten witness the maximum shock level to food security caused by biodiesel production, government expenditure on rural development and exchange rate. On the other hand, year five witness same effect due to exchange rate and population.

This study would contribute positively to the literature of food security in KSA. It provides valuable information regarding macroeconomic indicators affecting domestic consumption of poultry meat that support food policy formation and strategic plan.

## Materials and Methods

The study relied heavily on secondary data covering the period 1980-2020, collected from the Saudi central bank, FAO, Arab Organization for Agricultural Development (AOAD) and the World Bank. The collected data include production, exports and imports of poultry meat, real GDP, meat price index, population, and consumer price index.

The ARDL model produced by [Pesaran and Shin \(1995\)](#) was applied using Stata 14 to analyze the short-run and long-run association between the study variables. The model provides unbiased and efficient estimates ([Song and Witt, 2000](#)). This model does not necessitate variables integration of the same order; it could be integrated at level I (0) and at first difference I (1), However, the presence of I (2) would make the ARDL unsuitable. The Augmented Dickey-Fuller test (ADF) was done to check stationary of the variables. ADF equation as follows:

$$\Delta P_{it} = \delta P_{t-1} + \sum_{i=1}^p \beta \Delta P_{t-1} + \epsilon_{it} \dots (1)$$

It tests the null hypothesis that the variable is non-stationary against the alternative hypothesis that the variable is stationary ([Nkoro and Uko, 2016](#)).

The ARDL model was adopted by many researchers such as [Marques et al. \(2018\)](#) analyzing the effect of economic growth and sustainable development on meat consumption for 77 countries divided by income levels. [Mousavi et al. \(2012\)](#) also used the ARDL model to identify the factors affecting meat imports in Iran. [Aliyu and Ismail \(2017\)](#) used ARDL to find out the nexus of exchange rate policy and food imports in Malaysia. Moreover, [Hanafi \(2019\)](#) estimated the relationship between macroeconomic variables and food security in Egypt adopting the ARDL approach. The ARDL model was estimated as follows, the long-run relationship model is given in the following equation:

$$\ln MCC_t = \beta_0 + \sum_{i=1}^n \alpha_1 \ln MCC_{t-i} + \sum_{j=1}^n \alpha_2 \ln GDP_{t-j} + \sum_{j=1}^n \alpha_3 \ln FMPI_{t-j} + \sum_{j=1}^n \alpha_4 \ln POP_{t-j} + \sum_{j=1}^n \alpha_5 \ln CPI_{t-j} + e \dots (2)$$

The short- run relationship model as follows:

$$\begin{aligned} \Delta \ln MCC_t &= \beta_0 + \sum_{i=1}^n \alpha_1 \Delta \ln MCC_{t-i} + \sum_{j=1}^n \alpha_2 \Delta \ln GDP_{t-j} + \sum_{j=1}^n \alpha_3 \Delta \ln FMPI_{t-j} \\ &+ \sum_{j=1}^n \alpha_4 \Delta \ln POP_{t-j} + \sum_{j=1}^n \alpha_5 \Delta \ln CPI_{t-j} + \lambda ECT_{t-1} + e \dots (3) \\ \lambda ECT_{t-1} &= \ln MCC_{t-1} - \beta_0 - \beta_1 \ln GDP_{t-1} - \beta_2 \ln FMPI_{t-1} \\ &- \beta_3 \ln POP_{t-1} - \beta_4 \Delta \ln CPI_{t-1} \dots (4) \end{aligned}$$

Where;

MCC represents domestic consumption of poultry meat, (which is equal to domestic production + imports – exports).  $\beta_0$ = intercept;  $\Delta$ , The first difference  $\beta_1, \beta_2, \beta_3, \beta_4$ = Long-run coefficients;  $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$ = Short-run coefficients, i, j = number of lags; GDP= gross domestic product; FMPI = meat price index; POP= Population. CPI= Consumer Price Index; a proxy for fish Price Index.  $\lambda$  = Speed of adjustment,  $ECT_{(t-1)}$  = error correction term.

Akaike Information Criteria (AIC) was adopted to determine the optimal lag period, and the bound test was used to detect cointegration of the variables. The null hypothesis of the bound test assumes no cointegration between the variables against the alternative hypothesis assuming existence of cointegration. The test result indicates existence of cointegration among variables if the computed F-value is greater than the upper bound critical value at specific significance level, indicating long run association between variables. On the other hand,

the null hypothesis of absence of cointegration could not be rejected, if the computed F-value is less than the lower bound critical value (Puah *et al.*, 2018). Diagnostic tests were conducted to check model reliability. In that regard, Breusch-Godfrey test was used to check autocorrelation, Breusch-Pagan test for testing heteroskedasticity; Skewness and Kurtosis were used to test Normality and Cumulative Sum test (CUSUM) to test the model stability (Acar, 2020).

## Results and Discussion

### Performance of food security indicators during the period 2005-2020

Results of the trend analysis (Figure 1) showed that the food gap for poultry meat increased from 433 thousand tons in 2005 to 716 thousand tons in 2020 with an annual increase of 24 thousand tons. It also revealed that the self-sufficiency ratio is ranging from 58% in 2005 to 51% in 2020, with an annual decreasing trend of 0.11%.

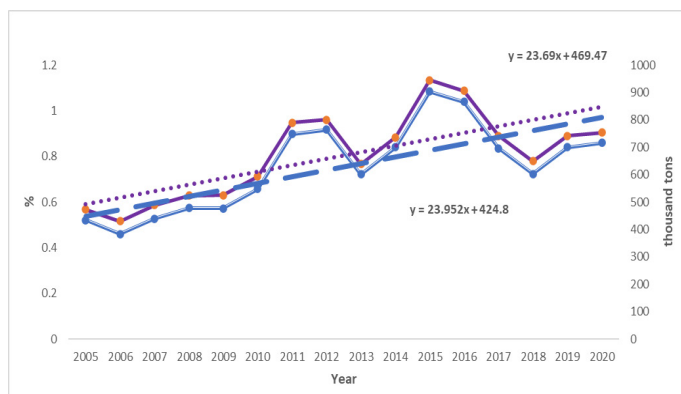


Figure 1: Performance of Food gap and Self-sufficiency of poultry meat (2005-2020) in Saudi Arabia.

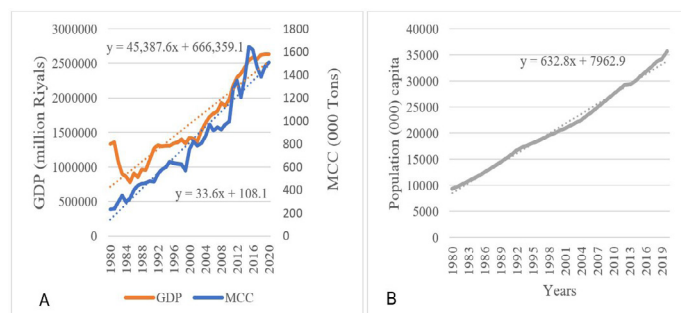


Figure 2: A: Performance of GDP and MCC; B: Performance of population in Saudi Arabia 1980-2020.

The trends of GDP, Population and MCC from 1980 to 2020 are illustrated in Figure 2a, b. The diagram showed that GDP, population and MCC are increased by 45388 million riyals, 633 capita and 34 thousand ton, respectively.

### Unit root test

The augmented Dickey-Fuller test (Table 1) revealed that the absolute calculated t-value of the lnMCC, lnPOP, lnCPI variables is greater than their absolute tabulated t-values at 5% level of significant. This result indicated that these variables are stationary at the level. Furthermore, the test results show that LnGDP and LnFPI are non-stationary at level, and they became stationary after first difference i.e., they are integrated of order one I (1). These results necessitate the use of the ARDL model, as it is the most proper approach for cointegration when the variables under study are stationary at different levels (level 0 and 1).

Table 1: Augmented dickey fuller test results (ADF).

Variable	Levels (0)		First difference (1)		Outcome
	T-statistic	5% critical	T-statistic	5% critical	
lnMCC	2.831	-1.950			I (0)
lnPOP	14.361	-1.950			I (0)
lnCPI	2.180	-1.950			I (0)
lnGDP	1.426	-1.950	-3.053	-1.950	I (1)
lnFMPI	0.312	-1.950	-5.136	-1.950	I (1)

### Bounds test

The Bound test results showed that the calculated F-statistic and t-value are greater than the upper bounds at 0.05 significance level (Table 2), reflecting existence of a long-run relationship between the domestic consumption of poultry meat and the model variables.

Table 2: Bounds test results.

F-statistic	F = 8.019					
t-test	t = -5.009					
Significance level	10 %		5 %		1 %	
critical values	I (0)	I (1)	I (0)	I (1)	I (0)	I (1)
F	2.619	3.990	3.206	4.783	4.642	6.705
t	-2.481	-3.599	-2.854	-4.038	-3.621	-4.937

### Estimation of Long-term and Short-term coefficients

The long-term and short-term relationship of the ARDL model (1, 3, 1, 2, 2) that was chosen by the AIC was estimated. The model results depicted a positive long-run significant relationship between domestic consumption of poultry meat and GDP and a negative one with meat price index (Table 3). Where 1% increase in GDP yields 0.77% increase in the domestic consumption of poultry meat, while 1% increase in the FMPI leads to 1.8% decrease in the domestic consumption of poultry meat. This

result is in line with elmaghra by [Elmaghraby et al. \(2007\)](#), indicating a positive association between the domestic consumption of poultry and its own prices in the short-term in Egypt. The model results also revealed a significant positive relationship between the consumer price index and domestic consumption of poultry meat, where 1% increase in the CPI leads to 2.1% increase in domestic consumption of poultry meat. Furthermore, the results indicated a positive significant relationship in the short run between domestic consumption of poultry meat and GDP and FMPI, where 1% increase in each of them result in an increase in domestic consumption of poultry meat by 0.38% and 1.4%, respectively. Moreover, the results depicted significantly negative relationship between domestic consumption of poultry meat and consumer price index for fish and a non-significant relationship with population in the long-run and short-run. This result is consistent with [Al-Muhanna \(2019\)](#) showing a non-significant relationship between domestic consumption of poultry meat and population in Saudi Arabia. The error correction term (ETC (-1)) is significant and have a negative sign (0.72) indicating that about 0.72% of the short-run deviations would be adjusted to equilibrium in the long-run before the next time period.

**Table 3:** Estimation of long-term and short-term model coefficients.

Variable	Coefficient	Std. error	t- statistic	Prob.
<b>Long-run</b>				
lnGDP	0.77	0.34	2.24	0.04
lnPOP	-0.74	0.69	-1.08	0.29
lnFMPI	-1.83	0.63	-2.88	0.01
lnCPI	2.18	0.70	3.11	0.01
Constant	4.90	5.20	0.94	0.36
<b>Short-run</b>				
D (lnGDP (-2))	0.38	0.19	1.99	0.06
lnPOP (D)	2.28	1.55	1.47	1.15
lnFMPI (D)	1.47	0.36	4.08	0.00
lnCPI (D)	-1.58	0.41	-3.83	0.00
ETC (-1)	-0.72	0.14	-5.01	0.00
R <sup>2</sup> = 0.69, adj. R <sup>2</sup> = 0.52, RMSE = 0.07				

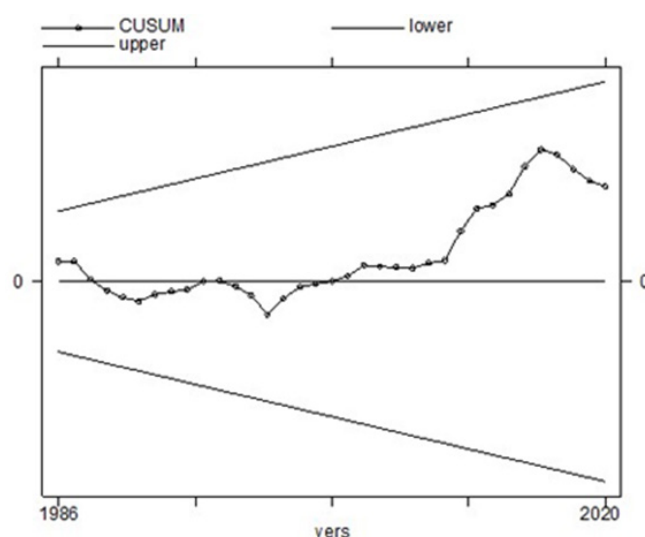
**Diagnostic tests**

The Breusch-Godfrey LM test is one of the most key tests to detect autocorrelation. It tests the null hypothesis of no serial autocorrelation against the alternative hypothesis stated the presence of autocorrelation. The test showed that the calculated chi-squared is higher than 5% significance level, therefore the null

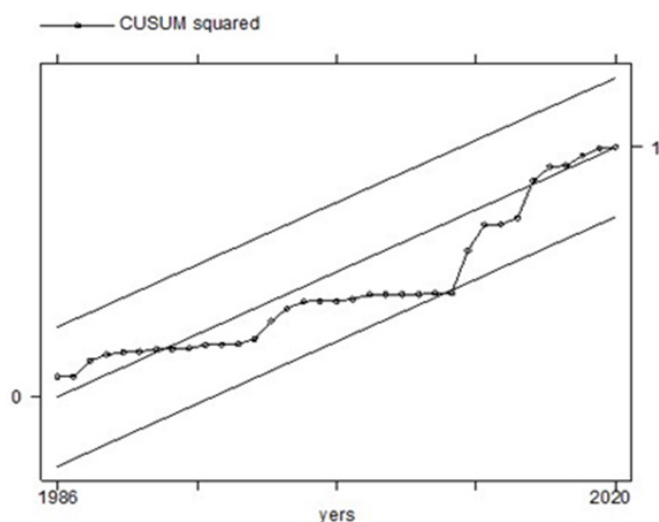
hypothesis could not be rejected, indicating absence of serial autocorrelation in the model. The Breusch-Pagan-Godfrey test is employed to test the problem of heteroskedasticity, it indicated homoscedasticity of the model as the calculated chi-squared is greater than 5% level of significance. Normality test using Skewness and Kurtosis test revealed that, the data has a normal distribution as the probability of chi-squared is greater than 0.05 (Table 4).

**Table 4:** Diagnostic test results.

Test	chi2	Prob.
Breusch-Godfrey LM test for autocorrelation	0.100	0.75
Heteroskedasticity	38.00	0.42
Skewness	12.12	0.52
Kurtosis	0.26	0.61



**Figure 3:** Cusum test of the ARDL model.



**Figure 4:** Cusum of squares test of the ARDL model.

The cumulative sum test (CUSUM) and the cumulative sum of squares (CUSUMQ) analyses revealed that the model is well stable (Figures 3 and

4) as the estimated coefficients of the ARDL model lie between the critical limits at a significant level of 5%.

## Conclusions and Recommendations

Poultry is one of the livestock subsectors that has potential contribution to food security in KSA. The Kingdom is keen to improve poultry production based on comparative of different regions to preserve and develop local breeds to meet the population food demand in quality and quantity wise. Poultry sector in KSA faces many challenges such as climate change, diseases, as well as an increasing demand for animal products. In recent years, the meat food gap has widened because of the growing population and food demand, thus the Kingdom became food import dependent which put a burden on the government import bills. The purpose of this study is to analyze the performance of food security indicators of poultry meat during the period 2005-2020 in Saudi Arabia. In addition, it assessed the relationship between poultry meat consumption and macroeconomic indicators during the period 1980-2020. The results revealed that the annual self-sufficiency of poultry meat is decreasing by 0.11% and the food gap is increasing by 24 thousand tons. The model results depicted a positive significant relationship between domestic consumption of poultry meat and GDP, and a negative significant relationship with meat price index in the long term. Moreover, it showed a positive significant relationship between domestic consumption of poultry meat and GDP in the short term. The study recommends improvement of poultry sector productivity and encouragement of foreign agricultural investment to ensure sustainable food supply and to fill the gap of the domestic production.

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## Novelty Statement

This study is concerned with food security issue due to its global importance. It provides valuable information regarding consumption of poultry meat and its determinants in Saudi Arabia. The study is also helpful in policy formation to ensure sustainable food supply and to fill the gap of the domestic

production.

## Author's Contribution

**Fatimah Mohammed Alsarawi:** Collected and analyzed the data.

**Azharia Elbushra:** Assisted in data analysis and the three researchers.

**Fatimah, Azharia and Ishtiag:** Contributed in manuscript preparation.

## Conflicts of interest

The authors have declared no conflict of interest.

## References

- Acar, R., 2020. Monetary model of exchange rate for Argentina: An autoregressive distributed lag (ARDL) Approach. Master Thesis, department of applied economic. Washington state University, Washington, USA. <http://ses.wsu.edu/wp-content/uploads/2020/07/702-Project-Ramazan.ACAR.pdf>.
- Aliyu, A.J., and N.W. Ismail. 2017. Food imports and exchange rate: the application of dynamic cointegration framework. *Malays. J. Math. Sci.*, 11: 101-114.
- Al-Muhanna, A.S., 2019. Economic policies to achieve food security in the Kingdom of Saudi Arabia. PhD thesis, Department of Islamic Economic. Umm Al-Qura University, Kingdom of Saudi Arabia. (Article in Arabic with an abstract in English).
- Applanaidu, S.D., N.A. Bakar and A.H. Baharudin. 2014. An econometric analysis of food security and related macroeconomic variables in Malaysia: A vector autoregressive approach (VAR). *UMK Procedia.*, 1: 93-102. <https://doi.org/10.1016/j.umkpro.2014.07.012>
- Arab Organization for Agricultural Development (AOAD). 2018. Arab food security situation report, Khartoum, Sudan. pp. 16-45. Available at: [http://www.aoad.org/Arab\\_food\\_Security\\_Report\\_2018.pdf](http://www.aoad.org/Arab_food_Security_Report_2018.pdf). Retrieved on 5 Sep 2020.
- Aweida, E., 2012. Basics of human nutrition. 4<sup>th</sup> ed. Al-Obeikan Library, Riyadh, Kingdom of Saudi Arabia.
- Bielik, P., and D. Hupkova. 2011. Modelling structural changes in the poultry meat demand the case of Slovakia. *Agric. Econ.*, 57(8): 363-369. <https://doi.org/10.17221/105/2011-AGRICECON>

- Elbogghi, E.G., A. Alawad and A. Qineti. 2016. Factors affecting the food gap and the share of self-sufficiency of selected commodities: The case of Arab countries. *Slovak Univ. Agric. Nitra*, pp. 907-922. <https://doi.org/10.15414/isd2016.s12.02>
- Elmaghraby, M.J., H.R. Abd-Almageed, M.A. Shata and A. Abdalrhman. 2007. An economic study for factors affecting on consumption of poultry in Egypt. *J. Agric. Sci. Mansoura Univ.*, 32(6): 4941– 4950. [https://jaess.journals.ekb.eg/article\\_47252\\_b7925070e44f003afe9f962b0192b5c7.pdf](https://jaess.journals.ekb.eg/article_47252_b7925070e44f003afe9f962b0192b5c7.pdf), <https://doi.org/10.21608/jaess.2007.47252>
- Erdogdu, H., and H. Cicek. 2017. Modelling beef consumption in turkey: The ARDL/Bound's test approach. *Turk. J. Vet. Anim. Sci.*, 41: 255-264. <https://doi.org/10.3906/vet-1606-43>
- Food and Agriculture Organization of the United Nations (FAO). 2015. The state of agricultural commodity markets, trade and food security: Achieving a Better balance between national priorities and the public good, Roma, Italy. pp. 18. Available at: <http://www.fao.org/3/i5090e/i5090e.pdf> Retrieved on 16 August 2021.
- Hanafi, S., 2019. Estimating the impact of macroeconomic variables on food security in Egypt. *Journal of Economic, management and commercial Sciences.*, 12 (2): 16-01. <http://dspace.univ-msila.dz:8080/xmlui/handle/123456789/20131> (Article in Arabic with an abstract in English).
- Marques, A.C., J.A. Fuinhas and D.F. Pais. 2018. Economic growth sustainable development and food consumption: Evidence across different income groups of countries. *J. Cleaner prod.*, 196: 245-258. <https://doi.org/10.1016/j.jclepro.2018.06.011>
- Ministry of Environment, Agriculture and Water, 2017. Executive Plan for the National Transformation Program, Riyadh, Kingdom of Saudi Arabia. Available at: <https://www.mewa.gov.sa/ar/Ministry/initiatives/MinistryInitiatives/Pages/default.aspx>
- Ministry of Environment, Agriculture and Water. 2020. Statistics yearbook 2020, Riyadh, Kingdom of Saudi Arabia.
- Ministry of Foreign and European Affairs. 2019. France's International Strategy for Food Security, Nutrition and Sustainable Agriculture, France. [https://www.diplomatie.gouv.fr/IMG/pdf/strategie\\_internationale\\_de\\_la\\_france\\_pour\\_la\\_securite\\_alimentaire\\_la\\_nutrition\\_et\\_l\\_agriculture\\_durable\\_vf\\_cle073dab.pdf](https://www.diplomatie.gouv.fr/IMG/pdf/strategie_internationale_de_la_france_pour_la_securite_alimentaire_la_nutrition_et_l_agriculture_durable_vf_cle073dab.pdf). Retrieved on 5 Sep 2020.
- Mousa, H., 2022. Food processing ingredients. United States Department of Agriculture. Global Agricultural Information Network. 2022. United States Department of Agriculture -Foreign Agriculture Service, Report Number: SA2022-0003.
- Mousavi, S.N., M.R. Rezaei and S.M. Akbari. 2012. Effect factors on meat imports to Iran. *Life Sci. J.*, 9(1): 374-377.
- Nkoro, E., and A.K. Uko. 2016. Autoregressive distributed lag (ARDL) cointegration technique: application and interpretation. *J. Stat. Econ. Methods*, 5(4): 63-91.
- Pesaran, M.H. and Y. Shin. 1995. An autoregressive distributed lag modelling approach to cointegration analysis. In S. Strom, A. Holly and P. Diamond (eds) Centennial Volume of Rangar Frisch, Econometric Society Monograph. Cambridge. Cambridge University Press.
- Poultry World, 2022. Available at <https://www.poultryworld.net/Meat/Articles/2021/7/Saudi-Arabias-changing-poultry-landscape-768241E/#:~:text=Under%20Vision%202030%2C%20the%20Saudi,offered%20to%20local%20poultry%20farmers>. Retrieved on Feb 2022.
- Puah, C., S. Huan. and F. Thien. 2018. Determinants of Chinese demand for tourism in Malaysia. *Bus. Econ. Horizons.*, 14(3): 501-512. <https://doi.org/10.15208/beh.2018.36>
- Rehman, A., Z. Deyuan. and A.A. Chandio. 2019. Contribution of beef, mutton, and poultry meat production to the agricultural gross domestic product of Pakistan using an autoregressive distributed lag bounds testing approach. *J. Sage Publ.*, pp. 1-10. <https://doi.org/10.1177/2158244019877196>
- Sibai, M., and H. Mansour. 2016. An Economic study to estimate the nutritional gap of meat and its predictability in the Kingdom of Saudi Arabia. *J. Assoc. Arab Univ.*, 24(2): 295-316. (Article in Arabic). <https://doi.org/10.21608/ajs.2016.14281>
- Song, H. and S.F. Witt. 2000. Tourism demand modelling and forecasting: Modern econometric approaches. Elsevier Science Ltd., the Boulevard, Langford Lane, Kidlington, Oxford, UK. pp. 74-80.