Food Security in Saudi Arabia (Case Study: Wheat, Barley, and Poultry)

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Abstract This study tries to identify methods to achieve food security for the essential food commodities in Saudi Arabia. In addition, we studied the current situation by estimating the size of the inventory and the coefficient of food security for the most critical strategic food commodities. We forecast the demand for wheat, barley, and poultry during 2017-2025. We also estimate food security, food gap, strategic stock, and self-sufficiency coefficient. The result shows a positive effect of wheat and poultry while barely had an adverse impact.

Keywords: food gap, strategic stock, self-sufficiency, Saudi Arabia

1. Introduction

Agriculture has a visible role in different fields such as economic, social, political, cultural and environmental. The importance of agriculture sector came from solving many of the financial problems facing developing countries, such as low-income rate, high unemployment rate, the deficit in the balance of payments, and lower the central banks of foreign currency reserves.

Wheat, barley, and poultry meat are the most critical foods in Saudi Arabia. Where the Saudi consumer depends on these commodities, especially the people who have low-income in their daily diet, due to contribute a high proportion of their total per capita daily calories. Saudi Arabia domestic food consumption is more reliant on foreign trade in general (import from other countries) instead of producing domestically, imposing a significant burden on the balance of payments to these countries.

The food gap, which influences the national economy in the selected product, has made agricultural products to be vital. One of the most critical issues that must be addressed and work on is to narrow the food gap and try to reach the self-sufficiency on wheat, barley, and poultry meat.

Several studies have addressed the issue of food security in Saudi Arabia. Mieczysław [1] described the grain sector in the Arab countries' economy with particular attention to its role in national and regional food security programs, by analyzing the production and consumption of grains between 1973 and 1984 in all Arab countries. He found that the growing gap of food supplies in Arab countries was because of the decline of grain production. The studded recommend that Policies must be supportive of increasing the grain production, reduce post-harvest losses, and improve capacity processing and storage of grain reserves. Ismaiel and Al-Ibrahim [2] studied food integration potential for the Gulf Cooperation Council countries. The results show the GCC countries rely on needs of foods on the world. It also turned out that the integration among the GCC countries could raise the level of food self-sufficiency. Some policies and mechanisms could achieve sustainable agricultural development and food security, and most importantly encourage and attract local and foreign investment and promote private sector participation in the production and manufacturing and commercial activities [3]. The government policy on wheat in Saudi Arabia needs to review again according to food security [4].

However, there had several recommendations for solving food security in Saudi Arabia [5]. First, the establishment of a specialist corporate entity responsible for the planning and control processes for the management and the formation of strategic reserves of essential food commodities, or the expansion of the Saudi Grains Organization to be responsible for the import of the most critical strategic food commodities (such as wheat, barley). Second, the official authority must activate King Abdullah initiative which is Saudi agricultural investment initiative abroad. Third, reconsider the government decision No. 335 issued on the restriction of cultivation of wheat in order to maintain a certain level of food security on one hand and protection of the pressure political and economic, which may resort to some of the monopoly countries for the production and export of wheat in the world on the other hand.

The problem in this study that we are going to address is the increasing food consumption, where the food value imports were $17.9 billion in 2016, where almost $ 3.6 billion for wheat, barley, and poultry and by 20% of total value import in 2016 [6]. Also, the decline in domestic production capacity of wheat, barley, and poultry, has led

to the food gap of 144.09, 4075.9, and 257.4 thousand tons, respectively as an average for period 1961-2016. Thus, the government is expanding the import quantity of these products to fill and close the food gap, which leading to a worsen deficit of payments balance and slowing economic development.

However, during 2016, wheat production recorded self-sufficiency of 21%, while barley and poultry production recorded a self-sufficiency rate of 7%, 47% respectively. Wheat and barley cultivated area decreased by 71% and 92%, respectively, in 2016 compared to 2000. Also, the volume of production of wheat and barley fell by 57% and 92% in 2016, respectively, compared with 2000. Due to the government decision No. 335 (support policy) in 2008, which reduces wheat cultivation by 12.5% per year, and may be attributed to the high efficiency of user inputs [7,8,9]. On the other hand, poultry production increased by 39% in 2016 compared to 2000. The amount of wheat and barley consumption increased with a decrease in the amount of production, while rapidly increase in the imports quantity as an implementation of the resolution No. (335).

This study tries to identify methods to achieve food security for the wheat, barley, and poultry commodities in Saudi Arabia. Also, we studied the current situation by estimating the size of the inventory and the coefficient of food security for the most critical strategic food commodities.

The study also estimates strategic stocks [1] (the quantities held by the government and private sector to meet   the EX-ante demand, by safely keeping goods for as long as possible), and food security coefficient for wheat, barley, and poultry meat during the period 1961-2016. Finally, identify the food security factors for wheat, barley, and poultry meat during the study period.

2. Research Method

We used different ways to investigate food security in Saudi Arabia. Economic equations also used in the strategic stock estimate, and the coefficient of food security, which is calculated by dividing the volume of strategic stock (the outcome of the surplus and the deficit) on the average annual domestic consumption. Also, it can be estimated by the result of the percentage change in the strategic stock to yearly domestic consumption [10,11,12].

We used some indicators to calculate food security coefficients such as daily domestic consumption, the period of coverage of imports, the change in the strategic reserves, food security coefficient, and the self-sufficiency ratio. The ranged value of the food security coefficient between zero and one, as the closer the value of the food security coefficient get closer to zero, the worsened the food security situation. Where the closer the coefficient value of the food security to one the rose or improved food security situation of the commodity.

Multi Regression Analysis was used to study the impact of economic factors on food security coefficient for wheat, barley, and poultry in Saudi Arabia during period 1961-2016. The ordinary least squares (OLS) model was estimated. The model can be expressed as follows:

$$FS_t = \alpha_0 + \alpha_1 Pro_{it} + \alpha_2 IM_{it} + \alpha_3 Con_{it} + e_t$$

Where: FS_t is food security of Wheat, Barley, and Poultry in Saudi Arabia in time t, Pro_{it} is the domestic production (i= wheat, barley and poultry), IM_{it} is wheat, barley, and poultry import quantity, Con_{it} is the domestic consumption of wheat, barley, and poultry, et is the random error term, and α's represent the model parameters. Our hypothesis in the expected sign for each variable that affects the food security coefficients are positively correlated with annual production and import quantity, while negatively correlated with annual consumption.

2.1. Data Sources

The research will be based on available data from many sources. Area, production, import quantity, and consumption came from General Authority for Statistics, Annual Statistical Yearbook 2006-2017, FAO: Food and Agriculture Organization of the United Nations, FAS: Foreign Agricultural Service, United States Department of Agriculture (USDA), and GATS: Global Agricultural Trade System, United States Department of Agriculture (USDA). Number population provided from United Nations, Department of Economic and Social Affairs, Population Division (2017).

3. Result and Discussion

3.1. Forecasting Strategic Food Commodities in Saudi Arabia

King Abdullah Initiative for Agricultural Investment Abroad in May 2008, identified these strategic commodities of interest to the government, which the government will support through Saudi agricultural investment abroad as the following commodities: Wheat, Barley, Rice, Maize, Soybean, Oilseed, Sugar, Green Fodder, and Animal and fishery products [7,8]. After we check that Saudi Arabia survived from hunger issues, then we could go to the next estimation. To forecast the demand for wheat, barley, and poultry during 2017-2025, we need first to estimate the prediction of the population in Saudi Arabia. The people of Saudi Arabia is expected to reach 41.75 million in 2025, of which 17.5 million are female and 24.3 million males. After that, we found that the average estimation of the consumption from wheat, barley, and poultry were 3.5, 10.7, and 1.6 million ton respectively, by annual increasing about 99.7, 30.2, and

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1 Strategic Stock Objectives: Achieving the government strategic objectives related to food security, get the best prices from domestic and international markets, putting off the large rise in commodity prices by pumping quantities of goods in the market that is reflected in the reduction of prices, taking advantage of the stock in emergency crises and unexpected natural factors, and respond to the low supply of goods especially seasonal goods.

44.15 thousand ton respectively during the period 2017-2025.

Table 1. Evolution of coverage periods of local production and imports for consumption, FSC and SSR for Wheat, Barley, and Poultry during the period (1961-2016)

		Daily consumption[1] 1000ton/day	Food gap 1000ton	Coverage period /day[2]		Total length of the periods of production and the coverage of imports	The change in the strategic reserves[3]	FSC[4]	SSR[5]
				local production for consumption	Imports for consumption				
Wheat	Average	3.77	-51.93	325.89	207.89	168.78	584604.15	0.46	96%
	Max	10.07	2205.204	890.21	581.42	593.77	2427204	1.63	244%
	Min	0.430	-2909.185	42.34	4.53	-69.04	-290110	-0.19	11.60%
Barley	Average	11.24	-3946.699	35.05	253.19	-76.76	-636172.2	-0.21	3.8%
	Max	30.21	-20.61	156.05	467.48	103.03	1932579	0.28	42.8%
	Min	0.099	-11015	0.15	29.13	-311.13	-5114417	-0.85	0.04%
Poultry	Average	1.39	-248.6	188.43	180.90	4.33	10865.93	0.01	50.8%
	Max	4.03	-0.300	332.79	301.93	13.43	50000	0.04	91.2%
	Min	0.009	-844.61	63.40	32.21	0	0	0.00	17.4%

[1] Daily domestic consumption = total consumption ÷ # of days/year (365 days).

[2] The period of coverage of imports = Total imports ÷ daily domestic consumption.

[3] The change in the strategic reserves (surplus or deficit) = [(total length of the periods of production and the coverage of imports - 365) × local daily consumption] - Quantity of exports.

[4] Food security coefficient (FSC) = strategic reserves ÷ average annual domestic consumption.

[5] Self-sufficiency ratio (SSR)= (production/consumption) *100

Source: GASTAT [13], FAO [6], GATS [14], and FAS [15].

3.2. Food Security

From our data, wheat barley, and poultry production fluctuated but in general increased during the period (1961-2016), with annually increased by 38.81, 3.1, and 13.55 thousand tons, respectively, and the annual growth rate of about 1.03, 1, 1.11.

The entire product import amount was increased during the period (1961-2016). Wheat, barley, and poultry annually growth rate of about 1.07, 1.13, and 1.16 respectively. Also, the consumption of these products was increased rapidly during the same period. However, wheat, barley, and poultry food gap decline with an annual change rate of 2.1%, 4.69%, and 5% respectively, during the period (1961-2016).

Self-sufficiency ratio for wheat was about 96% on average during the period (1961-2016). Barely self-sufficiency ratio was on average about 3.8% during the period (1961-2016). It was annually decreased by 0.004% and was statistically significant at 1%. Self-sufficiency ratio for Poultry fluctuated from a maximum of around 91% in 1962 and a minimum of approximately 17 % in 1980 with an average 51% during the period (1961-2016), and the general trend was not statistically significant at 1%.

3.3. Estimate Strategic Stocks and Food Security Coefficient

The size of strategic stocks of wheat, barley, and poultry in Saudi Arabia was estimated by estimating the size of the surplus and deficit of the commodities for consumption during the period 1961-2016 (Table 1).

The Time Interval of Productions Sufficiency for wheat, barley, and poultry decreased by 38%, 99%, and 48% in 2016 compared to 1961, respectively, with average study period 326, 35, and 180 days[2].

The Time Interval of Imports Sufficiency for wheat and barley decreased by 38% and 48% in 2016 compared to

1961, respectively, with the average study period 208 and 253 days while it raised for poultry by 515%, with the average study period 180 days.

There was a surplus of wheat from domestic consumption in Saudi Arabia, during all the years of study except 1978, 1981, 1995, 1996 and 1998. The total surplus was estimated at 33.3 million tons, enough to consume about 9611.5 days, about 320 months. The total surplus for the barley was estimated at 8.25 million tons, enough to consume about 575.41 days, about 19 months. The total surplus of the commodity was estimated at 608.5 thousand tons, enough to consume about 242.45 days, about eight months. This surplus is going to the development of strategic stocks of poultry to be withdrawn from the deficit in other years.

The result shows that wheat had a lower deficit in domestic consumption (less than a year). However, the barley had a high deficit (more than one year), which was covered by withdrawal from strategic stocks. There was no deficit in domestic consumption for poultry[3] during 1961-2016.

The amount of surplus which going to the development of the strategic stock of wheat exceeds the amount of deficit or withdrawal from that stock. Thus, the ratio of the deficit to the surplus amount was about 1.7% at the end of the period of study. The amount of surplus, which going to the development of the strategic stock of barley, not exceeds the amount of deficit or withdrawal from that stock.

According to the concept of strategic stocks as a result of surplus and deficit during the study period, the strategic poultry stock in Saudi was estimated at 608.5 thousand tons. It is enough for domestic consumption for an expected period of 242.45 days, about eight months.

Considering both strategic stock and domestic consumption of poultry, the average FSC for wheat, barley, and poultry in Saudi Arabia were estimated at 0.46, 0.21, and 0.01, respectively, during the period 1961-2016. Therefore, it is necessary to increase strategic stocks to

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2 Wheat had impact relative to the policy 335 after 2007 for several year. Since the support program from government was reducing 12.5% every year after 2007.

3 We do not expect the government increase poultry strategic stock due to high cost for keeping the meat in stock.

meet domestic consumption for at least six months as a consideration of food security.

3.4. The Impact of Economic Factors on Food Security Coefficient

To study and measure the impact of the economic factors for food security coefficient, we estimate the relationship between the food security coefficient of wheat, barley, and poultry in Saudi Arabia as the dependent variable, and production, the quantity consumed and the imports quantity as independent variables during the study period (1961-2016). We used a different function to estimate this relationship between dependent and independent variables. After testing the different function form, it was found that the best-estimated economic models are the linear model. For wheat, barley, and poultry, a review of the coefficients estimation shown in Table 2 that production and imports have a positive impact on food security coefficients, while the amount consumed hurts food security. Also, all the coefficients are significant at a significant level of 5% as well as high R2 and the significance of the function at 5% through the F test.

Table 2. Economic factors on food security coefficient

	Wheat	Barley	Poultry
PRO	0.00062	0.00019	0.00083
	(17.25)**	(2.71)**	(10.71)**
IMQ	0.00063	0.00016	0.0007
	(12.76)**	(9.5)**	(9.75)**
CON	-0.00086	-0.00012	-0.0008
	(-15.06)**	(-7.34)**	(-9.91)**
Constant	0.42	-0.25	0.002
	(9.95)**	(-6.91)**	(2.30)**
R^2	0.85	0.66	0.94
F	101.9	33.79	279.5

** $p < 0.01$
t statistics in parentheses
where PRO is production, IMQ import quantity, and CON is consumption.

4. Conclusion

The paper aims to investigate on hunger index, food security, food gap, and strategic stock, as well as to assess the self-sufficiency of the essential commodities in Saudi Arabia during the period 1961-2016. This study was adopted in achieving its objectives on economic equations and econometric analysis. The growth rate of wheat, barley, and poultry production was low and sometimes negative during the period 1961-2016. Saudi Arabia enjoys a good percentage of self-sufficiency in poultry as to sufficiency local production.

The average strategic stock was enough to cover the domestic consumption period for wheat, barley, and poultry to about 168.78, -76.76, 28.86, 4.33 days ((-76.76) means to be cover more than 77 days to be in safe), respectively. The average food security coefficient estimated by about 0.46, -0.21, 0.01, respectively. The period of production adequacy of consumption has decreased with an increase in the period of coverage of the domestic consumption of

wheat, and barley, which means a negative indicator. The period of production adequacy for consumption of poultry has increased with a decreasing of the period of import coverage, which means a positive indicator. Where increasing the length of the period of production adequacy with a decreasing the period of coverage of imports for domestic consumption is a good indicator of the national economy, and this indicates an attempt to reduce dependence on abroad and thus reduce the balance of payments deficit. Finally, production, imports, and consumption are the most critical factors that affect food security coefficient for wheat, barley, and poultry in Saudi Arabia. We recommend to increase the meat production due to high cost of storage these commodities. Also, increased the support for external agricultural investment, particularly in countries with abundant resources.

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