10.21608/MEAE.2023.195480.1166

المجلة المصرية للاقتصاد الزراعي
ISSN: 2311-8547 (Online), 1110-6832 (print)
https://meae.journals.ekb.eg/

دراسةٌ اقتصادية لتحليل الوضع الحالي لأعلاف الثروة الحيوانية في مصر

د. خالد احمد عبده هبة محمد صلاح
قسم الاقتصاد الزراعي- كلية الزراعة ـ جامعة القاهرة

المستخلص

قامت الدراسة بتحليل الوضع الحالي للأعلاف في مصر من حيث الاحتياجات والإنتاج والواردات. حيث اظهرت النتائج أن هناك فائضا من الاعلاف الخضراء يقدر بنحو 27.22 مليون طن، بينما يوجد عجز في الأعلاف المركزة يقدر بنحو 3.162 مليون طن، بالإضافة إلى وجود عجز في الاتبان يقدر بنحو 1.690 مليون طن. كما اوضحت النتائج أنه بالرغم من وجود 166 مصنعًا في مصر لإنتاج اعلاف الماشية بطاقة إجمالية سنوية تقدر بحوالي 5.5 مليون طن، إلا أن الانتاج الفعلي لتلك المصانع يقدر بنحو 1.3 مليون طن فقط، وهو ما يمثل 23٪ من الطاقة الإجمالية لهذه المصانع عام 2020. بالإضافة إلى اعتماد مصر على عدد محدود من الدول (الولايات المتحدة الأمريكية والأرجنتين والبرازيل) للحصول على وارداتها من الأعلاف واستغلال هذه الدول لكل من الذرة وفول الصويا في إنتاج الوقود الحيوي. لذلك توصى الدراسة بالبحث عن دول جديدة لاستيراد الحبوب العلفية وتحفيز المنتجين الزراعيين على التوسع في زراعة الذرة الصفراء وفول الصويا.

بيانات البحث

استلام 2023/2/21
قبول 2023/5/26

الكلمات المفتاحية:
الاقتصاد الزراعي ـ الاعلاف الحيوانية ـ الوحدة الحيوانية ـ الميزان العلفي ـ الثروة الحيوانية.

الباحث المسئول: هبة محمد صلاح
البريد الإلكتروني: Heba_ms11@yahoo.com

10.21608/MEAE.2023.195480.1166

Available Online at EKb Press
Egyptian Journal of Agricultural Economics ISSN: 2311-8547 (Online), 1110-6832 (print)
https://meae.journals.ekb.eg/

An economic study analyzing current situation of livestock fodders in Egypt

Khaled Ahmed Abdu Heba Mohamed Salah

Department of Agricultural Economics, Faculty of Agriculture, Cairo University, Giza, Egypt.

ARTICLE INFO

Article History
Received:21-2- 2023
Accepted:26**- 5- 2023**

Keywords:
Agricultural Economics, Animal fodders, Animal unit, Feed balance, Livestock

ABSTRACT

The current situation of fodder in Egypt in terms of needs, production and imports was analyzed. Results found that there was a surplus of green fodder estimated at 27.22 million ton, while there was a deficit in concentrated fodder estimated at 3.162 million ton, in addition to a deficit in straw estimated at 1.690 million ton. Moreover, findings showed that despite there are 166 factories in Egypt of the production of concentrated fodder for livestock, with an annual total capacity about 5.5 million ton, but its actual production reach only 1.3 million ton, representing 23% of the total capacity of these factories in 2020. In addition to Egypt dependence on a limited number of countries (USA, Argentina, and Brazil) for obtaining its imports from fodder and the utilization of these countries for both corn and soybean in the production of biofuels. Therefore, it is recommended to search for new countries to import fodder grains and motivate agricultural producers to expand the cultivation of yellow corn and soybean.

Corresponding Author: **Heba Mohamed Salah**
Email: Heba_ms11@yahoo.com

10.21608/MEAE.2023.195480.1166

Introduction

Agricultural sector is one of the important sources for national income, as it supplies the national economy with foodstuffs and proceeds of foreign exchange necessary for economic development [(27)]. The animal production income in turn is included in the agricultural income, as livestock in Egypt represents about 35.4% of the total monetary value of agricultural production in 2020 with a value reached 595.66 billion Egyptian pounds[(8)].

Animal production sector is considered one of the most important sectors which produce mainly meat and milk to the local market. That provide animal protein to the population which is one of the basic requirements for human safety nutrition. Population increases led to increase in demand for animal products, thus gap happened between meat production and consumption[(12)].

Sustainable agricultural development strategy (Egypt 2030) aims to increase the local production of red meat from 470 thousand ton in 2020 to 600 thousand ton by 2025 and to 745 thousand ton by 2030 to meet the increasing demand on one hand, improving quality and reducing costs on the other hand, through providing a safe fodder product in accordance with the specifications and standards that achieve the highest rates of productive, reproductive and immunological performance. In addition to, conducting research activities supporting the development of livestock and developing new varieties of fodder crops with high productivity and low water consumption. Moreover, maximizing the utilization of fodder crops, agricultural residues and by-products of the food industry.

The increase in livestock production mainly depends on availability of fodder in sufficient quantities and quality as stated by Gondal[(16)]. Therefore, animal fodder is considered an important productive element and a determinant of the capacity of animal production in Egypt through the absence of natural pastures, the demand of fodder is derived from the demand of animal products, as the increase in demand of these products leads to an increase in the demand of fodder. At present, fodder demand is becoming a challenging issue in most of the developing countries[(17)].

Area of fodder crops reached 3.2 million feddan, representing 20% of the total cropped area in Egypt amounted to 16.28 million feddan in 2020, with a total value reached about 141 billion Egyptian pounds, representing 93% of the total value of animal production requirements amounted to 152 billion Egyptian pounds, while representing 71% of the total value of agricultural production requirements amounted to 231 billion Egyptian pounds for the same year[(8)].

Research problem

The research problem is represented in the high value of fodder ingredients, which leads to high production costs and its reflection on the high prices of animal products, as well as the abundance of green fodder in the winter season and the

failure to make optimal use of it. Moreover, the low operating percentage of the livestock fodder production factories which indicates the existence of large idle investments in this field that may lead to the instability of animal production, especially with the lack of natural pastures. In addition to, Egypt dependence on a limited number of countries to obtain its needs of fodder components and the utilization of these countries for both corn and soybean in the production of biofuel which will lead to a rise in its prices and the difficulty to obtain it.

Study objectives

The present study was undertaken to estimate the fodder needs of livestock in Egypt and the available fodders for consumption according to its various forms to identify which type of fodder has a deficit and which type has a surplus to estimate the areas to be planted with fodder crops, to analyze the current situation of the fodder production factories and the factors affecting it. Moreover, the development of the Egyptian imports from fodder components was studied, their geographical distribution and relationship with the agricultural trade balance, in addition to the countries that utilize fodder grains in biofuel production, and its impact on the stability of animal production in Egypt.

Materials and methods

Data sources

The study relied on secondary data that were collected through some publications issued by Central Agency for Public Mobilization and Statistic, Economic Affairs Sector at the Ministry of Agriculture and Land Reclamation, Arab Organization for Agricultural Development, Food and Agriculture Organization of the United Nations, Renewable Fuels Association, United States Department of Agriculture, U.S. Energy Information Administration, in addition to recent studies related to the subject of the research.

Data analysis

Descriptive and quantitative analysis tools represented by arithmetic averages, percentages, and index numbers were used in explaining the phenomena related to the subject of the research. In addition to, the research relied on simple regression analysis models, and T-tests, R^2, F for the estimated equations.

The study used the Arabic animal unit to convert the different numbers of animals into similar animal units, and the following animal unit conversion factor are used to calculate the animal unit (cows = 0.7, buffaloes = 1, sheep = 0.2, goats = 0.16, camels = 1) [(5)].

Regarding the estimation of fodder needs to farm animals, many scientific references indicate that there is more than one method that can be used to estimate

the fodder needs of farm animals in Egypt and the following two common methods for estimating these needs:

The first method: This method depends on converting the numbers of different types of animals into corresponding animal units, based on the conversion factors. Using international standards, the nutritional needs of each animal unit expressed in total digested compounds (TDN) and digested protein (DCP), which is equivalent to 1.5 ton/year of total digested compounds, 140 kg/year of digested crude protein per animal unit. On this basis it is possible to estimate the nutritional needs of farm animals.

The second method: This method depends on estimating the needs of different types of animals from fodder materials (green fodder, concentrated fodder, and straw) directly. The needs of each type of animal from different fodder materials are calculated as follows: Cows: 3 kg of concentrated fodder daily + 3 kg of straw daily + 3000 kg of green fodder annually. Buffaloes: 4 kg of concentrated fodder daily + 3 kg of straw daily + 3000 kg of green fodder annually. Sheep: 0.6 kg of concentrated fodder daily + 0.6 kg of straw daily + 900 kg of green fodder annually. Goats: 0.25 kg of concentrated fodder daily + 0.4 kg of straw daily + 600 kg of green fodder annually. Camels: 2 kg of concentrated fodder daily + 6 kg of straw daily + 1850 kg of green fodder annually [(12)].

Study results

First: Development of livestock numbers and their fodder needs in Egypt during the period (2003-2020)

A- Development of livestock numbers in Egypt

The most important live animals producing red meat in Egypt are represented in cows, buffaloes, sheep, goats, and camels. It observed from the data in table 1 that all numbers of cows, buffaloes, sheep, goats, and camels in Egypt has decreased significantly reach their minimum points in 2020 amounted to 2.7, 1.3, 1.9 million head, 925 and 79 thousand head respectively, with a decrease of 35.1%, 64.3%, 60.8%, 75.7% and 41.9%, respectively compared to the base year 2003.

Table 1. Development of the most important animal numbers producing red meat in Egypt during the period (2003-2020), unit (1000 head)

Year	Cows	Buffaloes	Sheep	Goats	Camels
2003	4227	3777	4939	3811	136
2004	4369	3845	5043	3879	129
2005	4485	3885	5232	3803	142
2006	4610	3937	5385	3877	148
2007	4933	4105	5467	4211	84
2008	5023	4053	5498	4473	107
2009	4525	3839	5592	4139	137
2010	4729	3818	5530	4175	111
2011	4780	3983	5365	4258	137
2012	4946	4165	5430	4306	142
2013	4745	3915	5564	4153	153
2014	4762	3949	5503	4186	158
2015	4883	3702	5463	4046	153
2016	5012	3437	5556	4260	157
2017	4387	3433	5305	3974	156
2018	4379	3445	4829	3571	85
2019	2808	1427	2081	977	91
2020	2745	1347	1935	925	79
Average	4464	3559	4984	3724	128

Source: Collected and estimated from Central Agency for Public Mobilization and Statistics, annual bulletin of statistics livestock, various issues

All numbers of cows, buffaloes, sheep, goats, and camels took a general decreasing trend during the study period. Where the annual decrease of cows, buffaloes, sheep, goats, and camels amounted to 53 thousand head, 99 thousand head, 104 thousand head, 100 thousand head and 1000 head, respectively, representing 1.2%, 2.7%, 2.1%, 2.6% and 0.7% of the average number of cows, buffaloes, sheep, goats, and camels respectively (Table 2). The significance of those decrease was proved to all except cows and camels and the coefficient of determination of cows, buffaloes, sheep, goats, and camels were 0.18, 0.42, 0.25, 0.26 and 0.04, respectively, meaning that 18%, 42%, 25%, 26% and 4% of the change in the number of cows, buffaloes, sheep, goats, and camels in Egypt during the study period is due to the factors explained by the time factor.

Table 2. The general time trend equations for the development of livestock numbers in Egypt during the period (2003-2020), unit (1000 head)

Type	Equations	R^2	Change rate%	Significance
Cows	$\hat{Y}$= 110975.7 – 52.9 x (-1.8)	0.18	1.2	-
Buffaloes	$\hat{Y}$= 203442.7 – 99.4 x (-3.4)	0.42	2.7	**
Sheep	$\hat{Y}$= 215349 – 104.5 x (-2.3)	0.25	2.1	*
Goats	$\hat{Y}$= 204815.4 – 99.9 x (-2.4)	0.26	2.6	*
Camels	$\hat{Y}$= 2156.2 – 1.008 x (-0.7)	0.04	0.7	-

Note: (*) means significant at 0.05 level, (**) means significant at 0.01 level and (-) means not significant
Source: Collected and estimated from table (1)

B- Fodder needs for livestock in Egypt

There is more than one method that can be followed to estimate the fodder needs of farm animals and the following two common methods for estimating these need:

On this basis it is possible to estimate the nutritional needs of farm animals. It is clear from the data in table 3, that the average number of farm animals during the period (2003-2020) converted into animal units amounted to 8.404 million animal unit and therefore the units of energy, expressed in total digested compounds, estimated at 12606 thousand ton, while the digested crude protein amounted to 1176.6 thousand ton.

Table 3. Number of farm animals expressed in animal units during the period (2003-2020), unit (1000 head)

Type	Animal numbers	Conversion factor	Animal units
Cows	4464	0.7	3125
Buffaloes	3559	1	3559
Sheep	4984	0.2	997
Goats	3724	0.16	596
Camels	128	1	128
Total	16859		8404

Source: Collected and estimated from table (1)

By exploring the data in table 4, that shows the nutritive needs of farm animals estimated in the form of different fodder materials, which amounted to 31025.2 thousand ton of green fodder, about 11608.8 thousand ton of concentrated fodder and about 10700.6 thousand ton of straw. When converting these nutritive needs to the corresponding total digested compounds (TDN) on the basis of the average nutritional value of these fodder materials as follows: the green fodder contains 10% of the digestible compounds, while the concentrated fodder contains 60% of the digestible compounds and the rough materials contains 35% of the digestible compounds. Therefore, the total value estimated at 13813 thousand ton of the digestible materials. So, when comparing the value obtained from the first method, it is clearly explained that the two methods near to a large degree from each other.

Table 4. Nutritive needs of farm animals estimated in the form of different fodder materials as an average period (2003-2020), unit (1000 ton)

Type	Animal numbers	Green fodder	Concentrated fodder	Straw
Cows	4464	13391.3	4887.8	4887.8
Buffaloes	3559	10677	5196.1	3897.1
Sheep	4984	4485.9	1091.6	1091.6
Goats	3724	2234.1	339.8	543.6
Camels	128	236.9	93.5	280.4
Total	16859	31025.2	11608.8	10700.6

Source: Collected and estimated from table (1)

C- Available fodders for livestock consumption in Egypt

The available fodder for consumption of farm animals in Egypt is estimated at 58.25 million ton of green fodder, divided into 53.66 million ton of clover and 4.5 million ton of other green fodders, represents 92.1% and 7.7% respectively (Table 5). While straw estimated at 9 million ton, divided into 8.37 million ton of wheat straw, 164 thousand ton of barley straw and 474 thousand ton of other straws, represents 92.9%, 1.8% and 5.3% respectively. As for the concentrated fodder is estimated at 8.44 million ton, divided into 6.19 million ton of corn and 2.25 million ton of others, represents 73.4%, and 26.6% respectively.

Table 5. Quantity of the available fodders for consumption of farm animals in Egypt as an average period (2003-2020), unit (1000 ton)

Type	Available consumption		Nutritive value	
	Quantity	%	Digested crude protein	Total digested compounds
Permanent clover	46837	80.4	1011.7	3756.3
Tahreesh clover	4068	7	87.9	326.3
Alfalfa	2759	4.7	59.6	221.3
Total clover	53664	92.1	1159.1	4303.9
Other green fodders	4588	7.9	99.1	368
Total green fodders	58252	100	1258.3	4671.8
Wheat straw	8372.6	92.9	92.1	2176.9
Barley straw	164	1.8	1.8	42.7
Other straws	474	5.3	5.2	123.2
Total straws	9010.6	100	99.1	2342.8
Corn	6196.2	73.4	433.7	4956.9
Others	2250.7	26.6	157.6	1800.6
Total concentrated fodders	8446.9	100	591.3	6757.5

Source: Collected and estimated from Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, bulletin of the agricultural statistics, bulletin of estimates agricultural income and bulletin of food balance sheet, different issues

D- Feed Balance in Egypt

By comparing the fodder needs of livestock in Egypt with the available fodders for consumption, it indicated that there is a shortage estimated at 785 thousand ton of total digested compounds and a surplus of about 348 thousand ton of digested crude protein as shown in table 6. Moreover, it observed that there was a surplus of green fodder estimated at 27.22 million ton, this result agrees with Shata[22] and Mostafa and Afifi[19]. These previous results confirmed the findings of Al-Sharqawi[3] who reported that the issue of the green fodder deficit is not real, and the problem is not in the animal needs of green fodder, but the problem is in the way the animal feeds these fodder in its diet. Also, it was found that there is a deficit in straw estimated at 1.690 million ton. In addition to a deficit in concentrated fodder estimated at 3.162 million ton, this result is in accordance with the findings of Abd El-Fattah[1], El-Emary[11], Shata[22] and Al-Sharqawi[3], where livestock breeders rely on green fodder to feed their animals due to the high prices of concentrated fodder and the inability to buy it. It should be noted that the

surplus in green fodder can be enough to feed about 8 million animal units and thus local production can be increased and the self-sufficiency ratio of animal products can be raised. Moreover, due to the success of the government policy for the 2022 agricultural season in motivating the farmer to expand wheat cultivation by supplying a percentage of his wheat crop, thus this surplus can save about 908 thousand feddan of permanent clover and can give about 2.45 million ton of wheat.

Table 6. Feed balance in Egypt of farm animals as an average period (2003-2020), unit (1000 ton)

Fodder materials	Nutritional needs	Available for consumption	Surplus or shortage
Green fodder	31025.2	58252	27227
Concentrated fodder	11608.8	8446.9	(3162)
Straw	10700.6	9010.6	(1690)
Digested crude protein	1600.5	1948.7	348
Total digested compounds	14557.4	13772.1	(785)

Source: Collected and estimated from tables (4) and (5)

The green fodder contains 8.02% of the total digested compounds and 2.16% of the digested protein, the straw contains 26% of the total indigested compounds and 1.1% of the digested protein, and the concentrated grain (yellow corn) contains 80% of the total digested compounds and 7% of the digested protein.

Second: The livestock fodder industry in Egypt

A- Development of the production of livestock fodder factories

It is noticed that the number of factories producing livestock fodder in Egypt during the period (2003-2020) increased from 105 factories in 2003 to 166 factories in 2020, an increase of 61 factory representing 58.1%, compared to the base year 2003 (Table 7). The annual increase was about 3 factories, representing 2.7% of the average period which amounted to 131 factories, and the significance of this increase was proved. The value of the coefficient of determination was 0.66, meaning that 66% of the increase in the number of fodder factories is due to the factors explained by the time factor as shown in table 8.

Table 7. Development of full capacity and actual production of livestock fodder factories in Egypt during the period (2003-2020), unit (1000 ton)

Years	Number of factories	Index no.	Full capacity	Index no.	Actual production	Index no.	Operating %
2003	105	100	4561.8	100	1285.2	100	28.2
2004	108	102.9	5078.8	111.3	1379.2	107.3	27.2
2005	103	98.1	5059.4	110.9	1431.4	111.4	28.3
2006	96	91.4	4532	99.3	1401.5	109.0	30.9
2007	112	106.7	5795.9	127.1	1395.2	108.6	24.1
2008	105	100.0	4547.5	99.7	1388.9	108.1	30.5
2009	100	95.2	4300.9	94.3	1382.6	107.6	32.1
2010	152	144.8	4911.0	107.7	1476.3	114.9	30.1
2011	146	139.0	4440.3	97.3	1013.8	78.9	22.8
2012	151	143.8	4533.1	99.4	1122.3	87.3	24.8
2013	150	142.9	4447.1	97.5	923.5	71.9	20.8
2014	145	138.1	4606.2	101.0	761.1	59.2	16.5
2015	134	127.6	4499.1	98.6	823.0	64.0	18.3
2016	132	125.7	4388.0	96.2	809.7	63.0	18.5
2017	136	129.5	5271.5	115.6	1182.7	92.0	22.4
2018	149	141.9	5628.2	123.4	1429.8	111.3	25.4
2019	159	151.4	5782.4	126.8	1185.5	92.2	20.5
2020	166	158.1	5513.6	120.9	1269.1	98.7	23.02
Average	131		4883		1198		25

Source: Collected and estimated from Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, statistics of livestock, different issues

While the actual production of fodder factories decreased from 1.28 million ton in 2003 to 1.26 million ton in 2020, with a decrease of 16 thousand ton, representing 1.24% compared to the base year 2003 and the annual decrease amounted to 19.9 thousand ton, representing 1.66% of the average actual production of livestock fodder factories during the study period. The significance of this decrease was confirmed and the value of the coefficient of determination was 0.21. The operating percentage of fodder factories reached 25% as an average period (2003-2020), which indicates the existence of large idle investments in this field and the high fixed costs per ton produced from the processed fodder as mentioned by Ahmed [(2)]. These finding consistent with what stated by Mostafa and Afifi [(19)] about the existence of some private fodder factories that import

fodder ingredients and use it for other purposes, this is due to the low production capacity of these concentrated fodder factories in Egypt.

Table 8. General time trend equations of the development of livestock fodder production factories in Egypt during the period (2003-2020)

	Equations	R^2	Change rate %	Significance
Number of factories	$\hat{Y}$= 96.7 + 3.55 x	0.66	2.7	**
	(5.65)			
Actual production	$\hat{Y}$= 1387.2 – 19.9 x	0.21	- 1.66	*
(1000 ton)	(-2.03)			

Note: (*) Significant at 0.05 level, (**) significant at 0.01 level
Source: Collected and estimated from table (7)

B- Factors affecting the production of livestock fodder factories

There are many raw materials that are used in the manufacture of livestock fodders in Egypt such as bran, yellow corn, cotton cake, soybean cake, rice gain and molasses[23]. However, there are many factors that affect the production of livestock fodder factories in Egypt, such as the prices of yellow corn, soybean and bran, the number of animal units, as well as the prices of animal products, but it was noted that the most important of these factors influencing and in agreement with the economic theory are the price of bran (wheat bran) and the price of soyabean. By studying the relationship between bran import price and the production of livestock fodder factories in Egypt, a statistically significant inverse relationship was observed, and the value of the regression coefficient was 53 ton, meaning that an increase in the price of importing a ton of bran by one dollar leads to a decrease in the production of livestock fodder factories about 53 ton. The value of the coefficient of determination was 0.28, which mean that 28% of the change in the production of livestock fodder factories in Egypt refers to the bran import price, as shown in table 9.

Table 9. General time trend equation of the relation between bran import price and the production of livestock fodder factories in Egypt during (2003-2020)

Item	Equation	R^2	Significance
Bran import price (Dollar/ton)	$\hat{Y}$= 1146.6 – 0.7 x (-2.5)	0.28	*

Note: (*) means significant at 0.05
Source: Collected and estimated from tables (7) and (15)

From the data in table 10, it observed that there is a statistically significant inverse relationship between soyabean import price and the production of

livestock fodder factories in Egypt, where the value of the regression coefficient was 57 ton, meaning that an increase in the price of importing a ton of soyabean by one dollar leads to a decrease in the production of livestock fodder factories about 57 ton. The value of the coefficient of determination was 0.33, which mean that 33% of the change in the production of livestock fodder factories in Egypt refers to the soyabean import price.

Table 10. General time trend equation of the relation between soyabean import price and the production of livestock fodder factories in Egypt during (2003-2020)

Item	Equation	R^2	Significance
Soyabean import price (Dollar/ton)	$\hat{Y}$= 719.1 – 0.25 x (-2.7)	0.33	*

Note: (*) means significant at 0.05
Source: Collected and estimated from tables (7) and (13)

Third: The Egyptian imports of fodder

Given the existence of a feed gap in Egypt, meaning that the local fodder production does not cover the needs of livestock, this gap is covered through imports of fodder components such as corn, soybean and bran. It observed from the data in table 11 that the Egyptian imports of the most important fodder components are represented in corn and soybean, where they represent about 26.4% of the total value of the Egyptian agricultural imports in 2020. This result is in line with the finding of Mostafa and Afifi [(19)] who indicated that Egypt relying on imports to provide concentrated fodder requirements and facing difficulty in obtaining the necessary foreign exchange for importing fodder ingredients such as yellow corn and soybean, and their high prices. The total value of the Egyptian imports of the most important fodder components took an increasing general trend during the study period, where the annual increase amounted to 174 million dollars, representing 8% of the average value of the Egyptian imports of fodder during the same period and the significance of this increase was proved. The value of the coefficient of determination was 0.79, meaning that 79% of the change in the Egyptian imports of fodder during the study period is due to the factors explained by time, as shown in table 14.

Table 11. The relative importance of the Egyptian imports of the most important fodder components to the total Egyptian agricultural imports during the period (2003-2020), unit (1000 dollar)

Years	Corn	Soybean	Total corn and soybean	Agricultural imports	%
2003	528772	89000	617772	2781142	22.2
2004	364819	64507	429326	3123718	13.7
2005	696223	193914	890137	4009324	22.2
2006	545322	163321	708643	4539627	15.6
2007	1076837	427606	1504443	6291850	23.9
2008	1036637	450000	1486637	8952738	16.6
2009	947763	656000	1603763	8753659	18.3
2010	1271480	780762	2052242	11733312	17.5
2011	2179859	970900	3150759	14720754	21.4
2012	1958461	1029300	2987761	15252640	19.6
2013	1984982	994061	2979043	13808471	21.6
2014	1824955	1001375	2826330	14225898	19.9
2015	1477191	743225	2220416	13117965	16.9
2016	1544188	704790	2248978	11795923	19.1
2017	1723194	869600	2592794	13213497	19.6
2018	1848675	1442500	3291175	14269917	23.1
2019	1929765	1663182	3592947	15776930	22.8
2020	1880862	1600286	3481148	13207645	26.4
Average	1378888	769129	2148017	13207645	20.0

Source: Collected and estimated from Food and Agriculture Organization of the United Nations

A- Development of the Egyptian imports of the most important fodder components during the period (2003-2020)

1 - Development of the Egyptian imports of corn

It was noticed from the data in table 12 that the quantity, value and import price of the Egyptian imports of corn has increased from 2003 estimated at 4 million ton, 528.7 million dollars and 130.5 dollars per ton, respectively, to reach its maximum points in 2018 the quantity estimated at 9.29 million ton, in 2011 the value estimated at 2.17 billion dollars and in 2013 the import price estimated at 343.9 dollars per ton, representing 129.4%, 312.2% and 163.6% respectively compared to the base year 2003.

Table 12. Development of the Egyptian imports of corn during (2003 - 2020)

Years	Quantity		Average price		Value	
	1000 ton	Index no.	Dollar/ton	Index no.	1000 dollar	Index no.
2003	4052.6	100	130.5	100	528772	100
2004	2429.3	59.9	150.2	115.1	364819	69.0
2005	5095.0	125.7	136.6	104.7	696223	131.7
2006	3769.4	93.0	144.7	110.9	545322	103.1
2007	5263.1	129.9	204.6	156.8	1076837	203.6
2008	3979.9	98.2	260.5	199.6	1036637	196.0
2009	5416.3	133.7	175.0	134.1	947763	179.2
2010	6170.5	152.3	206.1	157.9	1271480	240.5
2011	7047.9	173.9	309.3	237.0	2179859	412.2
2012	6061.6	149.6	323.1	247.6	1958461	370.4
2013	5771.8	142.4	343.9	263.6	1984982	375.4
2014	8230.8	203.1	221.7	169.9	1824955	345.1
2015	7951.4	196.2	185.8	142.4	1477191	279.4
2016	8508.0	209.9	181.5	139.1	1544188	292.0
2017	8332.4	205.6	206.8	158.5	1723194	325.9
2018	9296.2	229.4	198.9	152.4	1848675	349.6
2019	8078.4	199.3	238.9	183.1	1929765	365.0
2020	7880	194.4	238.7	182.9	1880862	355.7
Average	6296.4		214.3		642394.6	

Source: Collected and estimated from Food and Agriculture Organization of the United Nations

As shown in table 14, the quantity, value and import price of the Egyptian imports of corn took a general increasing trend during the study period. Where the annual increase in quantity, value and import price amounted to 333.8 ton representing 5.3% of the average amount, 90.8 million dollars representing 14% of the average value and 4.7 dollar per ton representing 2.2% of the average import price of the Egyptian imports of corn, respectively. The significance of those increase was proved to all except the import price of corn. The coefficient of determination of the quantity of the Egyptian imports of corn was 0.82, meaning that 82% of the change in the quantity of the Egyptian imports of corn during the study period is due to the factors explained by time. While the coefficient of determination of the value of the Egyptian imports of corn was 0.68, meaning that 68% of the change in the value of the Egyptian imports of corn during the study period is due to the factors explained by time.

2 - Development of the Egyptian imports of soybean

It observed that the quantity, value and import price of the Egyptian imports of soybean has increased from 2003 estimated at 332 thousand ton, 89 million dollars and 268 dollars per ton, respectively, to reach its maximum points in 2019 except for the import price in 2013, estimated at 4.25 million ton, 1.6 billion dollars and 632.5 dollars per ton respectively, representing 1182.3%, 1768.7% and 135.9% respectively compared to the base year 2003 (Table 13).

Table 13. Development of the Egyptian imports of soybean during (2003 - 2020)

Years	Quantity		Average price		Value	
	1000 ton	Index no.	Dollar/ton	Index no.	1000 dollar	Index no.
2003	332.0	100	268.1	100	89000	100
2004	214.9	64.7	300.2	112.0	64507	72.5
2005	574.0	172.9	337.8	126.0	193914	217.9
2006	572.9	172.6	285.1	106.3	163321	183.5
2007	1136.2	342.2	376.4	140.4	427606	480.5
2008	1192.4	359.2	377.4	140.8	450000	505.6
2009	1471.7	443.3	445.7	166.3	656000	737.1
2010	1752.3	527.8	445.6	166.2	780762	877.3
2011	1712.4	515.8	567.0	211.5	970900	1090.9
2012	1815.3	546.8	567.0	211.5	1029300	1156.5
2013	1571.7	473.4	632.5	235.9	994061	1116.9
2014	1793.6	540.3	558.3	208.3	1001375	1125.1
2015	1764.3	531.4	421.3	157.1	743225	835.1
2016	1774.6	534.5	397.1	148.1	704790	791.9
2017	2152.3	648.3	404.0	150.7	869600	977.1
2018	3511.0	1057.5	410.9	153.3	1442500	1620.8
2019	4257.3	1282.3	390.7	145.7	1663182	1868.7
2020	4062.6	1223.7	393.9	146.9	1600286	1798.1
Average	1759		421.0		769129.4	

Source: Collected and estimated from Food and Agriculture Organization of the United Nations

The quantity, value and import price of the Egyptian imports of soybean took a general increasing trend during the study period. Where the annual increase in quantity, value and import price amounted to 196.6 ton representing 11.2% of the average amount, 83.2 million dollars representing 10.8% of the average value and 7.6 dollars per ton representing 1.8% of the average import price of the Egyptian imports of

soybean respectively (Table 14). The significance of those increase was proved to all except the import price of soybean. The coefficient of determination of both the quantity and the value of the Egyptian imports of soybean was 0.82 and 0.83 respectively.

Table 14. General time trend equations of the development of the Egyptian imports of the most important fodder components during the period (2003-2020)

Item	Unit	Equations	R^2	Change rate %	Significance
Corn	**Quantity** (1000 ton)	$\hat{Y}$= 3124.7 + 333.8 x (8.44)	0.82	5.3	*
	Price (Dollar/ton)	$\hat{Y}$= 169.2 + 4.7 x (1.76)	0.16	2.2	-
	Value (1000 dollar)	$\hat{Y}$= 516208.7 + 90808.3 x (5.96)	0.68	14	*
Soybean	**Quantity** (1000 ton)	$\hat{Y}$= - 108.9 + 196.6 x (8.54)	0.82	11.2	*
	Price (Dollar/ton)	$\hat{Y}$= 348.7 + 7.6 x (1.73)	0.15	1.8	-
	Value (1000 dollar)	$\hat{Y}$= - 21508.6 + 83225.1 x (8.73)	0.83	10.8	*
Total corn and soybean	**Value** (1000 dollar)	$\hat{Y}$= 494700 + 174033.4 x (7.9)	0.79	8.1	*

Note: (*) means significant at 0.01 level and (-) means not significant
Source: Collected and estimated from tables (11), (12) and (13)

3- Development of the Egyptian imports of bran

It is cleared from the data in table 15 that the quantity, value and import price of the Egyptian imports of bran has increased from 2003 estimated at 94.8 thousand ton, 11.8 million dollars and 124.7 dollars per ton, respectively, to reach its maximum points in 2011 except for the import price in 2015, estimated at 218.3 thousand ton, 60.5 million dollars and 1445 dollars per ton respectively, representing 130.3%, 412.1% and 1058.9% of the base year 2003 respectively.

Table 15. Development of the Egyptian imports of bran during (2003 - 2020)

Years	Quantity		Average price		Value	
	1000 ton	Index no.	Dollar/ton	Index no.	1000 dollar	Index no.
2003	94.8	100	124.7	100	11819	100
2004	47.7	50.3	113.1	90.7	5391	45.6
2005	80.3	84.7	127.8	102.5	10260	86.8
2006	13.0	13.7	130.0	104.3	1688	14.3
2007	64.8	68.3	158.8	127.4	10286	87.0
2008	65.4	69.0	204.5	164.0	13364	113.1
2009	36.8	38.8	577.0	462.7	21216	179.5
2010	38.3	40.4	135.4	108.6	5183	43.9
2011	218.3	230.3	277.2	222.3	60525	512.1
2012	156.6	165.3	219.1	175.7	34325	290.4
2013	71.3	75.2	543.3	435.7	38729	327.7
2014	116.7	123.1	252.9	202.8	29512	249.7
2015	10.5	11.1	1445.1	1158.9	15184	128.5
2016	44.0	46.5	172.3	138.2	7587	64.2
2017	86.9	91.6	162.9	130.7	14153	119.7
2018	59.1	62.3	184.5	147.9	10900	92.2
2019	69.6	73.4	169.9	136.2	11824	100.0
2020	156.8	165.4	167.4	134.2	26241	222.0
Average	79.5		287.0		18232.6	

Source: Collected and estimated from Food and Agriculture Organization of the United Nations

B- Geographical distribution of the Egyptian imports of the most important fodder components as an average period (2015-2020)

1. Geographical distribution of the Egyptian imports of corn

Argentina is considered the most important country from which Egypt imports corn, as the average imported quantity amounted to 2.9 million ton, valued about 532.7 million dollars, with an average price of 188 dollar per ton, representing 35% and 31% of the Egyptian imports of corn for both quantity and value respectively, as an average period (2015-2020). Followed by Ukraine, Brazil, USA, and the rest of the world, representing 28%, 23%, 9% and 4.5% of the Egyptian imports of corn for the quantity, respectively and representing 30.5%, 25%, 8% and 6% of the Egyptian imports of corn for the value, respectively as shown in table 16.

Table 16. Geographical distribution of the Egyptian imports of corn as an average period (2015-2020)

Countries	Quantity		Price	Value	
	1000 ton	%	Dollar/ton	1000 dollar	%
Argentina	2951.8	35.4	188.4	532762.2	30.7
Brazil	1940.8	23.3	222.8	429220.8	24.8
Ukraine	2334.9	28.0	279.3	529170.2	30.5
USA	740.5	8.9	198.9	144659.2	8.3
Other countries	373.1	4.5	263.1	98166.8	5.7
Total	8341.1	100	207.9	1733979.2	100

Source: Collected and estimated from Food and Agriculture Organization of the United Nations

2 - Geographical distribution of the Egyptian imports of soybean

The USA is considered the most important country from which Egypt imports soybean, as the average imported quantity amounted to 1.78 million ton, valued about 715 million dollars, with an average price of 410.5 dollar per ton, representing 61% of the Egyptian imports of soybean for both quantity and value, as an average for the period (2015-2020). Followed by Argentina, Ukraine, Brazil, and the rest of the world, representing 15.5%, 13%, 5% and 6% of the Egyptian imports of soybean for the quantity, respectively and representing 15%, 13%, 5% and 6% of the Egyptian imports of soybean for the value, respectively as shown in table 17.

Table 17. Geographical distribution of the Egyptian imports of soybean as an average period (2015-2020)

Countries	Quantity		Price	Value	
	1000 ton	%	Dollar/ton	1000 dollar	%
Argentina	452.8	15.5	395.4	177064.2	15.1
Brazil	135.9	4.7	272.6	57943.2	4.9
Ukraine	385.8	13.2	400.0	153895.7	13.1
USA	1780.1	61.0	410.5	715042.7	61.1
Other countries	165.76	5.7	402.1	66651.5	5.7
Total	2920.3	100	400.8	1170597.2	100

Source: Collected and estimated from Food and Agriculture Organization of the United Nations

It can be concluded that the Egyptian imports of corn and soybean concentrated in the USA, Argentina, Ukraine and Brazil, which poses a great danger to the stability of the Egyptian imports of fodder components from these countries, especially if we know that the USA and Brazil together constitute about 85% of the global ethanol production, where the amount of ethanol produced in the USA amounted to 13.94 billion gallons in 2020[26], representing 52.6% of the total global production of ethanol which estimated at 26.470 billion gallons. While the amount of ethanol produced in Brazil amounted to 8.10 billion gallons, representing 30.6% of the total global production of ethanol for the same year[21]. Several studies have reported that the USA and Brazil are the most important biofuel producing countries, as the production of the two countries together constitute about 90% of the global production[6] [7]. Corn ethanol production in Brazil is steadily growing, where the total ethanol production from corn in 2020 estimated at 2.5 billion liters (1 metric ton of corn = 417 liters of ethanol), with an increase of 1.17 million liters compared to 2019, based on information from the Corn Ethanol National Union (UNEM). Ethanol from corn represents approximately 8% of total ethanol production. UNEM forecasts that Brazil should produce 8 billion liters of corn ethanol by 2028. Industry sources in Brazil report that raw materials represent 75 to 80% of the biodiesel production cost, whereas other inputs such as methanol and additives represent 10% of the total cost. Given that 70% of biodiesel production still uses soybean oil as the feedstock (1 metric ton of soybean oil, crude = 1,113 liters of biodiesel), where total biodiesel production from soybean oil in 2020 estimated at 4 billion liters[24]. Moreover, Argentina is one of the world's largest soybean producers and exporters, and the largest soybean oil and meal exporter. Soybean oil is practically the only feedstock utilized by the local biodiesel industry, where the total biodiesel production in 2020 estimated at 1.315 billion liters and the total biodiesel production from soybean oil in 2020 estimated at 1.160 billion liters[25].

Conclusion and Recommendations

The world food economy is being increasingly driven by the shift of diets towards animal-based products such as meat, milk, and dairy [14]. Development of livestock depends upon accessibility of appropriate quantity and quality feed for livestock as reported by Gondal [15]. Means that feed and fodder are the most important contributing factors for the growth of livestock sector as stated by Mishra and Pathak [18]. While the lack of fodder and what it leads to a feed gap may contribute to a significant deficit in the agricultural trade balance as a result of the big amount of the Egyptian imports of fodder, which is consistent with what mentioned by Rathod and Dixit[20] that the deficit in fodder and feed have to be met through imports. Despite animal fodder is the most important contributing factor for the growth of livestock sector, the high value of fodder components leads to high production costs and reflect on high prices of animal products. In

this regard, the study analyzed the current situation of fodder in Egypt in terms of needs, production, and imports. In addition, estimated the feed gap and its sources. Results indicated that there is a surplus of green fodder, while there is a deficit in concentrated fodder and straw, where livestock breeders rely on green fodder to feed their animals due to the high prices of concentrated fodder and the inability to buy it. Moreover, findings showed that the actual production of the livestock fodder production factories decreased, with low operating percentage, which indicates the existence of large idle investments in this field and the high fixed costs per ton produced from the processed fodder. In addition to Egypt dependence on a limited number of countries for obtaining its imports from fodder components and the utilization of these countries for both corn and soybean in the production of biofuels, which will lead to a rise in their prices, increase the burden on the agricultural trade balance and the difficulty for obtaining them. Following recommendations suggested as follows: (1) The problem of green fodders shortage is not real, and the problem is not in the animal needs of green fodder but the problem is in the way the animal feeds these fodder in its diet, thus the study recommends the need to establish a factory under the government control so that it has a planned mechanism for implementation to convert the surplus of green fodders in the form of silage to make balance throughout the year and given the success of the government policy in motivating the farmer by supplying a percentage of his wheat crop, it is possible to repeat this policy to maximize the utilization of fodder crops. (2) Fodder production factories should be stimulated to operate at their full production capacity to increase local production of manufactured fodder as well as those factories carrying out a marketing campaign to promote their products, so that there are no idle investments and waste of resources. (3) Searching for new countries to import fodder grains through studying the international markets, while maintaining the current markets. (4) Motivating farmers to expand the cultivation of yellow corn and soybean and to expand the use of agricultural residues in feeding animals, providing the optimum ration for animals to secure the needs of livestock from fodder and to achieve the per capita needs of animal protein.

References

1- Abd El-Fattah, A. E., Nema, A. A. A. and Rafat, M. E. M. (2016). An economic study for untraditional fodder and its role to fix fodder shortage in Sharkia governorate. Egyptian Journal of Agricultural Research, 94(2):525-546.
2- Ahmed, K. Z. S., AL-Demeery, M. A. and Zakaria, M. R. (2022). The role of feed and its effects on the development of livestock in Egypt and Kafr El-Sheikh Governorate. Egyptian Journal of Agriculture Economics, 32(1):40-60.
3- Al-Sharqawi, E. M., Saleh, O. E., Ahmed, M. A., Abdel Razek, Y. S. and Mohamed, E. A. (2019). Animals need of feed, economics of their production and consumption in Egypt. Alexandria Science Exchange Journal, 40(1):87-103.

4- Annual Bulletin of Statistics Livestock (2003-2020). Central Agency for Public Mobilization and Statistics (CAPMAS), Cairo, Egypt.
5- Arab Organization for Agricultural Development (AOAD) (2016). Guidance guide concerning terms, nomenclature, and units of measurement for pastoral resources in the Arab homeland. 17p.: Available at: http://www.aoad.org/Guide_Pastoral_Terms_2017.pdf
6- Badr, O. A. and Farrag, W. A. (2017). Biofuel production in the world and the possibility of producing it of wastes in Egypt. Egyptian Journal of Agriculture Research, 95(3):1387-1401.
7- Badr, O. A., Farrag, W. A. and Shaban, N. E. A. (2018). The impact of biofuels production in the world on the prices of Egyptian imports of food commodities. Egyptian Journal of Agriculture Research, 96(4):1689-1702.
8- Bulletin of Estimates Agricultural Income (2003-2020). Central Administration of Agricultural Economics, Economic Affairs Sector, Ministry of Agriculture and Land Reclamation, Giza, Egypt.
9- Bulletin of Food Balance Sheet (2003-2020). Central Administration of Agricultural Economics, Economic Affairs Sector, Ministry of Agriculture and Land Reclamation, Giza, Egypt.
10- Bulletin of the Agricultural Statistics (2003-2020). Central Administration of Agricultural Economics, Economic Affairs Sector, Ministry of Agriculture and Land Reclamation, Giza, Egypt.
11- El Emary, A. E. M. (2017). An estimate efficiency of feed use in the production of red meat in small farms in Al Bahira governorate. Journal of Agricultural Economics and Social Sciences, Mansoura University, 8(2): 53-58.
12- El Khateb, R. A. M. and Ali, M. M. E. (2019). The impact of fodders production on increasing the animal wealth in the New Valley governorate. Egyptian Journal of Agriculture Economics, 29(4):1625-1642.
13- FAO (2003-2020). World Food and Agriculture Organization – Data, Trade database. Retrieved from: https://www.fao.org/faostat/en/#data/TCL
14- FAO (2018). World Food and Agriculture Organization, Statistical Pocketbook 2018. Rome. 254pp.
15- Gondal, M. R., Arshad, M., Ali, N., Dr. Rizvi, S. A., Jahangeer, A., Ijaz, S., Ashraf, M. S., Khan, M. N., Iqbal, N. and Idrees, M. (2022). Appropriate sowing technique to enhance productivity and maximize the net return of alfalfa crop. International Journal of Agricultural Technology 18(4):1477-1486.
16- Gondal, M. R., Rizvi, S. A., Hanif, M. S., Mahmood, T., Naseem, W., Hayat, S., Mustafa, S., Pervez, A. and Khan, A. (2021). Developing the quality seed production technology for berseem (Trifolium alexandrinum L.) fodder. International Journal of Agricultural Technology 17(2):479-496.
17- Islam, S., Begum, J., Sarker, N. R. and Khatun, M. (2017). Economics of fodder production for dairying in selected areas of Bangladesh. Bangladesh Journal of Animal Science, 46(2):140-149.
18- Mishra, S. and Pathak, P. S. (2015). Fodder production and Conservation: A Potential Source of Livelihood for Women. pp. 136-150. Available at: https://www.researchgate.net/publication/271510691
19- Mostafa, Y. S. and Afifi, A. A. (2019). Feed production and consumption determinants in Egypt. Alexandria Journal of Agricultural Sciences, 64(5):319-340.
20- Rathod, P. and Dixit, S. (2019). Green fodder production: A manual for field functionaries. Patancheru 502 324, Telangana, India: International Crops Research Institute for the Semi-Arid Tropics. 56 pp.
21- Renewable Fuels Association (RFA) (2020). Annual Ethanol Production: Available at: https://ethanolrfa.org/markets-and-statistics/annual-ethanol-production.

22- Shata, M. A., Abdul Ghaffar, M. S., Elsyed, H. M. and Omar, F. A. K. (2019). Economic analysis of feed needs in Egypt. Journal of Agricultural Economic and Social Science, Mansoura University, 10(6):375-383.
23- Statistics of Livestock (2003-2020). Central Administration of Agricultural Economics, Economic Affairs Sector, Ministry of Agriculture and Land Reclamation, Giza, Egypt.
24- United States Department of Agriculture (USDA) September (2020). Biofuels Annual report: Global Agricultural Information Network, Foreign Agricultural Service. 37pp.
25- United States Department of Agriculture (USDA) August (2021). Biofuels Annual report: Global Agricultural Information Network, Foreign Agricultural Service. 22pp.
26- U.S. Energy Information Adminstration (EIA) March (2022). Monthly energy review: Available at: https://www.eia.gov/energyexplained/biofuels/
27- Zedan, A. M., Mohamed, A. I., Aboelmajd, S. A. and Mahmoud, M. E. (2016). The current and future position of the production and consumption of red meat and its demand in Egypt. Assiut Journal of Agriculture Science, 47(4):251-262.