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المؤشرات الاقتصادية لإنتاج اللحوم الحمراء في مصر

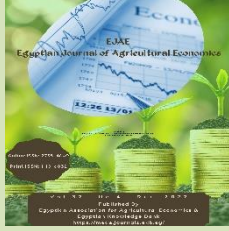
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قسم الاقتصاد الزراعي – كلية زراعة – جامعة عين شمس

بيانات البحث	المستخلص
استلام 2023 /2/4 قبول 2023 /6 / 15	يُعد قطاع اللحوم الحمراء أحد الأنشطة الإنتاجية الزراعية المهمة في مصر؛ حيث يُعد مصدر دخل للكثير من الأسر في الريف والحضر، ومصدراً أساسياً لاحتياجات الأسرة من البروتين الحيواني وتمثلت مشكلة البحث الرئيسية في عجز الطاقة الإنتاجية عن الوفاء بالاحتياجات المتزايدة من اللحوم الحمراء حيث تُعاني مصر بصفة عامة من انخفاض الطاقة الإنتاجية للحوم الحمراء، و إنخفاض نصيب الفرد من اللحوم الحمراء. ويواجه قطاع إنتاج اللحوم الحمراء في السنوات الأخيرة العديد من التحديات والمشكلات الإنتاجية والتسويقية التي أثرت عليه، وترتب عليها ارتفاع ملحوظ في الأسعار وعزوف كثير من المستهلكين عن إستهلاك اللحوم الحمراء ومُنتجاتها، وإفلاس وخروج أعداد كبيرة من المُنتجين في هذا القطاع. كما إستهدفت الدراسة التعرف على الوضع الراهن لكل من أسواق الحيوانات الحية والمجازر. ولقد بينت الدراسة أن استهلاك الفرد من اللحوم الحمراء تناقص خلال الفترة 2005-2020 بمعدل معنوي احصائيا بلغ 380 جرام سنويا. كما أن نسبة الاكتفاء الذاتي بلغت نحو 67.7% في المتوسط وأن تلك النسبة اتجهت للانخفاض خلال نفس الفترة بمعدل معنوي احصائيا. في المقابل اتجه الانتاج الكلي للحوم الحمراء نحو الزيادة بمعدل معنوي احصائيا بلغ نحو 12.5 الف طن خلال الفترة 1990-2020. وتبين الدراسة أن نسبة الأبقار المذبوحة في المجازر الحكومية الي الأبقار المذبوحة عموماً بلغت نحو 63% بينما بلغت تلك النسبة للاغنام نحو 19%. وتشكل تلك النسب المنخفضة صعوبة بالغة في الرقابة على ممارسات سلامة الغذاء. كما بلغ عدد المجازر الحكومية في مصر نحو 486 منهم 7 مجازر نصف الى و 15 مجزر الى والغالبية الساحقة عبارة عن مجازر يدوية.
الكلمات المفتاحية:	
الطاقة الإنتاجية- استهلاك اللحوم الحمراء- المجازر الحكومية- سلامة الغذاء.	

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Economic Indicators of Red Meat Production in Egypt

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ABSTRACT

The study shows that the average annual per capita consumption of red meat was about 13.4 kg during the period 2005-2020 with a minimum of about 9.03 kg in 2020 and a maximum of about 17.07 kg in 2007. The results of the time trend equation reveals that meat self-sufficiency in red meat has declined during the period 2005-2020 by a statistically significant ratio of about 1.45%. The study shows that the annual average of beef production in Egypt was about 347.5 thousand tons during the period 1990-2020. Time trend equations show that the amount of beef increased annually by about 7.45 thousand tons during the study period. It appears that the annual average of sheep meat production in Egypt amounted to about 70.7 thousand tons during the study period with a minimum of 42.0 thousand tons in 2019 and a maximum of 86.0 thousand tons in 2007-2008. The time trend analysis show that production of sheep meat decreased annually by 8 kg during the study period. This rate of decline was statistically insignificant.

The total number of government slaughterhouses in Egypt amounted to about 486 in year 2020. About 464 slaughterhouses are manual in nature and about 7 slaughterhouses are semi-automatic. The remaining 15 slaughterhouses are fully automated. The ratio of the total slaughtered animals in government slaughterhouses amounted to 28.90% as an average for the study period. That means that about 71 percent of all animals are slaughtered away from the public eye with no monitoring or inspection. The study recommends that efforts should be extended to establish more live animal markets and modern slaughterhouses. The distribution of slaughterhouses should be taken into consideration the size of population, the size of animal stocks, and the purchasing power of consumers. The objective here is to minimize the transportation costs to and from slaughterhouses and to keep strict monitoring of the food safety regulations.

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Introduction

The red meat sector is an important agricultural activity in Egypt, as it is one of the main sources of agricultural income and a major source of animal protein. The red meat production sector faces many production and marketing challenges, which resulted in a significant increase in the prices of red meat and the inability of large segments of the Egyptian population to purchase red meat and its products. Coupled with the significant increases in the cost of animal feed, livestock fattening enterprises find it rather difficult to stay in business. This study focuses on the evolution of different sources of red meat like cows, buffalos, sheep and goat. Likewise, the study will explore the situation of slaughterhouses and the availability of red meat for human consumption.

The Study Problem:

The main research problem is the underdeveloped production capacity of red meat and the failure of the meat industry to face up to the market dynamics. Egypt suffers from the high cost of fodder due to the lack of natural pastures, with the expectation that this problem will worsen in the future. Therefore, it is necessary to explore the possibilities of improving the capacity of meat production in Egypt.

Research Objectives:

The main objective of the study is to examine the main trends affecting the growth and sustainability of red meat production in Egypt.

Research Methods and Data Sources:

To achieve the objectives of the study, qualitative and quantitative techniques are utilized to address the subjects of the study. The research relies heavily on secondary data from various sources such as the Ministry of Agriculture and Land Reclamation, the Central Agency for Public Mobilization and Statistics, and the Food and Agriculture Organization of the United Nations.

Research Results:

Consumption of Red Meat:

This section covers the development of the average per capita consumption of meat, as well as the availability of meat for consumption at the national level and the self-sufficiency ratio of meat during the period 2005-2020.

Table (1) shows that the annual average of available meat for consumption at the national level amounted to 1.16 million tons, with a minimum of about 1.33 million tons in 2005 and a maximum of about 1.41 million tons in 2015. According to the time trend equation in Table (2), availability of meat for consumption has decreased by a statistically insignificant amount of about 9.47 thousand tons a year.

Similarly; Table (1) shows that the average annual per capita consumption of red meat was about 13.4 kg during the period 2005-2020 with a minimum of about 9.03 kg in 2020 and a maximum of about 17.07 kg in 2007. The time trend equation in Table (2) indicates that the average per capita share of red meat decreased by a statistically significant amount of about 0.38 kg / year.

Table (1): **Consumption and Self-Sufficiency of Red Meat**

Year	Consumption (thousands of tons)	Average per capita kg/year	self % sufficiency	gap thousand tons
2005	1133	15	75.3	280
2006	1312	17.07	66.8	435
2007	1382	17.67	66.2	467
2008	1176	14.77	81.5	217
2009	1196	14.74	81.9	216
2010	1052	12.71	75.2	261
2011	1033	12.22	76.2	246
2012	1052	12.17	74.9	264
2013	1118	12.65	69.8	338
2014	1223	13.53	62.9	454
2015	1408	15.23	56.3	615
2016	1167	12.36	67.8	376
2017	1155	11.98	68.6	363
2018	1263	12.83	50.6	624
2019	1003	9.99	54.2	459
2020	924	9.03	55.4	412
average	1162.3	13.4	67.7	376.7
minimum	924	9.03	50.6	216
maximum	1408	17.67	81.9	624

Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Livestock Statistics, various issues

Table (2): Time Trend Equations of Consumption and Self-Sufficiency of Red Meat

Variable	Time Trend Equation	R ²	F
Consumption (thousands of tons)	$\hat{Y} = 1242.8 - 9.47 X$ (18.03) (-1.33)	0.11	1.76
Average per capita kg/year	$\hat{Y} = 16.62 - 0.38 X$ (21.71) (-4.82)*	0.62	23.26
self sufficiency %	$\hat{Y} = 80.08 - 1.45 X$ (21.61) (-3.79)*	0.51	14.37
gap thousand tons	$\hat{Y} = 265.2 + 13.12 X$ (4.34) (2.07)*	0.24	4.3

Source: Collected and calculated from Table (1) of the study.

where :

\hat{Y} : denotes the estimated value of the dependent variable

X: Refers to the time variable during the period (2005-2020)

R²: indicates the value of the coefficient of determination

F: indicates the significance of the model as a whole

*: indicates significant regression coefficients and the model as a whole at a significance level of 0.05.:

Table (1) shows that the average self-sufficiency ratio during the period 2005-2020 stood at 67.7% with a minimum of about 50.6% in 2017 and a maximum of about 81.9% in 2018. The results of the time trend equation in Table (2) reveals that meat self-sufficiency in red meat has declined during the period 2005-2020 by a statistically significant ratio of about 1.45%.

Evolution of Red Meat Production:

The main sources of red meat in Egypt include cows, buffalos, sheep and goats. By far meat from cows and buffalos constitute the largest share of red meat in Egypt. The share of cow meat and buffalo meat is almost the same as table 3 indicates. Red meat from sheep and goats are of much lesser importance compared to cow and buffalo meat. Table (3) shows that the annual average of beef production in Egypt was about 347.5 thousand tons during the period 1990-2020. Time trend equation (1) in table (4) shows that the amount of beef increased annually by about 7.45 thousand tons during the study period. The standard deviation of beef production

was 81.9 tons while the coefficient of variation was 23.6 during the period 1990-2020.

Table (3) shows that the annual average of buffalo meat production in Egypt amounted to about 310.3 thousand tons during the study period with a minimum of about 161.0 thousand tons in 1990 and a maximum of about 407.1 thousand tons in 2015. The time trend equation number (2) in table (4) shows that the amount of buffalo meat increased by about 5.93 thousand tons during the study period. It appears from Table (3) that the annual average of sheep meat production in Egypt amounted to about 70.7 thousand tons during the study period with a minimum of 42.0 thousand tons in 2019 and a maximum of 86.0 thousand tons in 2007-2008. Time trend equation (3) in Table (4) shows that production of sheep meat decreased annually by 8 kg during the study period. This rate of decline is statistically insignificant.

Furthermore, table (3) shows that the annual average of goat meat production amounted to about 46.0 thousand tons during the period 1990-2020 with a minimum of about 12.0 thousand tons in 2019 and a maximum of about 62.0 thousand tons in 2008. The time trend equation in table (4) postulates that goat meat has decreased by statistically insignificant rate of 130 kg during the study period.

Table (3): Red Meat Production in Egypt, thousand tons.

Years	Beef Meat	Buffalo Meat	Sheep Meat	Goat Meat	Camel Meat	Total Meat
1990	143	161	54.5	27.5	22.1	408.1
1991	270	169	46	31	28	544
1992	276	173	65	33	29	576
1993	290	177	67	34	22	590
1994	287	233	65	45	24.9	654.9
1995	285	248	69	47	24.9	673.9
1996	245.3	267	69	48	26.9	656.3
1997	248	270	69	49	25.1	661.1
1998	258	283	71	50	25	687
1999	273	286	71	50	33.6	713.6
2000	282	288	73	51	30.7	724.7
2001	273	284	75	52	31.7	715.7
2002	336.4	337.5	82.7	53.8	28.1	838.5
2003	329	324	82.7	56.9	23.6	816.2
2004	340	330	80	57	21.3	828.3
2005	353	354	83	55	17.7	862.7
2006	367	360	85	55	16.2	883.2
2007	393.2	370	86	61	8.3	918.5
2008	429.9	375	86	62	6.1	959

Years	Beef Meat	Buffalo Meat	Sheep Meat	Goat Meat	Camel Meat	Total Meat
2009	446.7	381	85	59	8	979.6
2010	457.3	398.4	75.1	53	8.6	992.3
2011	454.5	395.8	73.6	53	10.6	987.5
2012	464.6	384.9	74.5	54	11	989
2013	434.8	389.7	75.9	52	11.9	964.3
2014	421	380	75	53	12.3	941.3
2015	430.3	407.1	74.3	50.9	11.8	974.5
2016	451.3	375.3	75.6	52.9	12.1	967.3
2017	388.9	369.3	60.2	33.4	15.4	867.2
2018	408.7	370.1	50.6	23.1	4	856.5
2019	425	217	42	12	11.5	707.5
2020	310.6	260.5	48.7	12.5	10.9	643.2
Average	347.5	310.3	70.7	46	18.5	793
standard deviation	81.9	75.5	11.8	13.2	8.5	156.7
coefficient of varition	23.6	24.3	16.7	28.6	45.9	19.8

Source: Compiled and calculated from: www.fao.org

Table (4): Time Trend Equations of Red Meat Production

Number	Variable	Time Trend Equation	R ²	F
1	Beef Meat	$\hat{Y}=228.3 + 7.45 X$ (12.59)* (7.54)*	0.66	56.78
2	Buffalo Meat	$\hat{Y}= 215.4+ 5.93 X$ (10.53)* (5.32)*	0.49	28.26
3	Sheep Meat	$\hat{Y} =70.79 - 0.008 X$ (15.73)* (-0.03)	0.0001	0.001
4	Goat Meat	$\hat{Y}= 48.07 - 0.13 X$ (9.6)* (-0.47)	0.008	0.22
5	Camel Meat	$\hat{Y} = 30.46- 0.75 X$ (15.4)* (-6.93)*	47.98	0.62
6	Total Meat	$\hat{Y} =593.01 +12.49 X$ (14.2)* (5.48)*	0.51	30.07

Source: Collected and calculated from Table (1) of the study.

where:

\hat{Y} : denotes the estimated value of the dependent variable (thousands of tons)

X : Refers to the time variable for the period (1990-2020)

R²: indicates the value of the coefficient of determination

F: indicates the significance of the model as a whole

:*indicates significant regression coefficients at a significance level of 0.05.

Finally; table (3) shows that the annual average of camel meat production in Egypt amounted to about 18.5 thousand tons during the period 1990-2020 with a minimum of about 4.0 thousand tons in 2018 and a maximum of about 33.6 thousand tons in 1999. Time trend equation (5) in Table (4) shows that the quantity of camel meat decreased by 750 kg during the study period. The standard deviation of camel meat production was about 8.5 tons while the coefficient of variation was 45.9 as it is evident from in table (3). At the aggregate level, Table (3) reveals that the annual average of total red meat production was about 793.0 thousand tons during the period 1990-2020 with a minimum of about 408.1 thousand tons in 1990 and a maximum of about 992.3 thousand tons in 2010. According to the time trend equation in table (4); total meat production increased annually by 12.49 thousand tons during the study period. The rate of increase of total red meat production was statistically significant at the 5 % level of significance.

Development of Per Animal Productivity of Red Meat in Egypt:

Table (5) shows that the average meat productivity per cow in Egypt amounted to about 261.5 kg during the period 1990-2020 with a minimum of about 134.3 kg in 1990 and a maximum of 356.9 kg in 2018. Equation (1) in Table (6) shows that the productivity of beef in Egypt was increasing at an annual rate of about 5.6 kg during the study period. This rate of increase is statistically significant at the level of 1 %. By contrast, the average productivity of buffalo meat in Egypt amounted to about 266.8 kg per animal during the period 1990-2020 with a minimum of about 132.5 kg per animal in 1990 and a maximum of about 345.3 kg per animal in 2015. Equation (2) in Table (6) shows that the productivity of buffalo meat in Egypt was increasing at an annual rate of about 7.5 kg per animal during the study period. Again this rate of increase was statistically significant at the level of 1 %.

Similar analysis shows that the average productivity of sheep meat in Egypt amounted to about 33.9 kg per animal during the study period with a minimum of about 18.7 kg per animal in 1991 and a maximum of about 43.2 kg per animal in 2005. The average productivity of goat meat in Egypt amounted to about 22.0 kg per animal during the study period with a minimum of about 15.7 kg per animal in 2018 and a maximum of about 25.1 kg per animal in 2009. The time trend analysis indicates that the rates of increase of meat productivity for sheep and goats were statistically insignificant during the period 1990-2020. Interestingly, the camel meat productivity during the same time period was declining at a statistically significant rate of about 6 kg per year.

Table (5): Evolution of Per Animal Meat Productivity in Kilograms

Years	Productivity of cows	Productivity of buffaloes	Productivity of sheep	Productivity of goats	Productivity of camels
1990	134.3	132.5	24.5	18	298
1991	216	153.2	18.7	17.7	311.1
1992	219.9	153.8	25.9	17.9	301.4
1993	212.2	154.3	25.6	17.5	329
1994	197	182	36	22.6	300
1995	190.4	180.4	36.3	22.9	302.3
1996	175.2	194.9	36.1	23.1	249.2
1997	175.5	186.2	35.9	23.3	248.9
1998	180.9	186.2	35.8	23.4	208
1999	202.2	181	36.2	23.2	305.5
2000	190.8	175.6	36.1	22.9	279.5
2001	191.3	264.6	36.4	22.9	276.8
2002	293.8	291.7	36	23.1	270.7
2003	286.3	309.2	35.9	23.2	212.3
2004	286.4	309	36.2	23.3	189.8
2005	290.3	317.5	43.2	23.3	151.7
2006	289.9	318	38.8	23.3	133.2
2007	310.3	317.1	35.3	23.4	120
2008	317.5	317.3	36.3	23.6	120
2009	316.1	310.3	36.2	25.1	120
2010	314.5	315.7	31.9	22.5	120
2011	315.4	311.4	31.9	23	120
2012	317.8	319.4	31.9	23.1	142.2
2013	308.6	333.1	31.9	21.8	191.2
2014	308	330.7	31.8	22.4	180.4
2015	319	345.3	31.9	20.4	142.4
2016	324.7	344.6	31.9	20.4	136.3
2017	245.3	342.9	32.9	21.9	194.9
2018	356.9	337.7	33.8	15.7	191.3
2019	306.6	329.3	40.3	24.5	166.6
2020	314.6	327	38.4	21.9	193.4
Average	261.5	266.8	33.9	22	209.9
standard deviation	60.5	73.5	4.8	2.2	69.8
coefficient of variation	23.1	27.5	14.2	10.2	333

Source: Compiled and calculated from: www.fao.org

Table (6): Time Trend Equations of Per Animal Meat Productivity

Number	Variable	Time Trend Equation	R ²	F
1	Productivity of cows	$\hat{Y}=171.3 + 5.6 X$ (13.4)* (8.1)*	0.69	65.7
2	Productivity of buffaloes	$\hat{Y}= 147.02 + 7.5 X$ (12.8)* (11.9)*	0.83	142.3
3	Productivity of sheep	$\hat{Y} =30.8 + 0.19 X$ (17.9)* (2.01)	0.14	4.1
4	Productivity of goats	$\hat{Y}= 21.2 + 0.05 X$ (25.3) * (1.02)	0.04	1.04
5	Productivity of camels	$\hat{Y}=305.4 - 5.97 X$ (13.4) * (-6.4)*	0.59	40.9

Source: Collected and calculated from Table (3) of the study.

where:

\hat{Y} : denotes the estimated value of the dependent variable (in kg for the animal)

X: Refers to the variable of time during the period (1990-2020)

R2: indicates the value of the coefficient of determination

F: indicates the significance of the model as a whole

:*indicates significant regression coefficients and the model as a whole at a significance level of 0.05.

Numbers of Slaughtered Animals:

Table (7) shows an increase in the number of slaughtered cows with an annual average of about 1334.1 thousand heads during the period 1990-2020 with a minimum of about 987 thousand heads in 2020 and a maximum of about 1585 thousand heads in 2017. The estimated time trend equation in Table (8) shows that the number of cows slaughtered in Egypt increased annually by an insignificant rate of 380 heads during the study period. On the other hand, the annual average number of buffaloes slaughtered during the study period amounted to about 1191.3 thousand heads with a minimum of 659 thousand heads in 2019 and a maximum of 1640 thousand heads in 2000. The time trend equation in Table (8) shows that the number of buffaloes slaughtered in Egypt decreased by about 10.9 thousand heads annually.

Along the same lines table (7) shows that the annual average of sheep slaughtered amounted to 2113.9 thousand heads with a minimum of 1041 thousand heads in 2019 and a maximum of 2614 thousand heads in 1993. The number of slaughtered sheep has decreased by a statistically insignificant rate of about 12.4 thousand heads per year. By the same token, Table (5) shows that the average annual number of goats slaughtered was 2080.3 thousand heads with a minimum of 489

thousand heads in 2019 and a maximum of 2626 thousand heads in 2008. The number of slaughtered goats trended downward with an insignificant rate of 8.7 thousand heads per year. Similarly, the number of slaughtered camels has declined during the study period with a statistically significant rate of 1.2 thousand heads per year.

Table (7): Numbers of Slaughtered Animals, Thousand Heads

Years	Cattle	Buffaloes	Sheep	Goats	camels	Total
1990	1065	1215	2225	1528	74	6107
1991	1250	1103	2464	1748	90	6655
1992	1255	1125	2511	1847	96	6834
1993	1367	1147	2614	1946	67	7140
1994	1457	1280	1807	1988	83	6615
1995	1497	1375	1903	2048	83	6906
1996	1400	1370	1913	2075	108	6866
1997	1413	1450	1924	2102	101	6990
1998	1426	1520	1982	2139	120	7187
1999	1350	1580	1961	2157	110	7158
2000	1478	1640	2020	2223	110	7471
2001	1427	1073	2063	2266	114	6944
2002	1145	1157	2295	2331	104	7032
2003	1149	1048	2302	2455	111	7065
2004	1187	1068	2209	2450	112	7026
2005	1216	1115	1920	2357	117	6725
2006	1266	1132	2190	2360	122	7070
2007	1267	1167	2433	2607	69	7543
2008	1354	1182	2372	2626	51	7585
2009	1413	1228	2346	2346	66	7399
2010	1454	1262	2354	2354	71	7495
2011	1441	1271	2305	2305	88	7410
2012	1462	1205	2335	2335	77	7414
2013	1409	1170	2383	2383	62	7407
2014	1367	1149	2362	2362	68	7308
2015	1349	1179	2331	2492	83	7434
2016	1390	1089	2371	2595	89	7534
2017	1585	1077	1833	1529	79	6103
2018	1145	1096	1496	1473	21	5231
2019	1386	659	1041	489	69	3644
2020	987	796	1267	574	56	3681
Average	1334.1	1191.3	2113.9	2080.3	86.2	6805.8
Minimum	987	659	1041	489	21	3644
Maximum	1585	1640	2614	2626	122	7585

Source: Compiled and calculated from: www.fao.org

At the aggregate level the annual average number of slaughtered animals of all kinds amounted to about 6805.8 thousand heads with a minimum of about 3644 thousand heads in 2019 and a maximum of about 7585 thousand heads in 2008.

Table (8): Time Trend Equations of Slaughtered Animals

Number	Variable	Time Trend Equation	R ²	F
1	Cattle	$\hat{Y}=1328.05 + 0.38 X$ (25.7)* (0.13)	0.001	0.02
2	buffaloes	$\hat{Y}=1365.2 - 10.9 X$ (21.4)* (-3.12)*	0.25	9.8
3	sheep	$\hat{Y}=2312.9 - 12.4 X$ (18.1)* (-1.8)	0.09	3.2
4	Goats	$\hat{Y}=2219.2 - 8.7 X$ (11.6)* (-0.8)	.002	0.69
5	Camels	$\hat{Y}=105.9 - 1.2 X$ (13.5)* (-2.9)*	0.22	8.3
6	Total	$\hat{Y}=7331.1 - 32.8 X$ (21.04)* (-1.7)	0.09	2.98

Source: Collected and calculated from Table (5) of the study.

where:

\hat{Y} : denotes the estimated value of the dependent variable (thousand vertices)

X: Refers to the variable of time during the period (1990-2020)

R²: indicates the value of the coefficient of determination

F: indicates the significance of the model as a whole

:*indicates significant regression coefficients and the model as a whole at a significance level of 0.05.

Government Slaughterhouses:

Table (9) shows that the annual average number of public slaughterhouses in Egypt during the study period amounted to about 460.7 with a minimum of about 407 in 2000 and a maximum of about 502 in 2012. The trend analysis shows that the number of slaughterhouses in Egypt increased by about 3.2 annually during the study period.

Table (9): Numbers of Animals Slaughtered in Government Run Slaughterhouses, thousand heads.

Years	Cows Local	Bulls Local	young calves		Buffalo		sheep	goat	imported camels	Total slaughtered	number of slaughterhouse
			local	imported	Big	young					
2000	34.16	0.95	638.99	159.23	119.18	494.88	447.61	25.25	109.96	2030.22	407
2001	39.4	0.82	617.02	132.01	122.28	549.86	427.31	24.37	117.84	2030.9	410
2002	54.43	0.75	674.97	75.91	144.41	604.3	421.67	21.97	103.9	2102.3	427
2003	80.47	0.75	740.36	30.86	172.51	636.2	397.07	20.97	90.81	2170	438
2004	88.82	0.66	723.24	3.91	167.68	554.58	323.41	16.93	73.6	1952.84	449
2005	55.79	0.64	771.91	27.41	136.29	368.13	364.73	17.3	81.63	1823.82	461
2006	46.43	0.74	863.88	17.77	159.34	465.62	438	22.55	93.57	2107.88	465
2007	79.06	1.05	754.25	13.86	148.89	447.25	394.87	20.62	82.19	1942.02	465
2008	102.95	0.45	803.35	4.73	210.95	582.02	372.23	25.47	90.5	2192.65	477
2009	82.35	0.41	796.09	30.25	180.24	478.43	354.3	25.34	115.49	2062.91	445
2010	41.6	0.35	683.49	91.87	117.39	325.56	333.82	20.72	150.24	1765.02	445
2011	27.3	0.26	569.52	80.75	101.35	356.64	298.44	13.55	113.67	1561.47	467
2012	35.45	0.2	553.41	63.27	111.63	400.35	291.28	12.65	100.7	2876.92	502
2013	43.48	0.26	635.27	61.11	112.32	401.15	265.82	12.57	62.3	1594.28	474
2014	45.13	0.3	683.99	65.77	129.03	361.42	311.86	17.13	68.39	1683.01	460
2015	47.07	0.19	741.07	96.93	108.25	281.38	427.87	19.44	83.26	1805.46	477
2016	41.96	0.21	705.96	159.46	99.87	205.09	478.2	19.7	89.48	1799.92	479
2017	37.85	0.21	607.95	131.61	83.59	173.28	438.29	14.34	79.07	1566.18	479
2018	43.24	0.29	710.22	104.42	77.24	197.14	523.08	18.13	93.96	1767.72	479
2019	93.37	0.27	771.42	91.14	106.59	231.27	563.34	21.45	68.53	1947.37	483
2020	95.14	0.23	802.56	35.17	103.09	205.21	535.34	23.99	52.57	2015.58	486
Average	57.87	0.48	706.66	72.95	129.73	397.71	402.92	19.72	92.47	1942.78	460.7
Minimum	27.3	0.19	553.41	3.91	77.24	173.28	265.82	12.57	62.3	1561.47	407
Maximum	102.95	1.05	863.88	159.46	210.95	636.2	563.34	25.47	150.24	2876.92	502

Source: Collected and calculated from the Annual Bulletin of Livestock Statistics, Central Agency for Public Mobilization and Statistics, separate issues.

Table (10): Time Trend Equations of Animals Slaughtered in Government Slaughterhouses, thousand heads.

Number	Variable	Time Trend Equation	R ²	F
1	Cows Local	$\hat{Y}=56.7 + 0.10 X$ (5.1)* (0.12)	0.001	0.01
2	Bulls Local	$\hat{Y}=0.89 - 0.04 X$ (12.8)* (-6.7)*	0.70	45.2
3	young calves local	$\hat{Y}=703.4 + 0.29 X$ (18.5)* (0.09)	0.001	0.01
4	young calves imported	$\hat{Y}=49.4 + 2.15 X$ (2.3)* (1.3)	08.0	1.6
5	Buffalo Big	$\hat{Y}=163.9 - 3.1 X$ (12.8)* (-3.1)*	0.33	9.3
6	Buffalo Young	$\hat{Y}=619.3 - 20.1 X$ (19.3)* (-7.9)*	0.77	62.1
7	Sheep	$\hat{Y}=347.7 + 5.02 X$ (9.2)* (1.7)	0.13	2.8
8	Goat	$\hat{Y}=22.2 - 0.23 X$ (12.3)* (-1.6)	0.12	2.5
9	imported camels	$\hat{Y}=106.9 - 1.3 X$ (11.9)* (-1.9)	0.15	3.4
10	Total slaughtered	$\hat{Y}=2095.4 - 13.9 X$ (16.4)* (-1.4)	0.09	1.9
11	number of massacres	$\hat{Y}=425.3 + 3.2 X$ (62.2)* (5.9)*	0.65	34.9

Source: Collected and calculated from Table (7) of the study.

where:

\hat{Y} : denotes the estimated value of the dependent variable

X: Refers to the variable of time during the period (1990-2020)

R²: indicates the value of the coefficient of determination

F: indicates the significance of the model as a whole

:*indicates significant regression coefficients and the model as a whole at a significance level of 0.05.

Table (9) indicates that the annual average of all animals slaughtered in government slaughterhouses amounted to about 1942.78 thousand heads during the period 2000-2020 with a minimum of about 1561.47 thousand heads in 2011 and a maximum of about 2876.92 thousand heads in 2012. The annual average of local cows slaughtered in government slaughterhouses amounted to about 57.87 thousand heads during the period 2000-2020 with a minimum of about 27.30 thousand heads in 2011 and a maximum of about 102.95 thousand heads in 2008. As the time trend in Table (10) shows the number of local cows slaughtered in government slaughterhouses increased annually by an insignificant rate of 100 heads during the study period. Similarly; the average number of local bulls slaughtered in Egypt during the study period amounted to about 480 heads with a minimum of about 190 heads in 2015 and a maximum of about 1050 heads in 2007. The time trend equation shown in Table (10) indicates that the number of local bulls decreased by about 40 heads annually during the study period.

The average number for slaughtered large buffaloes during the study period was about 129.73 thousand heads with a minimum of about 77.24 thousand heads in 2018 and a maximum of about 210.95 thousand heads in 2008. Table 10 indicates

that that the number of large buffaloes slaughtered decreased by about 3.1 thousand heads during the study period. Likewise the average number of young buffaloes slaughtered in Egypt during the study period amounted to about 397.71 thousand heads with a minimum of about 173.28 thousand heads in 2017 and a maximum of about 636.20 thousand heads in 2003. However, the trend equation shows that the number of young buffaloes slaughtered in Egypt decreased by about 20.1 thousand heads during the study period.

With regards to small animals table 9 reveals that the average number of sheep slaughtered in government slaughterhouses amounted to about 402.92 thousand heads during the period 2000-2020 with a minimum of about 265.82 thousand heads in 2013 and a maximum of about 563.34 thousand heads in 2019. According to the time trend equation in Table (10) the number of sheep slaughtered in government slaughterhouses increased annually at an insignificant rate of about 5 thousand heads during the study period. When it comes to goats, the average number slaughtered in government slaughterhouses amounted to about 19.72 thousand heads during the study period with a minimum of about 12.57 thousand heads in 2013 and a maximum of about 25.47 thousand heads in 2008. The time trend analysis in Table (10) shows that the number of goats slaughtered in government slaughterhouses decreased annually by about 230 heads during the study period.

As shown in Table (11) the ratio of the total slaughtered animals in in government slaughterhouses amounted to a minimum of about 21.07% for the year 2011 and a maximum of about 54.76% for the year 2020. The geometric mean of this ratio for the whole period is about 28.90%. That means that about 71 percent of all animals are slaughtered away from the public eye with no monitoring or inspection. That means that the public authorities are faced with great difficulties in their attempt to enforce food safety regulations. Table 11 reveals that smaller proportions of sheep and goats are slaughtered in government slaughterhouses. On average about 19.12 percent of sheep and 0.97 percent of goats are slaughtered in government slaughterhouses. By contrast, about 63.05 percent of cows and 44.4 percent of buffalos are slaughtered in government slaughterhouses.

Table (11) Percentage of Animals Slaughtered in Government Slaughterhouses, %.

years	cows	buffaloes	sheep	goats	Total
2000	56.38	37.44	22.16	1.14	27.17
2001	55.31	62.61	20.71	1.08	29.25
2002	70.4	64.71	18.37	0.94	29.9
2003	74.19	77.17	17.25	0.85	30.71
2004	68.8	67.63	14.64	0.69	27.79
2005	70.37	45.24	19	0.73	27.12
2006	73.37	55.21	20	0.96	29.82
2007	66.95	51.08	16.23	0.79	25.75
2008	67.32	67.09	15.69	0.97	28.91
2009	64.34	53.64	15.1	1.08	27.88
2010	56.21	35.1	14.18	0.88	23.55
2011	47.04	36.03	12.95	0.59	21.07
2012	44.62	42.49	12.47	0.54	38.8
2013	52.53	43.89	11.15	0.53	21.52
2014	58.17	42.68	13.2	0.73	23.03
2015	65.62	33.05	18.36	0.78	24.29
2016	65.29	28	20.17	0.76	23.89
2017	49.05	23.85	23.91	0.94	25.66
2018	74.95	25.03	34.96	1.23	33.79
2019	68.99	51.27	54.11	4.39	53.44
2020	94.5	38.71	46.42	4.12	54.76
geometric mean	63.05	44.44	19.12	0.97	28.9
Minimum	44.62	23.85	11.15	0.53	21.07
Maximum	94.5	77.17	54.11	4.39	54.76

Source: Collected and calculated from the Annual Bulletin of Livestock Statistics, Central Agency for Public Mobilization and Statistics, separate issues

Classification of Government Slaughterhouses.

Table (12) shows that the total number of slaughterhouses in Egypt amounted to about 486 in year 2020 with a total production capacity of about 30,720 heads per day. About 464 slaughterhouses are manual in nature with a total production capacity of 27,840 heads per day. And about 7 slaughterhouses are semi-automatic with a total production capacity of 630 heads per day. The remaining 15 slaughterhouses are automatic with a total production capacity of 2250 heads per day for the year 2020.

Table (12) indicates that Port Said has only one manual slaughterhouse while Miya governorate has 41 manual slaughterhouses. Out of the 15 automatic slaughterhouses 4 are located in Ismailia governorate and 2 are located in each of Cairo and Dakahlia.

Table (12) Types of Government Slaughterhouses for the year 2020.

Governorate	Manual	Half automatic	Full Automatic	Total slaughterhouses	population
Minya	41	0	0	41	6023203
Asyut	40	0	0	40	4802434
Menoufia	38	0	0	38	4578910
Sohag	33	0	0	33	5439346
Qalyubia	31	0	1	32	5953131
Dakahlia	24	0	2	26	6859894
Giza	24	1	1	26	9200884
Fayoum	24	0	1	25	3897412
Sharqiya	24	0	0	24	7640082
Aswan	21	2	1	24	1590377
Behara	20	1	1	22	6632497
Gharbya	20	0	0	20	5285660
Kafr El-Sheikh	19	0	0	19	3600196
Bani Sweif	17	0	0	17	3430098
Qena	17	0	0	17	3463061
the new Valley	13	0	0	13	257752
Damietta	12	0	0	12	1578340
Ismailia	8	0	4	12	1400315
Subtracted	9	0	0	9	502734
Cairo	4	1	2	7	10021820
South of Sinaa	6	0	0	6	111870
The Red Sea	5	1	0	6	387494
the shortest	5	0	0	5	1345279
Alexandria	2	1	1	4	5422608
North Sinai	4	0	0	4	489428
Suez	2	0	1	3	770333
Port Said	1	0	0	1	778544
Republic	464	7	15	486	101463702
Average	17	0	1	18	3757915
Minimum	1	0	0	1	111870
Maximum	41	2	4	41	101463702

Source: Collected and calculated from the Annual Bulletin of Livestock Statistics, Ministry of Agriculture and Land Reclamation 2020. Eighth: the statistical estimate of the relationship between the population in million and the number of Slaughterhouses.

The following equation represents the statistical relationship between the number of slaughterhouses as a dependent variable and the number of population as an

independent variable. The equation indicates that an increase in the population by about one million people leads to an increase in the number of slaughterhouses by about 2.2. That is densely populated governorates tend to have more slaughterhouses compared with less populated governorates.

$$\hat{Y}_i = 9.73 + 2.20 X_i$$

(2.93)* (3.12)*

$$R^2 = 0.28 \quad F = 9.75$$

Where (\hat{Y}_i) is the number of slaughterhouses in governorate i for the year 2020

(X_i) The population in governorate i for the year 2020.

Summary and Recommendations

The study shows that the average annual per capita consumption of red meat was about 13.4 kg during the period 2005-2020 with a minimum of about 9.03 kg in 2020 and a maximum of about 17.07 kg in 2007. The time trend equation in Table (2) indicates that the average per capita share of red meat decreased by a statistically significant amount of about 0.38 kg / year. The average self-sufficiency ratio during the same period stood at 67.7% with a minimum of about 50.6% in 2017 and a maximum of about 81.9% in 2018. The results of the time trend equation reveals that meat self-sufficiency in red meat has declined during the period 2005-2020 by a statistically significant ratio of about 1.45%.

The main sources of red meat in Egypt include cows, buffalos, sheep and goats. By far meat from cows and buffalos constitute the largest share of red meat in Egypt. The shares of cow meat and buffalo meat are almost the same. Red meat from sheep and goats are of much lesser importance compared to cow and buffalo meat. The study shows that the annual average of beef production in Egypt was about 347.5 thousand tons during the period 1990-2020. Time trend equations show that the amount of beef increased annually by about 7.45 thousand tons during the study period. It appears that the annual average of sheep meat production in Egypt amounted to about 70.7 thousand tons during the study period with a minimum of 42.0 thousand tons in 2019 and a maximum of 86.0 thousand tons in 2007-2008. The time trend analysis show that production of sheep meat decreased annually by 8 kg during the study period. This rate of decline was statistically insignificant.

One of the study findings is that the average meat productivity per cow in Egypt amounted to about 261.5 kg during the period 1990-2020 with a minimum of about 134.3 kg in 1990 and a maximum of 356.9 kg in 2018. The study indicates that the productivity of beef in Egypt was increasing at an annual rate of about 5.6 kg during the study period. This rate of increase is statistically significant at the level of 1 %. By contrast, the average productivity of buffalo meat in Egypt amounted to about 266.8 kg per animal during the period 1990-2020 with a minimum of about 132.5 kg per animal in 1990 and a maximum of about 345.3 kg per animal in 2015. Furthermore, the productivity of buffalo meat in Egypt was increasing at an annual rate of about 7.5 kg per animal during the study period. Again this rate of increase was statistically significant at the level of 1 %.

Similar analysis shows that the average productivity of sheep meat in Egypt amounted to about 33.9 kg per animal during the study period with a minimum of about 18.7 kg per animal in 1991 and a maximum of about 43.2 kg per animal in 2005. The average productivity of goat meat in Egypt amounted to about 22.0 kg per animal during the study period with a minimum of about 15.7 kg per animal in 2018 and a maximum of about 25.1 kg per animal in 2009. The time trend analysis indicates that the rates of increase of meat productivity for sheep and goats were statistically insignificant during the period 1990-2020. Interestingly, the camel meat productivity during the same time period was declining at a statistically significant rate of about 6 kg per year.

With regards to slaughtered animals at the aggregate level the study shows that the annual average number of slaughtered animals of all kinds amounted to about 6805.8 thousand heads with a minimum of about 3644 thousand heads in 2019 and a maximum of about 7585 thousand heads in 2008. The annual average number of public slaughterhouses in Egypt during the study period amounted to about 460.7 with a minimum of about 407 in 2000 and a maximum of about 502 in 2012. The trend analysis shows that the number of slaughterhouses in Egypt increased by about 3.2 annually during the study period.

As the study shows the ratio of the total slaughtered animals in government slaughterhouses amounted to a minimum of about 21.07% for the year 2011 and a maximum of about 54.76% for the year 2020. The geometric mean of this ratio for the whole period is about 28.90%. That means that about 71 percent of all animals

are slaughtered away from the public eye with no monitoring or inspection. That means that the public authorities are faced with great difficulties in their attempt to enforce food safety regulations. The study reveals that smaller proportions of sheep and goats are slaughtered in government slaughterhouses. On average about 19.12 percent of sheep and 0.97 percent of goats are slaughtered in government slaughterhouses. By contrast, about 63.05 percent of cows and 44.4 percent of buffalos are slaughtered in government slaughterhouses.

The total number of government slaughterhouses in Egypt amounted to about 486 in year 2020 with a total production capacity of about 30,720 heads per day. About 464 slaughterhouses are manual in nature with a total production capacity of 27,840 heads per day. And about 7 slaughterhouses are semi-automatic with a total production capacity of 630 heads per day. The remaining 15 slaughterhouses are automatic with a total production capacity of 2250 heads per day for the year 2020. The study found that densely populated governorates tend to have more slaughterhouses compared with less populated governorates. Regression analysis indicates that an increase in the governorate population by about one million people leads to an increase in the number of slaughterhouses by about 2.2. The study recommends that efforts should be extended to establish more live animal markets and modern slaughterhouses. The distribution of slaughterhouses should be taken into consideration the size of population, the size of animal stocks, and the purchasing power of consumers. The objective here is to minimize the transportation costs to and from slaughterhouses and to keep strict monitoring of the food safety regulations.

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