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اتجاهات إنتاج الحليب في مصر

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كلية الزراعة - جامعة عين شمس

المستخلص

توضح الدراسة أن حليب البقر في مصر كان ينمو بسرعة أكبر من حليب الجاموس خلال الفترة 1990-2019. ولقد اتخذت الإنتاجية لكل رأس حلوب اتجاها تصاعديا للجاموس والأبقار خلال نفس الفترة ولكن ابتداء من عام 2004 أصبحت إنتاجية البقرة الحلوب أكبر من نظيرتها للجاموس. كما أن اجمالى إنتاج حليب الأبقارتجاوز إنتاج حليب الجاموس لأول مرة اعتبارا من عام 2005. هذا وتعتبر الزيادة في حجم قطيع الأبقار مسؤولة عن 38.2 في المائة من الزيادة في إجمالي إنتاج حليب البقر خلال الفترة 1990-2019. في حين أن الزيادة فى إنتاجية البقرة الحلوب كان مسؤولا عن 61.8 في المائة من إجمالي الزيادة في إنتاج حليب الأبقار خلال نفس الفترة.

وتشير الدراسة إلى أهمية العمل على زيادة إنتاجية الحيوان الحلوب كوسيلة أساسية للنهوض بإنتاج الحليب في مصرو ذلك لأن إمكانيات التوسع في حجم قطيع الحليب محدودة إلى حد كبير بسبب ندرة الموارد الأرضية الزراعية وندرة موارد الرعي ومن ثم فانة سيتعين على مصر الاعتماد بشكل أكبر على التقدم التكنولوجي في مجالات الأعلاف الحيوانية والتلقيح الاصطناعي وصحة الحيوان وما شابه ذلك .و تبين الدراسة أن نشاط التلقيح الصناعى تركز بشكل كبير على الأبقار حيث ارتفع نصيب الأبقار الملقحة صناعيا من 8.6 في المائة في عام 2000 إلى 22.1 في المائة في عام2019 وفى نفس الوقت ما زالت معدلات التلقيح الاصطناعي للجاموس متواضعة للغاية.

وتوصى الدراسة بضرورة الاهتمام بتوفيرأسواق مضمونة للحليب الطازج من خلال عقود مسبقة مع المصنعين مما يؤدى الى تشجيع صغار المزارعين على الاستثمار في مشاريع الألبان وهو ما يؤدى بدورة اى زيادة دخل المزارع الصغير والى زيادة الأنتاج الكلى من الحليب.كما يجب التأكد من أن صناعة الألبان صناعة تنافسية وأن شركات الألبان الكبيرة لا تستخدم ممارسات احتكارية تؤدى الى تشوية أسعار الحليب .و تنتهى الدراسة الى أن هناك حاجة ملحة لتحديث الوحدات البيطرية مع التركيز على التمثيل الجغرافي في كل من الأراضي القديمة وكذلك في الأراضي الجديدة.

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Trends of Milk Production in Egypt

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ABSTRACT

The study reveals that cow milk in Egypt has been increasing more rapidly than buffalo milk during the period 1990-2019. Productivity per milking head took an upward trend for buffalos and cows during the same period. Starting from 2004 the cow productivity became larger than its counterpart for buffalos. In fact, starting from 2005 the production of cow milk surpassed the production of buffalo milk for the first time. The increase of the size of the cow herd is accountable for 38.2 percent of the increase in total cow milk production during the study period. While the enhancement of cow milk productivity was responsible for 61.8 percent of the total increase in cow milk production.

The study points to the importance of milk productivity per head as an essential vehicle for advancing milk production in Egypt. The possibilities of expansion in the size of milking herd are rather limited due to the limited land base and the scarcity of grazing resources. Egypt will have to rely more on technological advancement in the areas of animal feed, artificial insemination, animal health and the like. The share of artificially inseminated cows has increased from 9.5 percent in year 2000 to 29.1 percent in 2019. But the artificial insemination rates for Buffalos are still very modest.

Guaranteed markets for fresh milk through prior contracts with processors would play a positive role in encouraging small farmers to invest in dairy enterprises. The government should make sure that the dairy industry is competitive and large milk companies are not tempted to fix milk prices. There is an urgent need to modernize the veterinarian units with an eye on the geographic representation in the old lands as well as in the new lands.

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Introduction:

Animal production makes up an important part of the Egyptian agricultural economy. Milk and meat production contributes the largest portion of animal production in the country. Unfortunately, animal production is seriously hindered by several constraints such as low productivity, poor fertility and health conditions, and shortage of animal feed. An improvement in the production environment and relaxation of the mentioned constraints would certainly enhance animal production and thereof the socio-economic conditions of the vast majority of Egyptian small farmers. Small farmers' livelihood is closely linked to the health and productivity of their cattle. Milk production is an important activity to all stakeholders including farmers, processors, and consumers. Especially important is the cow and buffalo milk which constitute the bulk of milk production in Egypt. This paper aims to highlight the recent evolution of cow and buffalo milk production and the underpinning factors that could help in promoting dairy production in the country.

Problem Statement:

The increasing demand for milk and dairy products in Egypt should bring more attention to the possibilities of enhancing domestic milk production in light of the limited arable land and scarcity of grazing resources. Identification of the long term trends of milk production is necessary to determine the main approaches for increasing Egyptian production of milk.

Research Objectives:

The objective of this research paper is to identify the long term trends of milk production and the dimensions of future activities that are necessary for enhancing Egyptian production of milk.

Data and Methodology:

The research paper relies heavily on secondary data from the Ministry of Agriculture and Land Reclamation. Regression analysis and graphical representation are the main tools for data analysis.

Results and Discussion:

Milk Consumption:

In spite of the increase in cow and buffalo milk production in recent years, the country still relies on large supplies of imported milk and dairy products to fill the gap between domestic production and consumption needs. The Egyptian diet is still deficient in animal protein in general and in milk and dairy products in particular. For example, FAO data shows that per capita consumption of milk and dairy product equivalent in 1992-1994 was about 37.6 kg in Egypt, 57.7 kg in India, 144.1 in Turkey and 274.4 kg in Italy. Therefore, there is a big room for improvement in the Egyptian diet through concerted efforts to increase the availability of dairy products and enhancement of domestic dairy production.

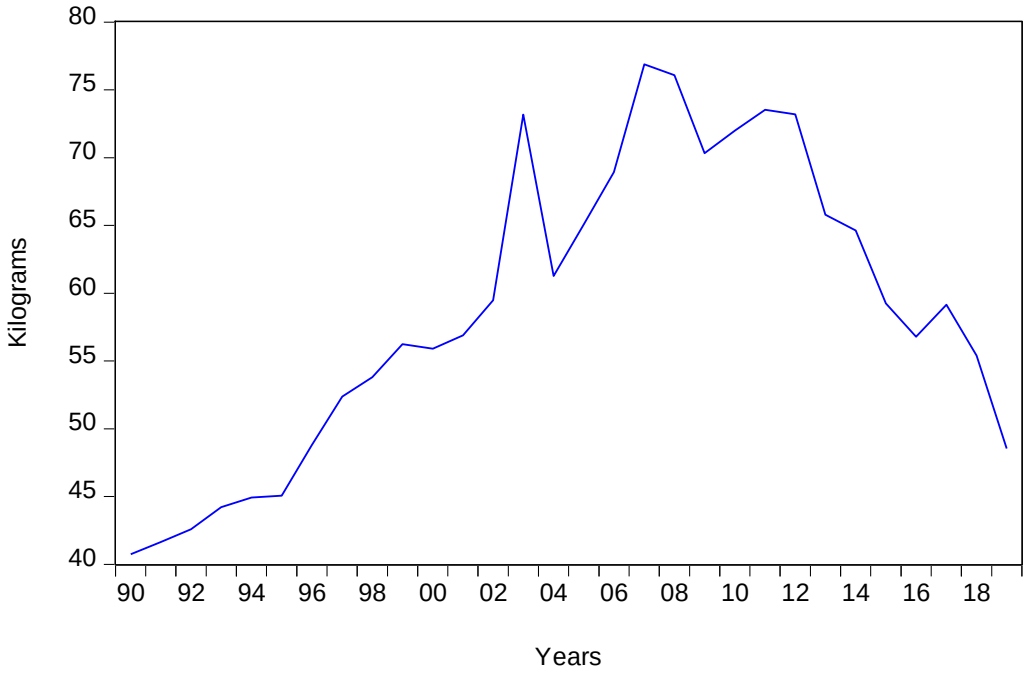
Figure 1 depicts the development of per capita consumption of milk and dairy products equivalent in Egypt during the period 1990-2019. After removing the outlier observations, the graph clearly points to an upward trend reflecting an increasing demand for dairy products due to rising per capita income, increased awareness of the nutritional value of milk and the increased availability of

long life milk products. The time trend equation below reveals that per capita milk consumption is increasing annually at the rate of 3 percent. The rate of growth in per capita consumption is statistically significant at the 1 percent level of significance. Coupled with population growth and the large population of young children, the demand for milk is expected to accelerate in the coming years. Therefore, Egypt is faced with a challenge to vastly increase domestic production of milk in the coming years.

Ln Cons = 3.68 + 0.03 Time
t- ratio (184.96) (20.85)
R^2 = 0.95 F = 343 (P-value =0.00) N= 22

Where: Ln Cons is the natural logarithm of per capita consumption in kilograms and time is the trend variable that takes the values of 1, 2, 3, etc.

Figure 1: Per Capita Consumption of Milk and Dairy Products



Milk Production:

Table (1) in the annex shows the total milk production during the period 1990-2019. The production of buffalo milk increased from 1250 thousand tons in 1990 to 1358 thousand tons in 1995 and then to 2923 thousand tons in year 2014. Figure (2) shows the upward trend of buffalo milk production. The trend equation is estimated below. The annual exponential rate of growth during the period 1990 –2019 is 2 percent and is statistically significant at the 1 % level of significance.

Ln Buffalo = 7.3 + 0.02 Time
t- ratio (133.34) (7.16)
R^2 = 0.65 F = 51.3 (P-value =0.00) N= 30
Where: Ln Buffalo is the natural logarithm of buffalo milk in thousand tons and time is the trend variable that takes the values of 1, 2, 3, etc.

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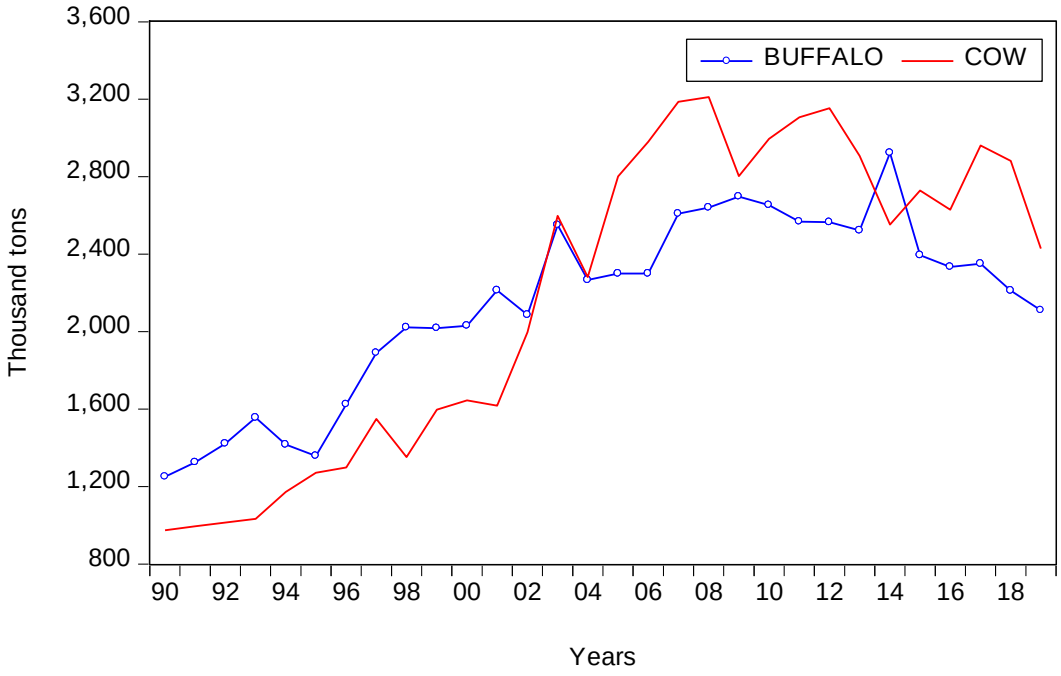
Figure (2): Evolution of Milk Production



Similarly, the cow milk production in Egypt has increased during the same period from 974 thousand tons in 1990 to 1272 thousand tons in 1995 and then to 3154 thousand tons in year 2012. In year 2000 the cow milk production was about 44 percent of the total cattle milk production. About 56 percent came from the buffalo milk in the same year. Figure (2) shows that buffalo milk production was larger than cow milk production for the years from 1990 to 2003. In year 2004 the two sources of milk almost coincided. Starting from 2005, the cow milk production surpassed buffalo milk production probably due to the expansion of hybrid and foreign cow herds. For example, cow milk contributed 55.7 percent to total milk production in year 2017. The time trend equation below indicates that the annual exponential rate of growth in cow milk production during the study period is 4 percent and is statistically significant at the level of 1 %.

Ln Cow = 6.96 + 0.04 Time
t-ratio (92.83) (9.96)
R^2 = 0.78 F = 99.3 (P-value =0.00) N= 30
Where: Ln Cow is the natural logarithm of cow milk in thousand tons and time is the trend variable that takes the values of 1, 2, 3, etc.

Milking Herds:

Table 1 in the annex shows the evolution of the numbers of milking cows and buffaloes during the period 1990-2019. The largest number of milking buffalos was about 1.87 million heads in year 2012. And the number of milking cows reached its maximum value in year 2016 with a total of about 1.78 million milking cows. In general, the numbers of milking buffalos were much larger than the numbers of milking cows in most years. As figure 3 shows the gap between the two sets of numbers was very noticeable in the early years of the 1990s and during the period 2009-2014. Starting from 2015, the stock of milking cows became consistently larger than the stock of milking buffalos.

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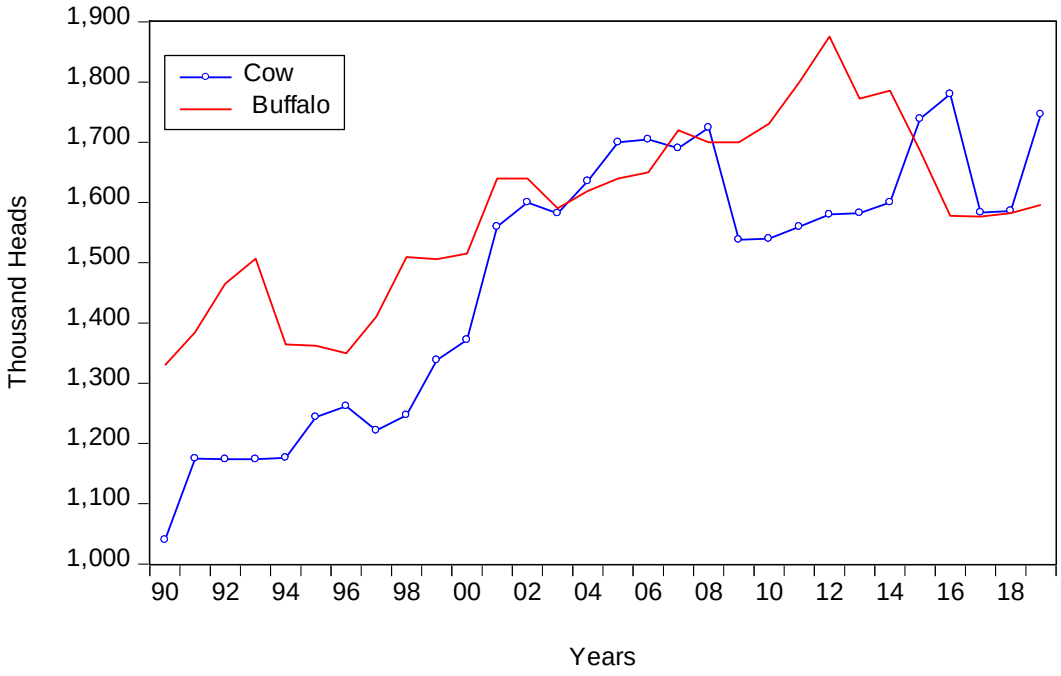
Figure 3: Number of Milking Heads ,000



The milk productivity per head is depicted in figure 4. Milk productivity per head took an upward trend for buffalos and cows during the period 1990-2019. But the buffalo productivity has leveled off starting from year 2004. Starting from 2004 the cow productivity became much larger than its counterpart for buffalos. The apparent gains in cow productivity could be explained by the expansion of artificial insemination in recent years. Buffalo artificial insemination, however, is lagging behind compared with cow artificial insemination.

The time trend equation for buffalo milk productivity is shown below. The annual rate of growth during the period 1990-2019 is a modest 1.4 percent. This rate of growth is statistically significant at the level of 1 percent as it is apparent from the t-ratio. Buffalo yield is measured in kilograms per year. The maximum attained productivity per buffalo head was 1637 kg in year 2016.

Ln Buffaloyield = 6.96 + 0.014 Time
t-ratio (174.49) (6.28)
R^2 = 0.58 F = 39.5 (P-value =0.00) N= 30
Where: Ln Buffaloyield is the natural logarithm of buffalo milk productivity in kilograms and time is the trend variable that takes the values of 1, 2, 3, etc.

The time trend equation for cow milk productivity is shown below. The annual rate of growth during the period 1990-2019 is about 2.7 percent. This rate of growth is statistically significant at the level of 1 percent as it is apparent from the t-ratio. Clearly the improvement in cow productivity is much better for cows than for buffalos. The growth rate of cow productivity was almost double that for buffalo productivity during the period 1990-2019. Cow yield is measured in kilograms per year. The maximum attained productivity per one milking cow was 1996 kg in year 2012.

Ln Cowyield = 6.81 + 0.027 Time
t-ratio (114.14) (8.04)
R^2 = 0.69 F = 64.7 (P-value =0.00) N= 30

Where: Ln cowyield is the natural logarithm of cow milk productivity in kilograms and time is the trend variable that takes the values of 1, 2, 3, etc.

Figure 4: Milk Productivity per Head, KG/Year

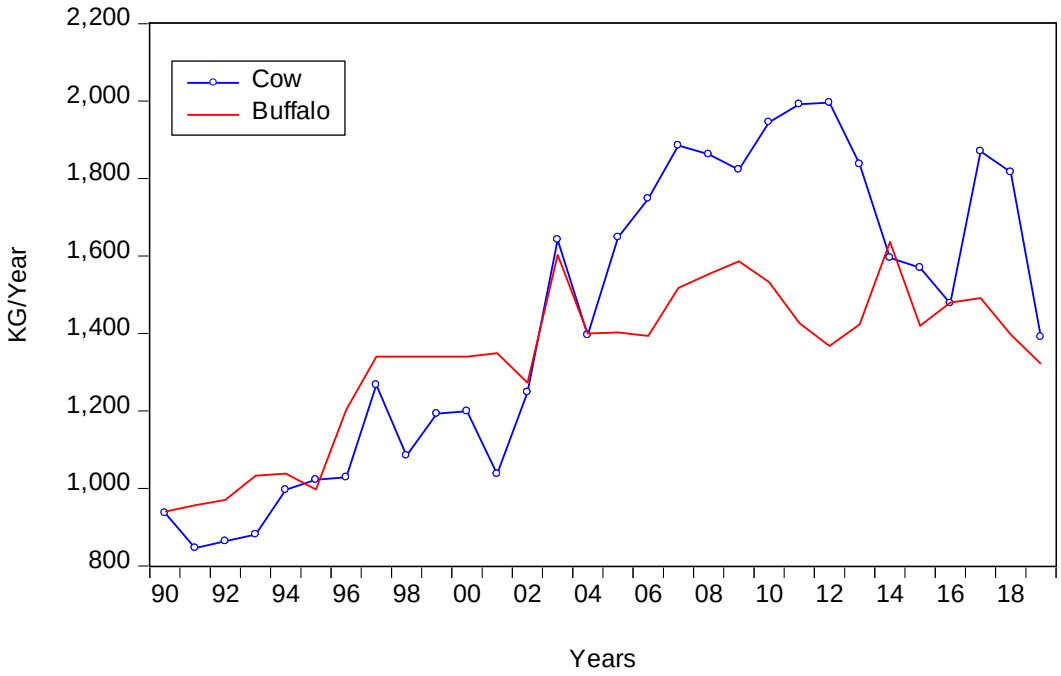


Table 1 is designed to help understand the relative contribution of the size of the milking herd and the productivity per head to overall milk production. The table reveals that annual average of buffalo milk production increased from 1385 thousand tons in 1990-1993 to 2252 thousand tons in 2016-2019. This increase in buffalo milk production is due to increase in the milking herd and the improvement in buffalo milk productivity. The annual average size of buffalo milking herd increased from 1421 thousand heads in the first period to 1583 thousand heads in the second period. While the annual average of milk productivity per buffalo increased from 974 kg in the first period to 1422 kg in the second period.

The annual average of cow milk production increased from 1005 thousand tons in 1990-1993 to 2743 thousand tons in 2016-2019. This increase in cow milk production is explained by the increase in the milking herd and the improvement of cow milk productivity. The annual average size of cow milking herd increased from 1140 thousand heads in the first period to 1674 thousand heads in the second period. And as table 1 shows the annual average of milk productivity per cow increased from 881 kg in the first period to 1638 kg in the second period.

Table 1: Arithmetic Averages for the Milking Herds

	1990-1993	2016-2019
Buffalo:		
Production , 000 tons	1385	2252
Milking Heads, 000 heads	1421	1583
Productivity, kg per head	974	1422
Cow:		
Production, 000 tons	1005	2743
Milking Heads, 000 heads	1140	1674
Productivity, kg per head	881	1638

Source: Calculated from table 1 in the annex.

Milk production is calculated as the product of herd size and average productivity per head. That is milk production = herd size x average productivity. Denote milk production in the first period as P_o, herd size as H_o and productivity as Y_o. And similarly for the second period we use P_c, H_c and Y_c for production, herd size and productivity respectively. Then;

$P_o = H_O \times Y_o$ -------- (1) and;

$P_c = H_c \times Y_c$ ------- --(2) .

Dividing equation (2) by equation (1) gives rise to equation (3);

$(P_C/P_O) = (H_C/H_O) \times (Y_C/Y_O)$ ------ (3) .

Taking the natural logs for both sides of equation (3) results in;

$\text{Ln}\ (P_C/P_O) = \text{Ln}\ (H_C/H_O) + \text{Ln}\ (Y_C/Y_O)$ ------(4).

Dividing equation (4) by Ln (P_C/P_O) and multiplying by 100 gives rise to the relative contribution of each component of the equation.

Applying this approach to the data in table 1 reveals that expansion of the herd size is responsible for 22.2 percent of the increase of buffalo milk production between the first period and the second period. While the improvement of the milk productivity per buffalo is responsible for 77.8 percent of the increase in total buffalo milk production. Likewise, the increase of the cow milking herd size is accountable for 38.2 percent of the increase in total cow milk production between the two periods. The enhancement of cow milk productivity has contributed 61.8 percent to the total increase cow milk production between 1990-1993 and 2016-2019.

These figures point to the importance of milk productivity per head as an essential vehicle for advancing milk production in Egypt. In fact, the possibilities of expansion in the size of milking herd

are rather limited due to the limited arable land base and the scarcity of grazing resources. In other words, intensive production systems rather than extensive production systems are more likely to contribute more to milk production in Egypt. That is Egypt will have to rely more on technological advancement in the areas of animal feed, artificial insemination, animal health and the like.

Artificial Insemination:

Genetic improvement of domestic livestock animals is imperative for enhancing milk production in Egypt. Artificial insemination is an important vehicle in the effort to improve the genetic make-up of Egyptian cattle. The total number of artificially inseminated cows in Egypt has been increasing steadily during the time period 2000-2019 as it is evident from table 2. The total number has almost doubled during this period. For example, the data indicate that only 130 thousand cows were artificially inseminated in year 2000 while 239 thousand cows were artificially inseminated in 2015 and 462 thousand were artificially inseminated in 2018. The share of artificially inseminated cows has increased from 9.5 percent in year 2000 to 29.1 percent in 2018. The rate of annual growth in artificial insemination application for cows was about 5 percent during the period 2000-2019. The time trend equation is reported below;

Ln AICOW = 4.74 + 0.05 Time
t- raio (46.05) (6.25)
R^2 = 0.68 F= 39.11 (P-value= 0.00) N=20 .
Where: Ln AICOW is the natural logarithm of artificially inseminated cows in thousand heads and time is the trend variable that takes the values of 1, 2, 3, etc.

As table 2 shows the artificial insemination rates for Buffalos are very modest. They range from low 1.7 % to high 4.8 %. Figure 5 clearly points to the wide gap between artificial insemination rates for cows and buffalos. The low rates of artificial insemination for buffalos could be explained by the shortage in high-yielding breeds and consequently shortage in frozen semen. In addition, most foreign funding especially from the European Union countries is directed towards cows' artificial insemination.

Table 3 indicates that the number of veterinarian units in Egypt has increased from 1705 units in year 2010 to 1769 units in year 2019. The last column of the table shows the number of veterinarian units that serve one thousand heads of the milking herd; the sum of buffalo and cow heads. The modal value is 2 units for each one thousand milking heads. This number seems to be constant over the period 2010-2019. The total number of veterinarian units is rather small given the fact that the veterinarian unit is the only public entity that is authorized to treat all kinds of livestock not just the milking cows and buffalos.

In fact, the veterinarian units do not cover most of the Egyptian villages. Egypt has about 5000 villages while the number of Veterinarian Units in 2019 was 1769 only. That is about two thirds of Egypt villages are not covered by veterinarian units. The absence of veterinarian service in close proximity to the farmer is a major constraint for the wide application of artificial insemination and vaccination against common diseases such as the foot and mouth disease. The farmer would be reluctant to take his cattle to a faraway unit because of the incurred cost and the lost time. There is an urgent need to modernize the veterinarian units and to increase their numbers with an eye on the geographic representation in the old lands as well as in the new lands.

Table 2: Share of Artificially Inseminated Livestock Cattle, 2000-2019

Years	Buffalo Herd			Cow Herd		
	Total Milking, 000 Heads	Artificially Inseminated 000 Heads	%	Total Milking, 000 Heads	Artificially Inseminated 000 Heads	%
2000	1515	35	2.3	1372	130	9.5
2001	1640	34	2.1	1560	151	9.7
2002	1640	35	2.1	1600	164	10.3
2003	1591	36	2.3	1582	176	11.1
2004	1619	36	2.2	1635	160	9.8
2005	1640	32	2	1700	153	9
2006	1650	37	2.2	1705	176	10.3
2007	1720	29	1.7	1690	133	7.9
2008	1700	31	1.8	1724	125	7.3
2009	1700	38	2.2	1538	150	9.8
2010	1731	47	2.7	1540	210	13.6
2011	1800	46	2.6	1560	222	14.2
2012	1875	41	2.2	1580	208	13.2
2013	1773	37	2.1	1583	185	11.7
2014	1786	35	2	1600	199	12.4
2015	1686	42	2.5	1739	239	13.7
2016	1578	56	3.5	1780	313	17.6
2017	1577	73	4.6	1583	434	27.4
2018	1583	76	4.8	1586	462	29.1
2019	1596	65	4.1	1747	352	20.1

Source: Ministry of Agriculture and Land Reclamation, Central Administration of Agricultural Economics, Bulletin of Agricultural Economics, Different Issues.

Figure 5: Rates of Artificial Insemination Applications

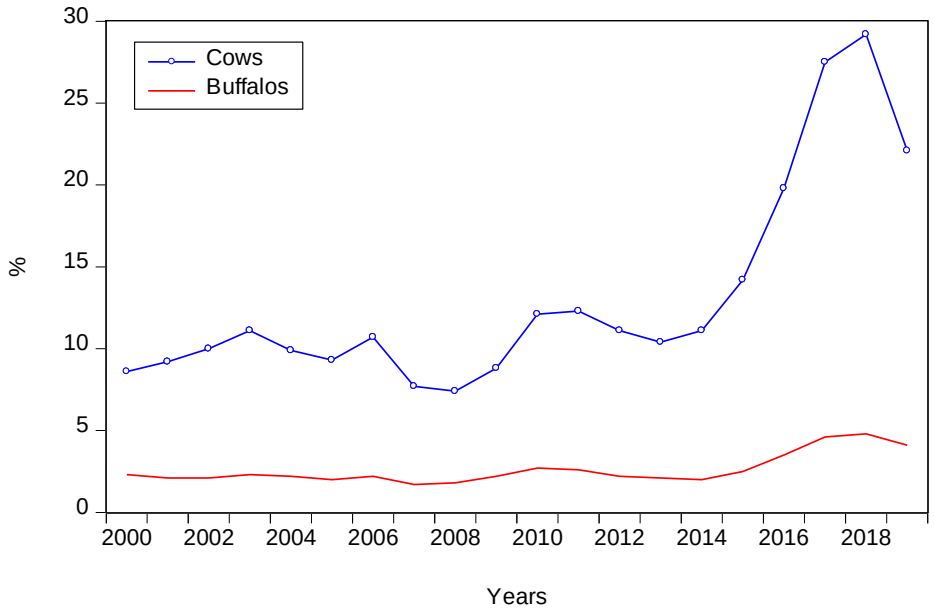


Table 3: Veterinarian Units per 000 Milking Heads, 2010:2019

year	Veterinarian Units	Milking Herd, ooo Heads	Vet Units per 000 Heads
2010	1705	3271	1.9
2011	1705	3360	2
2012	1706	3455	2
2013	1708	3355	2
2014	1709	3386	2
2015	1709	3425	2
2016	1746	3358	1.9
2017	1763	3160	1.8
2018	1763	3169	1.8
2019	1769	3343	1.9

Source: Central Administration of Agricultural Economics, Bulletin of Agri Economics, Different Issues.

Other Factors Influencing Milk Production:

Economic considerations are very important for incentivizing farmers to embark on dairy enterprises. Those include the prices of animal feed, the prices of calves, the cost of veterinarian services, the farm-gate prices of animal products, cost of cold storage facilities and availability of credit facilities. Of course higher prices of animal feed and veterinarian services would make dairy enterprises less profitable to breeders. On the other hand a favorable credit policy would make it easier for small breeders to borrow from the Egyptian Agricultural Bank to help in financing their dairy enterprises. Reasonable interest rates and less restrictive terms and conditions of lending would encourage farmers to borrow for the startup of dairy enterprises.

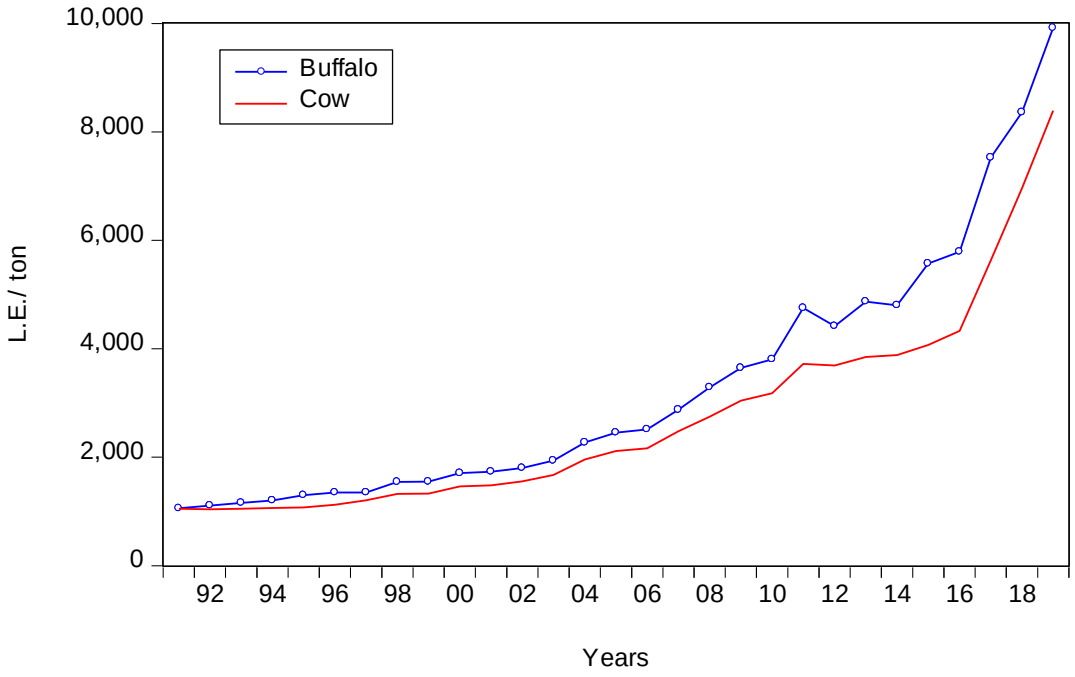
The bulk of milk production in Egypt is produced by small breeders. Small dairy enterprises are pro-poor in the sense that they provide farmers with employment and with daily cash from the proceeds of milk sales. Therefore, special attention should be directed towards those breeders in order to help make their livestock endeavors economically viable. In this regard, subsidized veterinarian services including artificial insemination and vaccination should be offered to small breeders.

Guaranteed markets for fresh milk through prior contracts with processors would play a positive role in encouraging small farmers to invest in dairy enterprises. The government should make sure that the dairy industry is competitive and that large milk companies are not colluding to fix milk prices. Figure 6 shows the evolution of farm-gate milk prices during the period 1991-2019. Clearly the price of buffalo milk is always higher than the price of cow milk. The prices are upward trending during the whole period. The prices of buffalo milk increased by annual rate of 7.7 percent while the price of cow milk increased by 7.2 percent during the period 1991-2019. These rates of growth are statistically significant at the level of 1 percent.

The prices in figure 6 are nominal prices and do not take inflation into consideration. In order to have real understanding of the movement of milk prices over time, we have to index the prices to some base year. To calculate inflation-adjusted prices we use a series of the consumer price index

(CPI) with January 2010 as the base period. It is clear from table 4 that although nominal prices are increasing over time the real prices are showing a downward trend. That means the purchasing power of the milk prices that farmers receive are in fact dwindling over time.

Figure 6: Milk Farm-Gate Prices, L.E. per ton



For example, the nominal price for cow milk in year 2019 is L.E. 8390 while the real price evaluated with 2010 prices is L.E. 2862 per ton. The time trend equations for real milk prices during the period 2006-2019 are listed below;

Ln BuffaloPrice= 8.39 – 0.025 Time
t-ratio (273.85) (-6.92)
R^2 = 0.89 , F = 47.8 (P-value = 0.00) , N =14

Ln CowPrice = 8.23 – 0.031 Time
P-value (194.79) (-6.36)
R^2 = 0.77 , F = 40.4 (P-value = 0.00) , N =14

Where: Ln BuffaloPrice is the natural logarithm of buffalo real price in L.E. per ton. And Ln CowPrice is the natural logarithm of cow real price in L.E. per ton. The time variable takes the values of 1, 2, 3 and etc.

The first equation reveals that the real farm-gate price for buffalo milk actually declined during the period 2006-2019 at the rate of 2.5 percent annually. The second equation shows that the real farm-gate price for cow milk declined during the same period at the rate of 3.1 percent annually. Both rates of decay are statistically significant at the level of 1 percent.

Table 4: Nominal and Real* Farm Milk Prices, L.E. per ton

Year	CPI Jan 2010=100	Buffalo		Cow	
		Nominal	Real	Nominal	Real
2006	64.4	2512	4111	2165	3543
2007	71.2	2874	4254	2477	3667
2008	84.8	3290	4089	2749	3417
2009	94.8	3645	4053	3045	3385
2010	105.4	3805	3805	3179	3179
2011	116.4	4750	4301	3720	3368
2012	125	4420	3728	3690	3113
2013	137.9	4870	3722	3850	2943
2014	151.8	4800	3332	3883	2695
2015	168	5570	3495	4070	2553
2016	192.3	5790	3174	4330	2373
2017	251.4	7527	3155	5629	2360
2018	286.3	8360	3077	6960	2562
2019	308.9	9920	3384	8390	2862

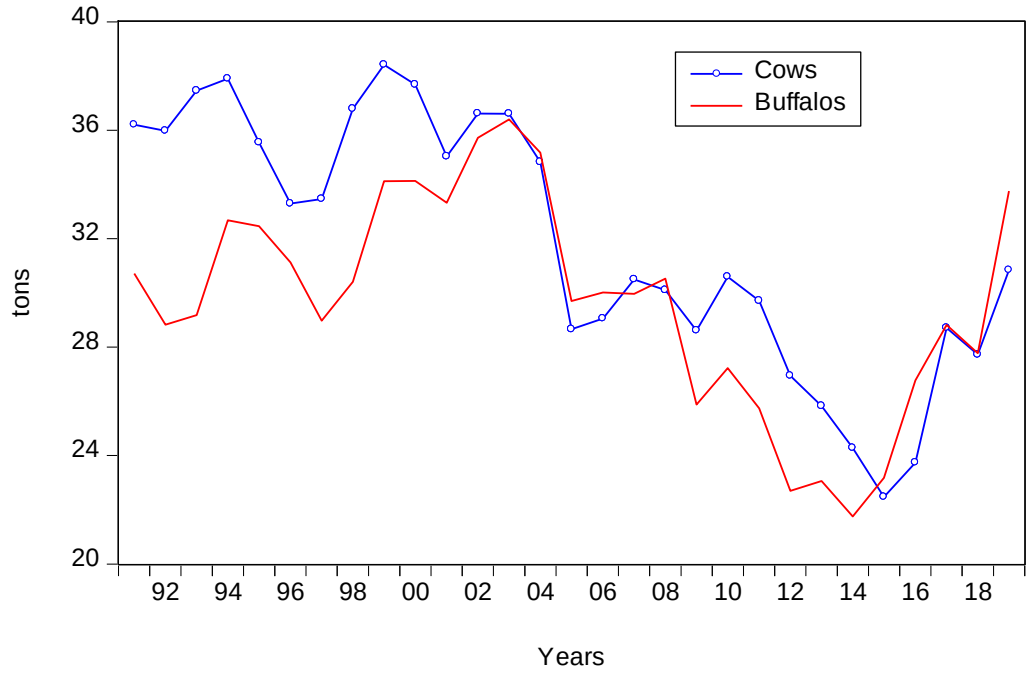
*Real prices are based on the prices of 2010.

Another important factor that influences milk production in Egypt is the availability of green fodder. Berseem clover is the main green fodder crop in Egypt. Figure 7 shows the evolution of the annual quantity of berseem clover available for each milking cattle during the period 1991-2019. It is obvious that the clover crop was more readily available during the first period of 1991-2005 than during the period 2006-2019. This decline in clover availability hampers the capacity of milk production in Egypt. The winter crop of clover berseem is in direct competition with the wheat crop. The government provides good incentives to farmers in order to expand the wheat acreage. This expansion in wheat acreage usually comes at the expense of the clover crop. The government should support the research and development efforts in order to increase the land productivity of berseem clover.

The average daily milk production for the baladi cow is about 6 kg in the winter season and 4 kg in the summer season. However, the average daily milk production for the cross-bred cow is about 8 kg in the winter season and 6 kg in the summer season. This seasonal differential in milk yield reflects the importance of good feeding rations which are usually available in the winter season when the berseem clover is grown.

10.21608/meae.2022.152762.1077

Figure 7: Berseem Clover Per One Head



Summary and Recommendations:

Time trend analysis reveals that per capita milk consumption was increasing at annual rate of 3 percent during the period 1990-2019. The exponential annual rate of growth in buffalo milk during the same period was 2 percent. And the annual exponential rate of growth in cow milk production during the same period was 4 percent. Milk productivity per milking head took an upward trend for buffalos and cows during the period 1990-2019. Starting from 2004 the cow productivity became much larger than its counterpart for buffalos. The annual rate of buffalo productivity growth during the period 1990-2019 is a modest 1.4 percent. In contrast, the annual rate of cow productivity growth during the same period was about 2.7 percent.

The study shows that expansion of the herd size is responsible for 22.2 percent of the increase of buffalo milk production during the study period while the improvement of the milk productivity per buffalo is responsible for 77.8 percent of the increase in total buffalo milk production. Likewise, the increase of the cow milking herd size accounted for 38.2 percent of the increase in total cow milk production. The enhancement of cow milk productivity has contributed 61.8 percent to the total increase in cow milk production during the study period.

The possibilities of expansion in the size of milking herd are rather limited due to the limited arable land base and the scarcity of grazing resources. In other words, intensive production systems rather than extensive production systems are more likely to contribute more to milk production in Egypt. That is Egypt will have to rely more on technological advancement in the areas of animal feed, artificial insemination, animal health and the like. The share of artificially inseminated cows has increased from 9.5 percent in year 2000 to 29.1 percent in 2018. The study asserts that the artificial insemination rates for Buffalos are very modest. They range from low 1.7 % to high 4.8 %. The low rates of artificial insemination for buffalos could be explained by the shortage in high-yielding breeds

and consequently shortage in frozen semen. In addition, most foreign funding especially from the European Union countries is directed towards cows' artificial insemination.

Guaranteed markets for fresh milk through prior contracts with processors would play a positive role in encouraging small farmers to invest in dairy enterprises. The government should make sure that the dairy industry is competitive and that large milk companies are not colluding to fix milk prices. The government should also support the research and development efforts of the Agricultural Research Center in order to increase the land productivity of berseem clover. There is an urgent need to modernize the veterinarian units and to increase their numbers with an eye on the geographic representation in the old lands as well as in the new lands.

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Annexes:

Table 1: Estimates of Milk Production and Milking Animals, 1990-2019

Years	Buffalos				Cows				Total	
	Milk Production 000 tons		Milking Buffalos 000 Heads		Milk Production 000 tons		Milking Cows 000 Heads		Milk Production 000 tons	Milking Animals 000 Heads
	No.	%	No.	%	No.	%	No.	%	No.	No
1990	1250	56.2	1330	56.1	974	43.8	1040	43.9	2224	2370
1991	1325	57.1	1385	54.1	994	42.9	1175	45.9	2319	2560
1992	1421	58.4	1465	55.5	1014	41.6	1174	44.5	2435	2639
1993	1556	60.1	1507	56.2	1034	39.9	1174	43.8	2590	2681
1994	1417	54.7	1364	53.7	1172	45.3	1176	46.3	2589	2541
1995	1358	51.6	1362	52.3	1272	48.4	1244	47.7	2630	2606
1996	1624	55.6	1350	51.7	1298	44.4	1262	48.3	2922	2612
1997	1890	55	1410	53.6	1548	45	1221	46.4	3438	2632
1998	2022	59.9	1509	54.8	1352	40.1	1247	45.2	3374	2756
1999	2018	55.8	1506	52.9	1597	44.2	1338	47.1	3615	2845
2000	2030	55.2	1515	52.5	1645	44.8	1372	47.5	3675	2887
2001	2213	57.8	1640	51.3	1618	42.2	1560	48.7	3831	3200
2002	2087	51.1	1640	50.6	1997	48.9	1600	49.4	4084	3240
2003	2550	49.5	1591	50.1	2598	50.5	1582	49.9	5147	3172
2004	2267	49.8	1619	49.8	2282	50.2	1635	50.2	4549	3254
2005	2300	45.1	1640	49.1	2802	54.9	1700	50.9	5102	3340
2006	2300	43.6	1650	49.2	2980	56.4	1705	50.8	5280	3355
2007	2610	45	1720	50.4	3187	55	1690	49.6	5797	3410
2008	2641	45.1	1700	49.6	3211	54.9	1724	50.4	5852	3424
2009	2697	49	1700	52.5	2803	51	1538	47.5	5500	3238
2010	2653	47	1731	52.9	2995	53	1540	47.1	5649	3271
2011	2568	45.3	1800	53.6	3107	54.7	1560	46.4	5675	3360
2012	2565	44.8	1875	54.3	3154	55.2	1580	45.7	5719	3455
2013	2523	46.5	1773	52.8	2908	53.5	1583	47.2	5431	3355
2014	2923	53.4	1786	52.7	2552	46.6	1600	47.3	5476	3386
2015	2394	46.7	1686	49.2	2729	53.3	1739	50.8	5123	3425
2016	2334	47	1578	47	2630	53	1780	53	4964	3358
2017	2351	44.3	1577	49.9	2961	55.7	1583	50.1	5313	3160
2018	2212	43.4	1583	49.9	2882	56.6	1586	50.1	5093	3169
2019	2109	46.5	1596	47.7	2429	53.5	1747	52.3	4538	3343

Source: Ministry of Agriculture and Land Reclamation, Central Administration of Agricultural Economics, Bulletin of Agricultural Economics, Different Issues.