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# An Economic Analysis of Red Meat Production Systems in Fayoum Governorate, Egypt

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## Introduction

The animal production sector is one of the vital agricultural activities in Egypt. Not only does it provide various food products but significantly contributes to soil fertility. While the average animal production per year represented 30.8% of national agricultural production during 1980-1995, the average annual red meat production reached 495,000 ton during the same period, contributing by 45% to overall meat produced.

During the aforementioned period, the bovine pattern represented 45.4% of national average red meat production per year, followed by buffalo meat and other patterns (sheep, goats, camels and pegs) which represented 33.9% and 20.7% of total red meat production respectively.

## I – Study Rationale

The Egyptian citizen's annual share of meat is still low, being 14.6 kg./year, as compared with its correspondence in many other countries. Whereas a large number of red meat producers permanently quitted the business in the early 1990s, currently some farms are not operating at full capacities. Therefore, there is a need to explore the issue with its different dimensions.

## II – Objectives

The study aims to identify the factors affecting red meat production - depending on male cows and buffaloes- through the study of the current situation of red meat in Fayoum governorate as well as the economic efficiency of using production resources. This is intended to find out some indicators that may help deal with problems facing this activity and constraints on expanded production as well.

## III – Methodology

The study uses both qualitative and quantitative analysis; the multiple-regression analysis is used to estimate production and cost functions.
As for data sources, the study used a sample-based data collected from 230 farm in three Districts of Fayoum including:

Small-scale farms: < 10 heads per fattening cycle (120 farm).
Medium-scale farms: 10 - < 50 heads per cycle (40 farm).
Graduates farms: 4-5 heads per cycle (40 farm),financed by the SFD [1].
Projects and cooperative farms: 50 or more head per cycle (30 farm).

A random stratified sample was taken from medium and small-scale farms whereas a simple random sample was selected from graduates, project/ cooperative farms due to the differences among the four systems in general, in addition to the relatively low number of graduate and project /cooperative farms, which weakens their contribution to a stratified sample.

## IV – Study Results

This section of the study reviews the indicators relating to: land holding of red meat producers, fodder-cultivated acreage, previous experience in meat production and farm operating capacities. In addition to some production factors such as: animal age and weight at the fattening start, length of fattening cycle and the relative importance of various cost items.

The aforementioned indicators are included in tables 1 and 2 that show the following:

***Land Holding:*** The study indicates that the larger the land holding the higher the farm capacity (i.e. the fattened units). The results also reveal that the green fodder-cultivated acreage represents 38 - 49% of land holding at the level of the four production systems.

***Previous Experience in Fattening:*** The study examined the producer's previous experience due to its vital role in the efficiency of resources use and production cost. The questionnaire data show that project / cooperative producers are the most experienced in bovine fattening (av. 30 cycles) followed by medium-scale producers (20 cycle), small-scale producers (12 cycle) and graduates (3 cycle). However, the medium-scale farmers proved to be the most experienced in buffalo fattening (21 cycle) followed by both small-scale and project/cooperative producers (19 cycle each), and finally graduates (3 cycle).

***Operating Capacity:*** Most of the production systems (bovine and buffalo) operate at less than 2/3 of their actual capacity. This high rate of unused capacity results in a higher cost per head. Producers attribute low operating rates to several problems such as: high prices of concentrates and their low quality, and the high prices of fattening calves.

***Average Age and Weight at Fattening Start:*** Both cooperative/ project and medium-scale farms prefer to start the fattening cycle with animals of older age and higher weights, which is intended to shorten the fattening period and reduce cost. This trend is attributed to their long experience in the business.

***The Relative Importance of Production Cost Items:*** As shown in tables 3 and 4, the costs of animal and concentrates purchase come first in terms of relative importance, representing each 80% (and sometimes 95%) of total production cost.

***Cost of Weight Increase/ kg.(LE):*** Tables 1 and 2 show that the higher farm capacities (i.e. cooperative/project, then medium farms) the lower the production costs. Under the bovine pattern, the cost of 1 kg of weight increase during fattening cycle is LE 3.1 and 4.6 for cooperative/project and medium farms respectively. The Figure for the small -scale farms is LE 4.8 whereas the highest cost occurs on the graduate farms (LE 5.6). Under the buffalo pattern, the cost of 1 kg of weight increase during fattening cycle is LE 2.2 and 3.8 for cooperative/project and medium farms respectively. The costs realized by graduate and small-scale farms are LE 6.3 and 4.4 respectively.

The above indicators suggest the efficiency of cooperative/project and medium farms in iterating their production elements for lower production cost as compared with the other production systems. Therefor, the quantitative analysis is confined to bovine and buffalo production of cooperative/project and medium farms

# V – Functions of Red Meat Production

The stepwise multiple-regression analysis of linear, double logarithmic and quadratic models is used to identify the relations between the red meat production as a dependent variable (y) and independent variables including: average animal weight in kg. at fattening start (x1), days of fattening cycle (x2), Consumed concentrates in ton evaluated by starch equivalent(x3), animal age at fattening start in month (x4), labor requirements man/day/cycle (x5), veterinary care in LE (x6), Consumed berseem in ton evaluated by starch equivalent (x7), Consumed hay in ton evaluated by starch equivalent (x8) and previous experience in fattening evaluated by the number of cycles (x9). The best models were selected from an economic and statistical perspective.

## 1. Medium-Scale farms (10- < 50 head/cycle)

### A. Production Function (Bovine pattern)

The study shows that the best model is the double logarithmic (Table 5) which suggests that the most effective explanatory variables for bovine meat production are: (x1) the average animal weight in kg. at fattening start, (x3) consumed concentrates in ton evaluated by starch equivalent and (x6) veterinary care in LE. The results indicate that the relation between farm production and the aforementioned variables are positive and significant with an elasticity of 0.783, 0.532 and 0.232 for x1, x3, and x6 respectively; when x1, x3, and x6 increase by 10% - with other elements being fixed-, meat yield will increase by 7.83%, 5.32 and 2.32% respectively.

The total elasticity of function is 1.55, suggesting the realization of increased production capacity, i.e. the increase of 1% in the function's production elements as a whole results in an increase of 1.55% in red meat yield.

The adjusted determination coefficient ($r^{-2}$) value shows that the aforementioned variables explain 66% of the change in production. The model proved to be significant (calculated F=18.40) as well as the regression coefficients of explanatory variables.

### B. Production Function (Buffalo Pattern)

The logarithmic model proved to be the best in this case. It reveals that the most effective explanatory variables for buffalo meat production are: consumed concentrates in ton evaluated by starch equivalent (x3) and the previous experience in fattening estimated by the number of cycles (x9).

The results shows a positive relation between the meat yield in kg. and the amount of concentrates consumed. The variable's elasticity is 0.751; the increase of 1% in the concentrates consumed, with other elements being fixed, results in an increase of 0.751 in meat yield.

The results indicate the same relation between meat yield and previous experience in fattening with an elasticity of 0.416.

The total elasticity of production function is estimated at 1.17, suggesting the realization of increased production capacity, i.e. the increase of 1% of total elements of function results in an increase of 1.17% in meat yield.

The $r^{-2}$ value indicates that the two explanatory variables account for 86% of the change in production. in addition, F value confirms the significance of the model used.

## 2. Cooperatives & Projects (> 50 head/cycle)

### A. Production Function (Bovine pattern)

Among the linear, logarithmic and quadratic models used, the double logarithmic model proved to be the best.

The most effective variables for bovine meat production in this case are average animal weight in (40 farm) kg. at fattening start (x1) and Consumed Concentrates in ton evaluated by starch equivalent (x3). The results show a positive relation between meat yield and average animal weight in kg. at fattening start with a production elasticity coefficient of 0.732; when this variable increases by 1% the meat yield will increase by 0.732%

The model shows the same relation between meat yield and the amount of concentrates consumed in ton with a production elasticity coefficient of 1.103; when this variable increases by 1% the meat yield will increase by 1.103%. The total function elasticity is estimated at 1,8357, suggesting the realization of increased production capacity, i.e. the increase of 1% of total elements of function results in an increase of 1.835% in meat yield.

The $r^{-2}$ value indicates that the two explanatory variables account for 96% of the change in production. In a0ddition, F value (339.9) confirms the significance of the model used.

### B. Production Function (Buffalo pattern)

The quadratic model proved to be the best as indicated in Table (5)

The most effective variables in this case are: consumed concentrates in ton evaluated by starch equivalent (x3) and consumed hay in ton evaluated by starch equivalent (x8).

The elasticity[2] of production for variables x3 and x8 are 0. 165 and 0.523 respectively, i.e. the increase of 1% in either variables will increase meat yield by 0. 165% and 0.523% respectively.

Total elasticity of production function is 0.774, suggesting the diminishing scale.
The $r^{-2}$ indicates that both explanatory variables account for 99% of the change in production.
The model proved to be significant since calculated F is 1469.21.

# VI – Cost Functions of Red Meat Production

The exploration of the production cost items is among the study objective. Tables (3) and (4) show the relative importance of cost items, of which the most important are the cost of animal purchase beginning of fattening cycle, then the cost of concentrates.

The analysis involved the study of the costs - meat yield relation and the use of its derivatives to determine some economic indicators (i.e. the optimum production size and production -maximizing profit), and the extent of farms' realization of these indicators in order to examine the farms efficiency in utilizing the production resources.

## 1. Medium-scale Farms

### A. Cost Function (Bovine pattern)

The results show that the cost function is best represented by a ($2^{nd}$ degree) linear equation (eq. 5, Table 6). The optimum production size is estimated by deriving and equating the average cost with marginal cost functions, being 5718 kg. which exceeds the average actual productivity (4948 kg.)

Equating the marginal cost with the dominant farm price[3] (LE 6.505/ kg. gross), the production - maximizing profit is estimated at 6377 kg., a level which is only realize by 14% of the farms studied (28 farm) and requires fattening of 16 head /cycle[4].
The net farm income was obtained for: production- maximizing profit, optimum production and actual production, being LE 6113, 5785 and 4543 respectively.
The actual net income represents 74.3% and 78.8% of the incomes from production -maximizing profit and optimum production.

### B. Cost Function (Buffalo pattern)

The results show that the cost function is best represented by a (2nd degree) linear equation (eq. 6, Table 6). The optimum production size is estimated by deriving and equating the average cost with marginal cost functions, being 12618 kg. which exceeds the average actual productivity (5861 kg.)

Equating the marginal cost with the dominant farm price[5] (LE 5.404/ kg. gross), the production - maximizing profit is estimated at 22161 kg., a level which is not realize by any of the farms studied as it requires fattening of 49 head cycle[6].
The net farm incomes were obtained for: production- maximizing profit, optimum production and actual production, being LE 40823, 29621 and 8143 respectively.

The actual net income represents 20% and 27.5% of the incomes from the production -maximizing profit and optimum production.

## 2. Cooperative & Project Farms

### A. Cost Function (Bovine pattern)

The results show that the cost function is best represented by (2nd degree) linear equation (eq. 7, Table 6). The optimum production size is estimated by deriving and equating the average cost with marginal cost functions, being 65028 kg. which exceeds the average actual productivity (50655 kg.)
Equating the marginal cost with the dominant farm price[7] (LE 6.669/ kg gross), the production - maximizing profit is estimated at 139296 kg., a level which is only realize by 8.3% of the farms studied as it requires fattening of 341 head /cycle[8].

The net farm income was obtained for: production- maximizing profit, optimum production and actual production, being LE 107740, 68578 and 51954 respectively.

The actual net income represents 48.2% and 75.8% of the incomes from the production -maximizing profit and optimum production.

### B. Cost Function (Buffalo pattern)

The results show that the cost function is best represented by a (2nd degree) linear equation (eq. 8, Table 6). The optimum production size is estimated by deriving and equating the average cost with marginal cost functions, being 195555 kg which exceeds the average actual productivity (129160 kg.)

Equating the marginal cost with the dominant farm price[9] (LE 5.02/ kg gross), the production - maximizing profit is estimated at 700000k.g., a level which is not realize by any of the farms studied as it requires fattening of 1562 head /cycle[10].

The net farm incomes were obtained for: production- maximizing profit, optimum production and actual production, being LE 949000, 414000 and 264000 respectively.

The actual net income represents 28% and 64% of the incomes from the production -maximizing profit and optimum production.

## VII – Constraints on Red Meat Production in Fayoum Governorate

The red meat producers face several problems that hamper both vertical and horizontal expansion of production. The field study reveals some significant problems that can be listed in terms of relative importance as follows:

a) The high prices of concentrates.

b) The lack of fodder which is associated with weak control over its manufacturers.

c) The high prices of calves to be fattened.

d) Inadequate veterinary car and the high prices of veterinary medicaments.

e) The low supply of summer fodder.

f) The need to protect the local industry against the imported red meat.

g) The financing problems facing the red meat producers

## Recommendations

1. The rise in processed fodder prices (from LE 38/ton in the 1980s to 400-450/ton at present) entails the review of cost items with the fodder plants in order to produce it at lower prices, which will help producers reduce meat production costs, raise production capacities and eventually upgrade the farms' economic efficiency.
2. Find solutions for the inadequacy of animal feed such as: improve fodder qualities, encourage research to develop new low-priced types of fodder and strengthen the control over fodder industry to ensure standard products.
3. Support the programs that are concerned with the genetic improvement of local cow breeds in order to develop breeds of higher transformation rates, which will eventually contribute to the promotion of red meat production.
4. Under the bovine production pattern, the study shows that the recommended operating capacities for maximized profit are 10, 16, 5 and 341 head/cycle for small-scale, medium-scale, graduates and cooperatives/projects farms respectively.
5. Under the buffalo production pattern, the recommended operating capacities for maximized profit are 3, 49, 25 and 1562 head/cycle for small-scale, medium-scale, graduates and cooperatives/projects farms respectively.
6. The results indicates that the cooperatives/ projects farms achieve the lowest cost of bovine and buffalo meat (LE 2.25 and 3.86/kg. gross respectively), followed by medium-scale farms (LE 3.2 and 4.6/kg gross respectively). Therefore, both systems must be supported as an effective means for the development of red meat local production.

**Table 1. The study's qualitative results (bovine pattern)**

| Statement | Unit | Small- scale farm | Medium-scale farm | Graduates farm | Project/Cooperative farm |
|---|---|---|---|---|---|
| Av. land holding | fed. | 2.38 | 9.15 | 0.60 | 31.90 |
| Green fodder/ land holding | % | 38.70 | 38.50 | 100.00 | 49.20 |
| Previous experience | cycle | 12.00 | 20.00 | 3.00 | 30.00 |
| Operating capacity/ t.capacity | % | 36.40 | 44.80 | 66.70 | 42.90 |
| Animal age at fattening start | month | 13.57 | 14.71 | 17.00 | 18.38 |
| Av. weight at fattening start | kg. | 199.99 | 200.00 | 240.83 | 260.83 |
| Fattening cycle | day | 163.50 | 195.38 | 136.67 | 153.75 |
| Total cost | LE | 2415.30 | 2274.50 | 2527.30 | 2322.90 |
| Av. sale weight | kg. | 383.80 | 390.70 | 380.00 | 408.75 |
| Weight increase during cycle | kg. | 183.80 | 190.70 | 139.20 | 174.90 |
| Cost of weight increase | LE/kg. | 4.80 | 4.60 | 5.60 | 3.12 |

Source: Study Sample

**Table 2. The study's qualitative results (buffalo pattern)**

| Statement | Unit | Small- scale farm | Medium-scale farm | Graduates farm | Project/Cooperative farm |
|---|---|---|---|---|---|
| Av. land holding | fed. | 4.44 | 13.20 | — | 54.60 |
| Green fodder/ land holding | % | 41.20 | 38.22 | — | 46.15 |
| Previous experience | cycle | 19.00 | 21.00 | 3.00 | 19.00 |
| Operating capacity/ t.capacity | % | 15.40 | 53.80 | 50.00 | 45.80 |
| Animal age at fattening start | month | 8.54 | 8.67 | 15.00 | 10.40 |
| Av. weight at fattening start | kg. | 141.50 | 180.42 | 297.10 | 210.00 |
| Fattening cycle | day | 248.10 | 297.10 | 105.00 | 266.00 |
| Total cost | LE | 1930.40 | 1798.10 | 2608.30 | 1546.20 |
| Av. sale weight | kg. | 377.30 | 448.30 | 414.40 | 448.00 |
| Weight increase during cycle | kg. | 235.80 | 267.90 | 117.40 | 238.00 |
| Cost of weight increase | LE/kg | 4.40 | 3.80 | 6.30 | 2.25 |

Source: Study Sample

**Table 3. The relative importance of cost items per head for bovine fattening farms in Fayoum Governorate**

| Cost Items | Small- scale farm | | Medium-scale farm | | Graduates farm | | Projects/Coopts farm | |
|---|---|---|---|---|---|---|---|---|
| | Value (LE) | % | Value (LE) | % | Value (LE) | % | Value (LE) | % |
| Purchase price/head | 1532.78 | 63.46 | 1396.15 | 61.38 | 1745.83 | 69.07 | 1777.67 | 76.53 |
| Concentrates | 580.95 | 24.05 | 625.42 | 27.50 | 298.35 | 23.68 | 461.60 | 19.87 |
| Labor | 139.80 | 5.79 | 125.98 | 5.54 | 81.88 | 3.24 | 33.72 | 1.45 |
| Farm rent | 34.50 | 1.43 | 19.89 | 0.87 | 24.80 | 0.98 | 9.27 | 0.40 |
| Vet. care | 35.70 | 1.48 | 34.68 | 1.53 | 8.95 | 0.35 | 16.33 | 0.70 |
| Berseem | 61.70 | 2.86 | 52.95 | 2.33 | 34.80 | 1.38 | 9.11 | 0.40 |
| Hay | 21.05 | 0.87 | 15.35 | 0.67 | 17.93 | 0.71 | 10.77 | 0.46 |
| Insurance | 1.33 | 0.09 | 4.05 | 0.18 | 14.83 | 0.59 | 4.40 | 0.19 |
| T. Cost | 2415.30 | 100.00 | 2274.48 | 100.00 | 2527.33 | 100.00 | 2322.86 | 100.00 |

Source: Study Sample

**Table 4. The relative importance of cost items per head for buffalo fattening farms in Fayoum Governorate**

| Cost Items | Small- scale farm | | Medium-scale farm | | Graduates farm | | Projects/Coopts farm | |
|---|---|---|---|---|---|---|---|---|
| | Value (LE) | % | Value (LE) | % | Value (LE) | % | Value (LE) | % |
| Purchase price/head | 896.15 | 46.42 | 777.09 | 43.21 | 1872.78 | 71.80 | 1010.84 | 65.37 |
| Concentrates | 646.20 | 33.47 | 709.70 | 39.47 | 569.40 | 21.80 | 433.06 | 28.00 |
| Labor | 208.65 | 10.80 | 151.84 | 8.44 | 75.20 | 2.90 | 40.24 | 2.60 |
| Farm rent | 40.20 | 2.10 | 19.41 | 1.08 | 32.95 | 1.30 | 7.62 | 0.50 |
| Vet. care | 47.88 | 2.48 | 35.69 | 2.00 | 14.70 | 0.56 | 16.78 | 1.09 |
| Berseem | 67.13 | 3.48 | 80.59 | 4.48 | 11.70 | 0.44 | 12.58 | 0.81 |
| Hay | 21.23 | 1.10 | 19.08 | 1.06 | 14.93 | 0.57 | 23.71 | 1.53 |
| Insurance | 3.00 | 0.15 | 4.73 | 0.26 | 16.65 | 0.63 | 1.40 | 0.10 |
| T. Cost | 1930.43 | 100.00 | 1798.12 | 100.00 | 2608.30 | 100.00 | 1546.24 | 100.00 |

Source: Study Sample

**Table 5. Production Functions**

| Production System | Production Pattern | Equation # | Equation | r-2 | Calculated F | T. Elasticity |
|---|---|---|---|---|---|---|
| Medium farms | Bovine | 1 | $\log y = \log 1.68 + 0.783 \log x_1 + 0.532 \log x_3 + 0.232 \log x_6$ (1.33) (3.99) (4.585) (3.22) | 0.66 | 18.40 | 1.550 |
| | Buffalo | 2 | $\log y = \log 7.875 + 0.751 \log x_3 + 0.416 \log x_9$ (18.7) (6.45) (4.57) | 0.86 | 34.61 | 1.170 |
| Project/ copts | Bovine | 3 | $\log y = \log 1.96 + 0.732 \log x_1 + 1.103 \log x_3$ (1.446) (3.048) (26.02) | 0.96 | 339.98 | 1.835 |
| | Buffalo | 4 | $y = 16657.11 + 102.22 x_3 + 1318.28 x_8 + 0.86 x_3 x_8$ (2.864) (1.702) (4.039) (1.982) | 099 | 1469.21 | 0.744 |

Source: Results of Sample Statistical Analysis

**Table 6. Cost Functions**

| Production System | Production Pattern | Equation # | Equation | r-2 | Calculated F |
|---|---|---|---|---|---|
| Medium farms | Bovine | 5 | $T.\ cost = 25503.55 - 3.427\ y + 0.0078\ y^2$ (3.302) (1.23) (3.349) | 0.898 | 121.044 |
| | Buffalo | 6 | $T.\ cost = 19583.49 - 0.0476\ y + 0.000123\ y^2$ (2.699) (0.024) (1.362) | 0.870 | 37.890 |
| Project/ copts | Bovine | 7 | $T.\ cost = 30023.81 + 4.691\ y + 0.0000071\ y^2$ (1.498) (6.822) (1.823) | 0.980 | 864.790 |
| | Buffalo | 8 | $T.\ cost = 80307.85 + 2.08\ y + 0.0000021\ y^2$ (1.304) (1.509) (0.760) | 0.990 | 305.000 |

Source: Results of Sample Statistical Analysis

## Notes

1. SFD = Social Fun for Development
2. Production elasticity of variable
   Production elasticity of variable
   Means of variables x3 , x8, y = 208.96, 51.21, 129160 respectively.
3. Based on the study sample.
4. Calculated using the average animal sale weight on the studied farms.
5. Based on the study sample.
6. Calculated using the average animal sale weight on the studied farms.
7. Based on the study sample.
8. Calculated using the average animal sale weight on the studied farms.
9. Based on the study sample.
10. Calculated using the average animal sale weight on the studied farms.

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