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Economic Impact of Different Feeding Schemes on Home-Raised Broiler Chickenin Fayoum

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Abstract:*The study aims at identify the feeding scheme at which the home-raised broilers is economically effective. Data obtained through an investigation of a random sample of 500 households raising broilers at home using different feeding schemes using combinations of concentrated fodders and home food residues. Technical and profitability indicators have been estimated for the different schemes. Large households with females not employed and not educated are likely to use more home food residues in the home-raised broilers. The production index PI, adjusted production index API, and economic indicator EI are shown to be higher in the herds used more concentrated fodders than those used more food home residues although only those in the first scheme are considered good according to the API with API more than 100. The five schemes are shown to be profitable and the net revenue is shown to be high in schemes using concentrated fodders, however, the return on invested EGP is high in schemes using home food residues. Significant increase in households' incomes occurred due to the home-raising of broilers. Incomes of households in scheme 1 are higher than other schemes and decrease as long as we move towards scheme 5 either before the home-raising or after. Up to 114% increase in chickens consumed per household. As a result, the per capita animal protein consumption per day has been increased for the households included in the sample between 17%and 68%.*

Keywords:*Poultry – broiler – feeding scheme –home-raising –home food residues*

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I. Introduction

The poultry industry is considered one of the important agricultural industries in Egypt. In addition to the size of the large investments that the industry is based on, which amounted to about 30 billion Egyptian pounds [1], it provides a large number of job opportunities of about 2.8 million workers in both permanent and temporary employment categories [2]. The industry also provides a large portion of animal protein such as white meat and eggs. The official statistics at the national level indicate that the poultry wealth in Egypt includes the production of the commercial and rural sectors. The actual production of fattening farms for the total commercial and rural sectors reached 875 million chickens, of which 172.8 million chickens are from the rural sector representing 15.9% of the total production [3]. The total number of table eggs from the two sectors reached about 8.91 billion eggs, of which 1.23 billion eggs are from the rural sector 13.8% of the total production [4].

Chicken meat is one of the most important poultry in economic terms. It is considered the most common type of domestic poultry farming. It also comes in the forefront of farm animals producing the food needed by humans as a quick source of animal protein at suitable prices for low-income people.

The poultry production is characterized by rapid reproduction, short life cycle and high productive efficiency, which makes it profitable. It's known and common that home poultry farming depends on feeding on the availability of food residues to reduce the cost of production as it represents about 70% of the production costs.

II. Statement Of Research Problem

Home-raised broilers face different problems that negatively affect the quantity and quality of the meat produced. The negative impact is mainly due to the extensive use of food residues which do not contain all the essential nutrients needed for the chickens, therefore, chickens are undernourishment and infected with many diseases. Mortality rate, accordingly, gets higher. In addition, the duration of raising chickens gets longer comparing to other feeding schemes using concentrated fodders.

III. Objectives Of The Study

The study aims at identify the feeding scheme at which the home-raised broilers is economically effective and the produced meat meets the specifications at the lowest possible price. To achieve this goal, the

following objectives would be investigated; studying the measures of production performance for home-raised broilers under different feeding schemes, measuring the economic efficiency and profitability indicators of home-raised broilers under different feeding schemes, and estimating the impact of home-raised broilers on the average per capita animal protein and monthly income under different feeding schemes.

IV. Data Sources

Data obtained through an investigation of a random sample of 500 households raising broilers at home. The sample is divided into 5 categories based on the feeding scheme. Each category consists of 100 households. Each household is raising 75 broilers. The feeding schemes investigated include 5 schemes with different combinations of concentrated fodder and home food residues. The different combinations for each feeding scheme are listed in table 1. This means that category 1 consists of 100 households using 100% concentrated fodder and 0% home food residues…etc.

Table 1: combinations of concentrated fodder and home food residues

Feeding Scheme	% of concentrated fodder	% of home food residues
1	100	0
2	75	25
3	50	50
4	25	75
5	0	100

V. Research Methodology

Descriptive and quantitative analysis methods are used to achieve the study objectives, where the study used the profitability indicators such as net return and the rate of return on the pound invested as indicators for the feasibility of the activity.The study also used the indicators of production performance and economic efficiency to identify the technical and economic efficiency of home-raised broilers. Following is a description of each indicators used and how it indicates efficiency. Weekly measures have been obtained for estimating the technical and profitability indicators used.

Technical Indicators

Several measurements have been obtained and recorded weekly over the seven-week production cycle of the home-raised broilers for every single household in the sample. Measurements included the following measures; the total number of chickens in the sample for each scheme, death percentage, vital ratio, the quantity of fodders and home food residues for the whole sample in kilograms, the quantity of fodder and home food residues per chicken in grams, total weight of the whole sample in kilograms, the average weight per chicken, and the increase in weight per chicken in grams. A weekly average of the measurements for each categoryhas been calculated. Data collected was used to calculate the following indicators [5];

Food Conversion Coefficient

$$\frac{\text{average quantity of fodder per chicken per cycle}}{\text{average chicken weight at the end of the cycle}}$$

Food Conversion Efficiency

$$\frac{\text{average quantity of fodder per chicken per cycle}}{\text{average increase in chicken weight during the production cycle}}$$

Vital Ratio % $100 - \text{death ratio}$

Production Index PI

$$\frac{\{\text{average chicken weight in grams} * \text{vital ratio}\}}{\{\text{number of raising days} * \text{food conversion efficiency} * 10\}}$$

Adjusted Production Index API

$$\frac{\{\text{average increas of chicken weight in grams} * \text{vital ratio}\}}{\{\text{number of raising days} * \text{food conversion efficiency} * 10\}}$$

It is obvious that the higher the PI, the better the performance of the herd. It is known that results are bad if the PI is less than 100, good in the range of 100 – 200, very good in the range of 200 - 230, and excellent performance if more than 230.

Economic Indicator EI

$$\frac{\{\text{total number of live chickens at the end of the production cycle} * \text{average chicken weight at the end of the cycle}\}}{\{\text{number of sample items} * \text{number of raising days} * \text{food conversion efficiency}\}} * 100$$

It is also obvious that the higher the EI, the better the performance of the herd. It is known that results are bad if the EI is less than 100, good in the range of 100 – 200, very good in the range of 200 - 230, and excellent performance if more than 230.

Profitability Indicators

Average revenues, costs and net revenues per group and per chicken were estimated [6].

Total Revenue

The total revenue includes the values of the marketed chickens, home-consumed chickens, and manure.

$$(\text{number of marketed chickens} * \text{average weight of chicken} * \text{price of the kilogram}) + \text{value of home consumed chickens} + \text{value of manure}$$

Average Revenue per Chicken

$$\frac{\text{total revenue of the sample}}{\text{number of chickens at the end of the production cycle}}$$

Total Cost

The total cost includes the values of the chicks purchased, cost of fodder, and other costs (including other nutrients, vaccines, and transportations).

$$\text{cost of chicks purchases} + \text{cost of fodder} + \text{other costs}$$

Average Cost per Chicken

$$\frac{\text{total cost of the sample}}{\text{number of chickens at the end of the production cycle}}$$

Net Revenue $\text{total revenue} - \text{total costs}$

Average Net Revenue per Chicken

$$\frac{\text{net revenue}}{\text{number of chickens at the end of the production cycle}}$$

Return on invested EGP

$$\frac{\text{net revenue}}{\text{total cost}}$$

Economic indicators

Other indicators have been calculated such as; annual net revenue per capita, total revenue of household before home-raising, total revenue of household after home-raising, increase of household income, % increase in household income, increase in per capita income, and % increase in per capita income.

VI. Overview Of Poultry Production In Egypt

Egyptian poultry industry has become a very significant sector of Egyptian agricultural production. Large investments have been contributed to the industry over the last decades. Egypt's annual consumption of poultry is around 1.2 billion birds, the equivalent of around 1125 million tons of poultry meat [7]. The broilers are the major portion of the poultry production and consumption. Table 2 indicates the local production of broilers in million heads and in million tons as gathered from [8]. The total number of chickens produced increased from 750 million heads in 2010 to 730 million heads in 2016 with an average annual increase of 31.6 million heads and percentage annual increase of 5.9% as an average of the whole period. The local production in tons also increased from 744 thousand tons in 2010 to 1052 thousand tons in 2016 with an average annual increase of 51.3 thousand tons and percentage annual increase of 6.9% as an average of the whole period. The increase in production indicates improved technical efficiency over the time.

Table 2: production and trade of broiler

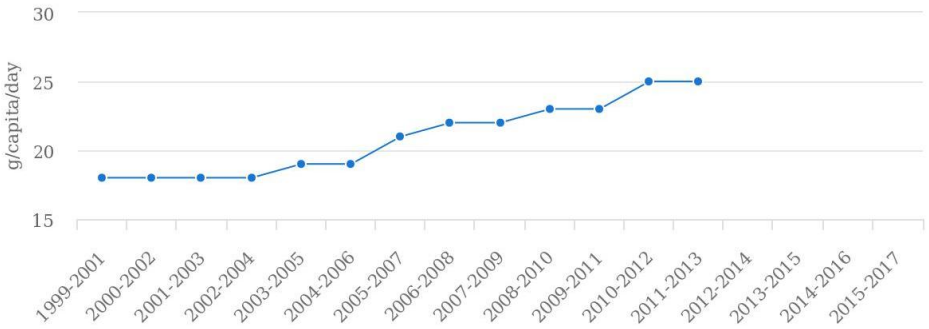
Year	Local production (million heads)	Local production (million tons)
2010	540	744
2011	578	796
2012	592	822
2013	658	952
2014	718	1035
2015	710	1028
2016	730	1052

Source: FAOSTAT database, www.fao.org/faostat/

According to [9], the total poultry consumption in Egypt will increase to 1156 thousand tons in 2026 with per capita consumption staying around 9.2 kg during the whole period. This means that the total volume of poultry meat consumed in 2026 will be 14% more than the volume consumed in 2017. With food prices going 278% higher in 2017 comparing to 2010 [8], home-raised broilersare becoming a good choice for rural households.

The increasing number of chicken raised and number of tons produced contributed to increase the supply of animal protein. As indicated by [8], the moving average (3 years average) of the animal protein supply in Egypt shown in figure 1 has increased from 18 grams per capita per day as an average of the years 1999-2001 to 25 grams per capita per days as an average of the years 2011-2013.

Figure 1: Egypt per capita supply of animal protein



Source: FAOSTAT database, www.fao.org/faostat/

VII. Findings

Sample characteristics

The following characteristics of the respondents have been investigated; age, education level, type of house, employment, husband job, household income, number of household, and social status. Table 3 shows the distribution of the respondents according to the characteristics investigated in each category.

Table 3: characteristics of the respondents in the feeding schemes

	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Scheme 5
Age					
Less than 20	1	40	37	44	4
20 – less than 30	9	30	33	25	6
30 – less than 40	20	15	19	13	19
40 – less than 50	30	10	9	17	31
More than 50	40	5	2	1	40
Education level					
Ignorant	13	2	1	0	40
Read & write	14	1	0	0	30
Basic education	16	16	14	6	26
Mid-level education	32	58	60	59	3
University graduate	15	23	25	35	1
Type of house					
Own house	88	82	60	35	15
Shared house	12	18	40	65	85
Employment					
House wife	6	10	24	45	54
Help husband in farming	13	29	22	37	33
Help husband in other job	49	29	27	15	11
Daily basis work	32	32	27	3	2

Social status					
Married	75	65	40	26	14
Divorced	12	19	30	39	41
Widow	13	16	30	35	45
Husband job (for married respondents)					
Farming	5	3	9	10	9
Farming + other job	16	11	11	7	3
Other job	25	26	8	6	1
Daily basis work	29	25	12	3	1
Number of household					
Up to 4	61	48	7	2	0
5– 7	29	30	30	7	9
8 – 10	7	10	33	41	40
More than 10	3	12	30	50	51
Annual household income (in EGP)					
Less than 10,000	1	2	5	55	59
10,000 – less than 20,000	3	5	11	37	33
20,000 – less than 30,000	59	39	36	9	6
More than 30,000	37	54	38	9	2

Source: study survey.

The respondents are categorized into five age categories; less than 20 years, 20 – less than 30, 30 – less than 40, 40 – less than 50, and more than 50 years. Younger respondents tend to use combinations of concentrated fodders and home food residues where older respondents tend to use either 100% concentrated fodders or 100% home food residues.Younger respondents are more educated and behave business-wise as the combinations guarantee using home food residues and gain good production performance. Older respondents are either poor using only home food residues or well experienced using concentrated fodders for best results.

The respondents also are categorized according to the education level into the following categories; ignorant, read &write, basic education, mid-level, and higher education. Respondents within the low level education (ignorant, read & write, and basic education) tend to use either 100% concentrated fodders or 100% home food residues due to the lack of experience, where respondents within the higher education level tend to use combinations of concentrated fodders and home food residues.Noticeably, the great majority of respondents are mid-level educated.

As for the type of house of the respondents, they either live in their owned houses or live in shared houses (common for extended families). Respondents live in their owned houses tend to use concentrated fodders more than home food residues where respondents live in shared houses are more dependent on home food residues than concentrated fodders due to the big number of households resulting more home food residues.

As for the employment type of the respondents; they are either house wives, help husband in farming, help husband in other job, or work on daily basis. Housewives and respondents who are helping husbands in farming are using home food residues more than concentrated fodders where employed respondents or those helping husbands in other jobs rather than farming tend to use more concentrated fodders. Using home food residues in this case is subject to availability of the respondents in the houses longer time.

Households with stable social status (married respondents) tend to rely more on concentrated fodderswhere other households with instable status (divorce or widow respondents) tend to rely more on home food residues. Using more home food residues is subject to household income and the capability to spend more for concentrated fodders.

Similar to the respondents' jobs impact on using home food residues, respondents with husbands working in farming tend to use more food residues where respondents with husbands working in other career (not working in farming) tend to use more concentrated fodders.

Relatively small households (up to 4 and 5-7) tend to use more concentrated fodders than food residues where those large households (8-10 and more than 10) tend to rely more on home food residues. The reason in this case is subject to the number of households resulting more food wastes (extended families living in shared houses).

Respondents are categorized according to the level of income into 4 categories. Households with income up to 10,000 EGP and between 10,000 – 20,000 EGP are using combinations containing more food residues than fodders where the relatively high income level households (20,000-30,000 EGP and more) use concentrated fodders more. Remarkably, high level income households are more business-wise than low level.

All previously mentioned relationships are logically accepted. Figure 2 summarizes the relationship between the respondents' characteristics and feeding schemes applied by the respondents.

Figure2: relationship between the respondents' characteristics and the feeding schemes

	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Scheme 5
Age	Old	Young	Young	Young	Old
Education level	Low	High	High	High	Low
Type of house	Owned	Owned	Owned	Shared	Shared
Employment	Employed	Employed	Employed	Housewife	Housewife
Social status	Stable	Stable	Stable	Not stable	Not stable
Husband job	Other Job	Other Job	Other Job	Farming	Farming
Household income	High	High	Low	Low	Low
Number of household	Small	Small	Small	Big	Big

Source: compiled from table 2.

Technical Indicators

Table 4 shows a summary of the technical indicators. Chick weight at the purchase time was 70 grams. Measuring the average chicken weight at the end of the production cycle shows that herds used more concentrated fodders have increased in weight more than the herds used more home food residues. The average increase in chicken weight for scheme one using only concentrated fodders is 1.8 kilogram where the increase in the opposite side (for scheme 5 using only food residues) is only 1.2 kilogram. However, the food conversion coefficient and food conversion efficiency are higher in the herds used home food residues, due to the form of elements in the food residues but, definitely, the composition of food residues is poor comparing to concentrated fodders.

The vital ratio of the herds used more concentrated fodders are shown to be higher than those used more home food residues due to the use of vaccines jointly with concentrated fodders. The production index PI and the adjusted production index API are shown to be higher in the herds used more concentrated fodders than those used more food home residues although only those in the first scheme are considered good according to the API (more than 100). The same is applied for the economic indicator EI where herds used more concentrated fodders show higher EI than those used more home food residues. However, all herds in all the feeding schemes are poor according to the EI. Significant differences between schemes have been identified with regard to, the average increase in chicken weight (in grams), vital ratio, production index, adjusted production index, and economic indicator.

Table 4: technical indicators for the different feeding schemes

Technical indicators	**Scheme 1**	**Scheme 2**	**Scheme 3**	**Scheme 4**	**Scheme 5**
Chick weight at the purchase time(in grams)	70	70	70	70	70
Chicken weight at end of the cycle (in grams)	1877	1705	1629	1586	1277
Average increase in chicken weight (in grams)	1807	1635	1559	1516	1207
Food conversion coefficient	2.94	3.28	3.75	3.61	5.18
Food conversion efficiency	3.13	3.42	3.92	3.78	5.44
Vital ratio %	87.8	85.6	83.3	84.2	66.9
Production index	111.7	98.7	73.3	84.2	66.9
Adjusted production index	107.5	94.8	70.7	81.5	64.3
Economic indicator %	83	68.1	55.4	64.9	49.9

Source: calculated from the study survey.

Profitability Indicators

The profitability indicators including cost, revenue, and net revenue have been calculated for each scheme per production cycle in addition to the return on invested Egyptian Pound EGP. Total cost varied from 164.2 thousand EGP for the households in scheme 1 to 82 thousand EGP for scheme 5. Revenue, as well, is decreasing from 256.5 thousand EGP for scheme 1 to only 150 thousand EGP in scheme 5. Accordingly, the net revenue is also decreasing by increasing food residues in feeding broilers from 92.3 thousand for scheme 1 to 68 thousand for scheme 5. The same rule applied for the average cost per household & per chicken and average revenue per household & per chicken where the averages decrease as long as the home food residues increase.

As for the net revenue, the previous rule applied except in scheme 4 where the average net revenue per household and per chicken show higher results more than the previous scheme. The return on invested EGP ranged from 0.55 EGP for scheme one and 0.73 EGP on scheme 5 with the highest value for scheme 4 as 0.81 EGP. For all schemes, the return on the investment is considered high. See table 5. The LSD test has shown significant differences between schemes with regard to total cost per sample, average cost per household, average cost per chicken, total revenue per sample, average revenue per household and average revenue per chicken. No significant differences between schemes have been identified with regards to total net revenue per sample, average net revenue per household, and average net revenue per chicken.

Table 5: profitability indicators for the different feeding schemes per production cycle

Economic Indicators	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Scheme 5
Costs (total cost and average cost per capita in thousand EGP, average cost per hen in EGP)					
Total cost (for 100 households)	164.2	139.6	121.4	104.9	82
Average cost per household	1.64	1.39	1.21	1.04	0.82
Average cost per chicken	24.94	21.75	19.43	17.12	17.65
Revenue (total revenue and average revenue per capita in thousand EGP, average revenue per hen in EGP)					
Total revenue (for 100 households)	256.5	229	215	199.9	150
Average revenue per household	2.56	2.30	2.15	1.90	1.50
Average revenue per chicken	38.95	35.67	34.42	35.50	25.55
Net Revenue (total net revenue and average net revenue per capita in thousand EGP, average net revenue per chicken in EGP)					
Total net revenue (for 100 households)	92.3	90	93.6	95	68
Average net revenue per household	0.92	0.90	0.94	0.95	0.68
Average net revenue per chicken	14.01	14.02	14.98	15.36	10.45
Return on invested EGP	0.56	0.65	0.77	0.81	0.73

Source: calculated from the study survey data.

Considering that the year has 5 production cycles, the changes of the households' incomes have been calculated as shown in table 5. It can be realized that significant increase in households' incomes occurred due to the home-raising of broilers. Incomes of households in scheme 1 are higher than other schemes and decrease as long as we move towards scheme 5 either before the home-raising or after. However, the increase in incomes is higher in the last schemes than the first ones where the increase in income for scheme 1 is 4.16 thousand EGP (13.8% increase) and is 9.59 thousand EGP (98% increase). The contrast is due to the very low incomes of the households relying on food residues. Significant differences between schemes have been identified with regard to the increase in income after the home raising of broilers.

Table 6: changes in households' income per year

Indicator	**Scheme 1**	**Scheme 2**	**Scheme 3**	**Scheme 4**	**Scheme 5**
Total income of household before home-raising	30.20	26.50	21.20	13.70	10.10
Total income of household after home-raising	34.36	32.33	28.65	24.65	20.12
Increase of household income	4.16	5.83	7.45	10.95	9.59
% increase in household income	13.8	24	33	67	98

Source: calculated from the study survey data.

Protein consumption

Due to the households raising broilers at homes, they tend to consume part of the production. Table 7 shows the increase in chickens consumed per household for each scheme. Scheme 1 households has increased the number of chickens consumed per year from 77 to 90 with 16.7% increase while scheme 2 households increased consumption from 80 to 95 with 19.6% increase. Scheme 3 and 4 households increased their consumption by 40.6% and 38% respectively. Remarkably, scheme 5 households increased their consumption from 68 to 114 with 68% increase.

Table 7: changes in households' consumption of broilers

	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Scheme 5
# of chickens consumed before home raising per household/ year	77	79.7	60.94	62.73	67.86
# of chickens consumed after home raising per household/ year	89.85	95.33	85.70	86.53	114.13
Increase in # of chickens consumed	12.85	15.62	24.76	23.80	46.27
% increase in # of chickens consumed	16.69	19.60	40.63	37.94	68.18

Source: calculated from the study survey data.

As a result of consuming more chickens per household, the per capita animal protein consumption per day has been increased for the households included in the sample as shown in table 8. The per capita daily protein consumption for scheme 1 has increased from 66 grams to 77 grams with 17% increase. Consumption for schemes 1, 2, and 3 has increased by 20%, 39%, and 37% respectively. Consumption of scheme 5 has been remarkably increased from 22 grams to 37 grams with 68% increase.

Table 8: changes in per capita protein consumption per day (in grams)

	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Scheme 5
Before home raising	66	51	32	29	22
After home raising	77	61	45	40	37
Increase	11	10	13	11	15
% increase	17	20	39	37	68

Source: calculated from the study survey data.

VIII. Discussions

Although the Egyptian economy increased the local production of poultry in general and broilers in particular, it seems to be in significant need to increase the production more to cover the increasing demand for animal protein. The home-raising seems to be good alternative for commercial-raising of broilers considering the use of home food residues to feed the broilers.

Category 5 of households are categorized by, older ages, low level education, living in shared houses, husbands are working in farming, wives are not employed, big families, and very low income level. Apparently, the category 5 is depending completely on home food residues which are logically accepted due to the level of income and education. As long as characteristics improve, households increase the use of concentrated fodders.

Although the technical indicators for categories using more home food residues are poorer than categories depending more on concentrated fodders, home food residues is good option for these categories of households.

It's noticed that the profitability indicators for all categories are high due to zero fixed costs as the process is completely done in houses, in addition to reduced variable costs.

The profitability indicators show more costs, revenues, and net revenues for the categories depending more on concentrated fodders against those use the home food residues as the main nutrition component. However, the return on invested pound show more returns for categories 3, 4 and 5.

A very important issue to mention is the increase in income for households. Category 5 households have achieved an average of 98% increase in income due to the home-raising of broilers although the production process is using very traditional production techniques especially the nutrition components. This issue is very critical taking into consideration that income level of those households is very low.

Another important issue to consider is the increase in protein consumption for households. All categories of households increased the number of chickens consumed as a result of raising broilers at home and, accordingly, increased the amount of animal protein per family member. Most important to mention is that the highest increases occurred in the low income categories using home food residues.

A final remark, although the use of home food residues resulting poor technical indicators and low net revenues, it's a good solution to increase the availability of animal protein to poorer households.

Recommendations

Based on the findings of the study, it's recommended to;

- Authorities should regulate and encourage home-raising of broilers to increase the availability of animal protein to poorer households.
- Research and educational institutions should provide technical assistance to households to better use of home food residues as part of the nutrition schemes in order to achieve better technical and profitability indicators.
- Government should consider financial policy to give access to microfinance by these households.

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