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An Economic Study of the factors affecting the efficiency of Poultry Slaughterhouses in Sharkia Governorate

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Abstract: The poultry slaughter sector is also considered one of sectors that work to balance between supply and demand of poultry meat through the volume of production and stock quantities. Although poultry slaughterhouses are one of the most important ring in the poultry sector that works on a balance between supply and demand, especially after the gradual transformation of consumption patterns from buying live birds to chilled and frozen birds as well as, their production efficiency is very low, ranging between 10% to 24% of the total production. Due to low production efficiency of poultry slaughterhouses, so the production capacity of poultry slaughterhouses decreased by 50%.The owners submitted many suggestions for developing this sector as: Transferring slaughterhouses outside the residential block, and converting them to automatic and semi-automatic slaughterhouses, closed live bird stores and establish poultry compound that includes a number of automatic and semi-automatic slaughterhouses, which leads to double the production capacity of them. The study relied on published, unpublished data from various sources, and primary data was obtained by preparing a questionnaire for the research purpose about poultry production in automatic slaughterhouses which is divided into semi-automated and automated slaughterhouses, and was relied on a quarterly sectorial deliberate sample that was determined through a comprehensive inventory obtained from the Directorate of Agriculture and the Directorate of Veterinary Medicine of Sharkia Governorate to provide required data during 2021, This research is aimed mainly to study some of the factors affecting the efficiency of automatic poultry slaughterhouses and reached to several results, as :there is a deficit in the operating capacity is about 3803, 30628 and 17299 birds per hour, thus the production efficiency decreases by about 76%, 90% and 88% for each of manual, semi-automatic and automatic slaughterhouses, respectively. **In addition,** Costs of operating energy are high, as its represented 3.4% of the total costs, and it ranks the first in operating costs and the second in total costs after purchasing of live chickens. So it is possible to increase the net return to be about 33% if those slaughterhouses are transformed the use of alternative energy represented in solar energy, and the use of slaughterhouses' waste to generate gas and preserve the environment**.**

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Key words: poultry slaughter**, broiler,** meat gap**,** operational efficiency**,** production efficiency

Introduction

Poultry sector is one of the most important sectors producing animal protein; as it is considered as one of the most important alternatives offered to consumer, also the quantity produced of red meat and fish. It contributes significantly in filling the deficit of animal protein and increasing the average of per capita share **(Abo-Alyazidet al., 2021).** The poultry slaughter sector is also considered one of sectors that work to balance between supply and demand of poultry meat through the volume of production and stock quantities (**Shehata, 2007**). Production strives towards one goal, which is to satisfy the desires of consumers, while those desires are many and varied according to consumer patterns that control the product structure. This requires multiple production lines as broiler sector, where consumer patterns are accustomed to trade live birds. But recently, it has shifted towards processed meat in its various forms (whole – fillet pieces - minced) (**Ebrahim and Ahmed, 2007**). This made poultry slaughterhouses an important role, especially after the spread of various epidemics and diseases, which required to take many administrative decisions towards the circulation of live birds, focusing on the service sector of all kinds of slaughterhouses (manual - automatic - semi-automatic) to satisfy consumer desires, as a result of changing consumption patterns, especially in poultry meat, which is accompanied by a variety of preparation and consumption methods(**Al-Ashmawy and Al-Sherif,2000**).

The study Problem

Because of low production efficiency of poultry slaughterhouses, the production capacity of poultry slaughterhouses decreased by 50% (**Emam, 2010**). The owners submitted many suggestions for developing this sector as: Transferring slaughterhouses outside the residential block, and converting them to automatic and semi-automatic slaughterhouses, closed live bird stores and establish poultry compound that includes a number of automatic and semi-automatic slaughterhouses, which leads to double the production capacity of them **(Yonis and Mohamed, 2022**).

Objectives of the study

This research is estimated factors affecting the efficiency of poultry slaughterhouse production by studying and achieving the following objectives:

1 - Evolution of poultry meat gap, and the number of poultry slaughterhouses during the period (2010-2020).
2- Studying the operational efficiency of poultry slaughterhouses and their geographical distribution in Egypt during 2021.
3- Estimating the relative importance of costs and revenues items of the slaughterhouse in the sample of the study during 2021.
4- Studying the productive efficiency indicators of slaughterhouse in the sample of the study during 2021.
5- Estimating the statistical analysis of the most important factors affecting production efficiency in poultry slaughterhouses.
6- Estimating the relative weight of the most important problems and proposed solutions affecting the production efficiency of slaughterhouse in the sample of the study during 2021.

Data sources and methodology

The study relies on published, unpublished data from various sources, and primary data was obtained by preparing a questionnaire for the research purpose about poultry production in automatic slaughterhouses which is divided into semi-automated and automated slaughterhouses, and due to the similarity in production units so the study was relied on a quarterly sectorial deliberate sample that was determined through a comprehensive inventory obtained from the Directorate of Agriculture and the Directorate of Veterinary Medicine from the centers of Sharkia Governorate to provide required data during 2021, whereas data collected from 6 automated and 3 semi-automated slaughterhouses in Sharkia Governorate.

Descriptive and quantitative statistical analysis methods were used to display the results of the research, as: averages, relative importance, coefficient of variation, growth rate. In addition to the multiple regression model to clarify the most important factors related to automatic poultry slaughter.

Results

Firstly: Production, consumption, food gap, self-sufficiency, and the average per capita share of poultry meat in Egypt.

It is shown in table (1) the evolution of numbers of broilers that produced and directed to the slaughterhouse sector were about 443.1 million birds in 2010 then increased to be about 1396.2 million birds in 2020 with an average 636 million birds annually during the period (2010-2020), which contributed in increase the production quantity of poultry meat from 744 thousand tons in 2010 to 2.02 million tons in 2020, with an average 1.1 million tons per year during the period (2010-2020), with an annual growth rate 10%. In addition, the self-sufficiency rate decreased from about 96.6% in 2010 to its lowest 89.4% in 2017, with an average 95.4% during the period (2010-2020), due to the population increase, while maintaining the same growth rate in the average per capita share, which was about 10%.

Also it is shown the evolution of the consumption quantity of poultry meat produced from the slaughterhouse sector, which increased from 770,000 tons in 2010 to its maximum value 1.9 million tons in 2020, with an average 1.16 million tons and an annual increase growth rate 9% that showed the increase of the annual consumption quantity, while the growth rate of production was higher by about 1% annually, which causes a decrease in the size of its gap (**Al-Garhy,L.S.,2014**).

In addition, the average of per capita share of poultry meat is constantly increase, as it was about 6.8 kg in 2010, and then increased to its maximum value 20.2 kg per person in 2020 with an annual growth rate 10%. Consequently, the average of operational capacity of poultry slaughterhouses was 636 million birds annually, whereas average of bird weight 1.750 kg, and produced about 1.119 million tons of poultry meat.

Secondly: Relative importance of poultry slaughterhouses in Sharkia Governorate.

Poultry slaughterhouses is a place equipped for receiving, slaughtering, cleaning, preparing, packaging and keeping birds in their various forms. Poultry slaughterhouses are divided into two types of slaughterhouses:

(1) Manual slaughterhouses in which all operations are done manually.

(2) Automatic slaughterhouses are divided into two types: (i) Automatic slaughterhouse operate with an automatic weight gradation system. (ii) Semi-automatic slaughterhouse that does not have that

technology, whereas the only difference between them is in the design.

These slaughterhouses are based on making the final product fit for consumption through various operations (such as slaughtering - cleaning - cutting - packing - packaging - cooling - freezing) to suit tastes of consumers.

As it was shown from data in table (2) the evolution of numbers of all kinds of poultry slaughterhouses in Sharkia Governorate and its relative importance in relation to their numbers in Egypt, as the follow:

Table(1): Evolution of production, consumption, gap, self-sufficiency, and average of per capita share of poultry meat in Egypt during the period (2010-20-20).

year	number of broilers	Production	consumption	Gap	self-sufficiency rate**	per capita share
	Million birds	Thousand tons	Thousand tons	Thousand tons	%	Kg/year
2010	443.1	744	770	26	96.6	6.8
2011	479.8	796	830	34	95.9	7.2
2012	512.9	822	857	35	95.9	7.3
2013	544.6	953	1003	50	95	8.3
2014	577.8	1035	1106	71	94.7	12.7
2015	589	1028	1126	98	92.9	12.7
2016	576.9	1007	1092	85	92.22	10
2017	595.2	1017	1137	120	89.45	11.2
2018	690.1	1303	1400	97	93.7	14.8
2019	594.4	1575	1624	49	96.98	16.7
2020	1396.2	2029	1912	*(117)	106.2	20.2
Average	636.3	1119	1168.8	49.8	95.4	11.6
Standard deviation	260.4	383.3	349.9	63.3	4.2	4.3
Coefficient of variation	40.9	34.3	29.9	127.0	4.4	37.2
Annual Growth rate	10.00%	10.00%	9.00%	0.00%	1.00%	10.00%

***()**: surplus, ****Self-sufficiency** = production / consumption * 100, coefficient of variation = standard deviation / mean * 100, **Growth rate** = Calculated by the existing function In Excel, as follows: = RATE (12; - D2; D13) where 12 is (no. of years), D2 value of the first year, D13 is the value of the last year

Source: (1) Ministry of Agriculture and Land Reclamation, General Administration of Food Security, annual report on food security projects, various issues.

(2) Central Agency for Public Mobilization and Statistics, bulletin of Water Resources Statistics, various issues.

Table(2): The relative importance of numbers of poultry slaughterhouses in Sharkia Governorate during the period (2011-2020).

Year	Manual slaughterhouses			Semi-automatic slaughterhouses			Automatic slaughterhouses			Total poultry slaughterhouses		
	Egypt	Sharkia	%	Egypt	Sharkia	%	Egypt	Sharkia	%	Egypt	Sharkia	%
2011	205.0	8.0	3.9	37.0	6.0	16.2	37.0	4.0	10.8	279.0	18.0	6.5
2012	212.0	8.0	3.8	49.0	5.0	10.2	37.0	6.0	16.2	298.0	19.0	6.4
2013	202.0	8.0	4.0	53.0	7.0	13.2	44.0	6.0	13.6	299.0	21.0	7.0
2014	200.0	8.0	4.0	60.0	9.0	15.0	44.0	6.0	13.6	304.0	23.0	7.6
2015	200.0	8.0	4.0	62.0	9.0	14.5	45.0	7.0	15.6	307.0	24.0	7.8
2016	201.0	8.0	4.0	65.0	9.0	13.8	47.0	7.0	14.9	313.0	24.0	7.7
2017	202.0	8.0	4.0	71.0	11.0	15.5	48.0	7.0	14.6	321.0	26.0	8.1
2018	201.0	8.0	4.0	75.0	11.0	14.7	49.0	7.0	14.3	325.0	26.0	8.0
2019	201.0	7.0	3.5	81.0	12.0	14.8	49.0	7.0	14.3	331.0	26.0	7.9
2020	200.0	7.0	3.5	84.0	12.0	14.3	49.0	7.0	14.3	333.0	26.0	7.8
Average	202.0	8.0	4.0	64.0	9.0	14.0	45.0	6.0	14.0	311.0	23.0	7.0
Standard deviation	3.7	0.4	0.2	14.7	2.5	1.6	4.6	1.0	1.4	17.0	3.0	0.6
cv	1.8	5.4	5.3	23.1	27.1	11.5	10.3	15.1	10.1	5.5	13.0	8.4
Growth rate	0%	-1%	-1%	9%	7%	-1%	3%	6%	3%	2%	4%	2%

Source: Directorate of Veterinary Medicine in Sharkia Governorate, slaughterhouses sector, unpublished data.

1- **Manual slaughterhouses**:

It's shown that the average numbers of manual slaughterhouses in Sharkia Governorate were about 8, representing 4% of the average number of manual slaughterhouses in Egypt during the period (2011-2020). Also numbers of slaughterhouses were 8 in 2011, representing 3.9% of the total number of manual slaughterhouses in Egypt, and then decreased to be 7 in 2020, representing 3.5% of the total number of manual slaughterhouses, with a decrease annual growth rate 1% in Sharkia Governorate.

2- **Semi-automatic slaughterhouses**:

It's shown that the average numbers of semi-automatic slaughterhouses in Sharkia Governorate were about 9, representing 14% of the average number of slaughterhouses in Egypt during the period (2011-2020). Also numbers of slaughterhouses were 6 in 2011, representing 16.2% of the total number of slaughterhouses in Egypt, and then increased to be 12 in 2020, representing 14.3% of the total number of semi-automatic slaughterhouses, with an annual growth rate increased by about 7% and 9% for the number of semi-automatic slaughterhouses in Sharkia Governorate and Egypt, respectively.

3- **Automatic slaughterhouses:**

It's shown that the average numbers of automatic slaughterhouses in Sharkia Governorate were about 6, representing 14% of the average number of automatic slaughterhouses in Egypt during the period (2011-2020). Also numbers of slaughterhouses were 4 in 2011, representing 10.8% of the total number of slaughterhouses in Egypt, and then increased to be 7 in 2020, representing 14.3% of the total number of automatic slaughterhouses, with an increase annual growth rate by about 3% and 6% for the number of automatic slaughterhouses in Sharkia Governorate and Egypt, respectively.

4- **Total number of poultry slaughterhouses:**

It's shown that the average total number of slaughterhouses in Sharkia governorate were about 23, representing 7% of the average total number of slaughterhouses in Egypt during the period (2011-2020). Also numbers of slaughterhouses were 18 in 2011, representing 6.5% of the total number of slaughterhouses in Egypt, and then increased to be 26 in 2020, representing 7.8% of the total number of slaughterhouses, with an increase annual growth rate by about 2% and 4% for the number of slaughterhouses in Sharkia Governorate and Egypt, respectively.

Thirdly: Operational efficiency of poultry slaughterhouses in Sharkia Governorate.

As it was shown from data in table (3) the total numbers of slaughterhouses were 8, 10 and 6 slaughterhouses for each of manual, semi-automatic and automatic slaughterhouses, respectively. In addition, the total production capacity were 4995, 34000 and 19750 birds per hour, respectively. While the actual capacity were 1192, 3372 and 2450 birds per hour, so the operational efficiency becomes 24%, 10% and 12% for each of manual, semi-automatic and automatic slaughterhouses, respectively.

The decrease in operational efficiency is due to the producer's preference for dealing with slaughterhouses that there are traders for live sale as can be finished and obtained his money in the one day, also It increases the weight of chickens to achieve a higher gain, by bearing on price of chicks, rent, labor, etc., whereas it was inappropriate with the required weights for the slaughterhouse., as follow:

1- **Manual slaughterhouse**:

It was shown that the Al-Noor slaughterhouse in Mashtoul Al-Souq had the highest efficiency as its production capacity is 1000 birds per hour, and the actual capacity is 784 birds per hour, as its operational efficiency is 78%. While Al-Safwa slaughterhouse in Mashtoul Al-Souq is the least efficient, whereas its production capacity is 1000 birds per hour, and the actual production is 30 birds per hour, and then its operational efficiency is 8%. It was also found that there are two slaughterhouses that have stopped their production (Coco slaughterhouse in Belbeis & Al-Rida slaughterhouse) in the Mashtoul Al-Souq.

2- **Semi-automated slaughterhouse**:

It's shown that the Al-Tawheed slaughterhouse in Belbeis is the most efficient, as its production capacity is 2000 birds per hour, while the actual capacity was 793 birds/hour, with an operational efficiency of about 40%, while Al-Baraka slaughterhouse in Belbeis is the least efficient, as its production capacity is 2000 birds per hour, while the actual capacity was 110 birds / hour, with an operational efficiency 6%. It was also found that there are 4 slaughterhouses that stopped production, with a production capacity 8000 birds per hour.

3- **Automatic slaughterhouses**:

It is shown from the table that Romi-Chicken slaughterhouse in Belbeis is the most efficient, as the production capacity is 2500 birds per hour, while the actual capacity is 1995 birds per hour, with an operational efficiency 80%. While Cairo Poultry slaughterhouse (Koki) is the least efficient one, as its production capacity is 7000 birds per hour, while the actual capacity is 150 birds per hour, with an operational efficiency 2%. It was also found that there were three slaughterhouses had stopped working, as their production capacity was about 7250 birds per hour.

From the previous, there is a deficit in the operating capacity is about 3803, 30628 and 17299 birds per hour, thus the production efficiency decreases by about 76%, 90% and 88% for each of manual, semi-automatic and automatic slaughterhouses, respectively. This is due to the producer's preference of deal with slaughterhouses in case of presence of traders of live sale for many reasons, the most important are: It increases the weight of chickens to achieve a higher gain, by bearing on price of chicks, rent, labor, etc., whereas it was inappropriate with the required weights for the slaughterhouse **(Helal, A.F.,2011).**

Fourth: Relative importance of slaughterhouse cost of the sample of study in 2021.

Data in table (4) showed costs items of poultry slaughterhouse and their relative importance of total costs. It was estimated that the total costs were 3.07 million L.E, whereas the fixed costs were 46.291 thousand L.E that represented about 1.5% of the total costs, while variable costs were 3.02 million L.E per month, as follow:

Table(3): Operational efficiency of poultry slaughterhouses (bird per hour) in Sharkia Governorate 2022.

Type	Center	Name	production capacity	actual capacity	**operational efficiency
Manual slaughterhouse	Minya Al-Qamh	Al-Hana	700.0	184.0	26%
		Al-Khors	200.0	31.0	16%
	Mashtoul Al-Souq	Badawy	1200.0	99.0	8%
		Al-Nour	1000.0	784.0	78%
		Al-Safwa	1000.0	30.0	3%
		Al-Reda	125.0	stopped	0%
	Belbeis	Al-Mahrosa	270.0	64.0	24%
		Koko	500.0	stopped	0%
	Total		4995.0	1192.0	24%
Semi-automated slaughterhouse	Minya Al-Qamh	Roky	3000.0	208.0	7%
		Egypt company	2000.0	433.0	22%
	Mashtoul Al-Souq	Al-Madina	15000.0	1210.0	8%
		Al-Basem	2000.0	618.0	31%
		25 January	2000.0	stopped	0%
	Belbeis	Al-Gohary	2000.0	stopped	0%
		Al-Baraka	2000.0	110.0	6%
		Al-Tawheed	2000.0	793.0	40%
	Faquos	Al-Fadadnah	2000.0	stopped	0%
	Al-Salhya	Egyptian Emirati	2000.0	stopped	0%
	Total		34000.0	3372.0	10%
Automated slaughterhouse	Belbeis	Romi chichen	2500.0	1995.0	80%
		Eastern company	3000.0	306.0	10%
		Dana investment	3000.0	stopped	0%
	Dyarb Negm	Al- Leba	3000.0	stopped	0%
	Al-Hessenya	San Al-Hajar	1250.0	stopped	0%
	10th ofRamadan	Koki	7000.0	150.0	2%
	Total		19750.0	2451.0	12%

Source: Directorate of Veterinary Medicine in Sharkia Governorate, slaughterhouses sector, unpublished data.

- Purchasing of live chickens which ranks the first in terms of relative importance that is estimated to be 2.7 million L.E, and representing about 88% of the total costs, and represent the annual production of the slaughterhouse which is 52 thousand birds per year.
- Energy expenditures as solar and electricity ranked the second in terms of relative importance, as they were about 104.3 thousand L.E and represented 3.4% of the total costs.
- Labor expenditures ranked the third in terms of relative importance that were estimated to be 97 thousand L.E, and represented about 3.1% of the total costs.
- Detergents and disinfectants costs are ranked the fourth in terms of relative importance that are estimated to be about 67.9 thousand L.E, and represented about 2.2% of the total costs.
- Total transportation expenses are ranked the fifth in terms of relative importance, as they are estimated to be 35.4 thousand L.E, and represented about 1.15% of the total costs.
- Packaging materials costs are ranked the sixth in terms of relative importance that are estimated to be about 24.3 thousand L.E, and represented about 0.79% of the total costs.
- Other expenses are ranked the seventh in terms of relative importance that were estimated to be about 13.4 thousand L.E, and represented about 0.44% of the total costs.

So that it can be calculated that costs of operating energy are high, as it represented 3.4% of the total costs, and it ranks the first in operating costs and the second in total costs after costs of purchasing of live chickens. So it is possible to increase the net return to be 33% if those slaughterhouses are transformed into use of alternative energy represented in solar energy, and recycling of slaughterhouses' waste to generate gas and preserve the environment.

Table (4): Relative importance of average costs items of slaughterhouse in 2021.

Costs items		No	price	Value	%
Fixed costs	Rent of slaughterhouses	-	-	21666	0.71
	Maintenance costs	-	-	24625	0.80
Total fixed costs				46291	1.51
Variable costs					
Purchasing of live chickens		52000	52	2704000	88.09
Detergents and disinfectants	water	1	15000	14877	0.48
	disinfectants	150	300	44911	1.46
	Detergents	150	30	4503	0.15
	Acids	60	22	1320	0.04
	Tools	600	4	2387	0.08
Total costs of Detergents and disinfectants				67998	2.21
Packaging materials		1	25000	24385	0.79
Energy expenditures	Electricity	1	65000	65000	2.12
	Solar and oil	1	15000	15000	0.49
Total costs of Energy expenditures				104385	3.40
Labor expenditures	Transport worker	5	3450	17250	0.56
	butchers	6	3500	21000	0.68
	Vet	2	5000	10120	0.33
	Maintenance	2	3500	7125	0.23
	Quality Supervisor	2	4000	8000	0.26
	workers	3	3000	9150	0.30
	liver	3	2400	7200	0.23
	gizzards	3	2400	7250	0.24
	sort	2	2000	3850	0.13
	Accountant	2	3500	7000	0.23
Total costs of Labor expenditures		-	-	97945	3.19
Other items		-	-	13400	0.44
Transportation	Poultry	4	3000	12300	0.40
	Items	1	2400	2150	0.07
	Products	6	2500	17500	0.57
	Workers	1	3500	3500	0.11
Total of transportation costs				35450	1.15
Total variable costs		-	-	3023178	98.40
Total costs		-	-	3069469	100.00

Source: Collected and calculated from data of the sample in Sharkia Governorate in 2021.

Fifth: Relative importance of revenue items in the slaughterhouses in 2021.

The results in table (5) showed the relative importance of various revenue items in the sample of automatic slaughterhouses, as their total revenue was about 3.4 million L.E per month. Revenues consist of eight items that as follows:

1- Whole birds represented 34.7% of the total produced quantities in slaughterhouses and ranked the first in terms of the relative importance of revenues, as the quantity produced is 30.4 tons per month, with an average price 42 L.E / kg, so that total return is estimated to be 1.28 million L.E, and represent about 37.9% of the total revenue.

2- 2- Minced meat represented 13.9% of the total produced quantities in slaughterhouses and ranked the second in terms of the relative importance of revenues, as their quantity produced is 12.1 tons per month, with an average price 95 L.E / kg, so that total return is estimated to be 1.15 million L.E, and represent about 34.3% of the total revenue.

3- Strips (fillet) represent 4.9% of the total produced quantities in slaughterhouses and occupied the third rank in terms of the relative importance of revenues, as the quantity produced is 4.29 tons per month, with an average price of about 76 L.E per kg, so that total return is estimated to be 322 thousand L.E, and represented about 9.5% of the total revenue.

4- Chicken thighs represent 9.2% of the total produced quantities in slaughterhouses and ranked the fourth in terms of the relative importance of revenues, as the quantity produced is 8 tons per month, at an average price of about 35 L.E per kg, so the total return is 281 thousand L.E, and represent about 8.3% of the total revenue.

5- Livers, gizzards & hearts represent 6.2% of the total produced quantities in slaughterhouses and represented the same percentage of slaughter chickens, which was accepted to the technical side, and ranked the fifth in terms of the relative importance of revenues, as the produced quantity is about 5.4 tons per month, with an average price 40 L.E per kg, so total return is about 218 thousand L.E, that represented about 5% of the total revenue.

6- Wastes are consists of blood, feathers and viscera, also they represent 22.8% of the total produced quantities in slaughterhouses whereas they ranked the sixth in terms of the relative importance of revenues, as the quantity produced is about 2 tons per month, with an average price 3.5 L.E per kg, and then the total return is about 70 thousand L.E, and represent about 2.1% of the total revenue.

7- Bones (skeleton) which represent 3.1% of the total produced quantities in slaughterhouses, ranked the seventh in terms of the relative importance of revenues, as the quantity produced was about 2.6 tons per month, with an average price 12 L.E per kg, with a total return of about 32 thousand L.E and represent about 1% of the total revenue.

8- Legs represent 5.2% of the total produced quantities in slaughterhouses ranked the eighth in terms of the relative importance of revenues, as the quantity produced is about 4.5 tons per month, with an average price 4.2 L.E per kg, so total return is estimated to be 18.2 thousand L.E, which represent about 0.5% of the total return volume.

From the previous, consumer tastes are the main factor in revenue items, as it was found that consumption patterns are divided into three sections: The first prefers whole birds, that occupied the first rank, and represents about 37.9% of the total revenues, and reflects the desire of the largest number of consumers. Then its followed by Minced poultry meat, which reflects the change in consumption patterns, and represented 34.3%, then consumption patterns were formed towards different parts which represented about 28%.

Table(5): Relative importance of poultry slaughterhouses revenues in 2021.

Items	Quantity (Kg)	%	Price(L.E/Kg)	Value(L.E)	%
Whole birds	30485	34.7	42	1280370	37.90
Minced meat	12194	13.9	95	1158430	34.30
Strips	4298	4.9	76	322379	9.50
Chicken thighs	8048	9.2	35	281681	8.30
Livers, gizzards & hearts	5460	6.2	40	218400	6.50
Wastes	20020	22.8	4	70070	2.10
Bones (skeleton)	2683	3.1	12	32192	1.00
Legs	4550	5.2	4	18200	0.50
Total revenues	87738		-	3381722	100.00

Source: Collected and calculated from data of the sample in Sharkia Governorate in 2021.

Sixth: Efficiency indicators of automatic poultry slaughterhouses in the sample at Sharkia Governorate during 2021.

As it was shown from data in table (6) the efficiency indicators in the sample of the study, as it was found that the average of slaughtered chicken in the automatic slaughterhouses were about 52 thousand birds, (2000 birds per day / slaughterhouse), at an average price 26 L.E per live kg, so that the average cost of buying live birds is estimated about 2.7 million L.E per month, which represents about 88% of the total costs, as follow:

1- The costs per one ton of slaughtered chicken were 29514 L.E, while the total return per ton of slaughtered chicken was 32,516 L.E, thus the net return was 3101 L.E /chicken.
2- Total costs were 3 million L.E per month distributed between fixed and variable costs, as they were 46.2 & 3023 thousand L.E respectively, and the share of one thousand chickens were 890 L.E AND 58138 L.E respectively.
3- The total return is 3.4 million L.E, and about 56 thousand L.E/1000 chickens.
4- Net return is about 312 thousand L.E and about 6000 L.E / 1000 chickens, also 6 L.E/ chicken.
5- Ratio of Total revenue to total variable costs was about 1.10%, while the ratio of total revenue to variable costs was about 1.12%.
6- Gross margin was about 358.5 thousand L.E and about 6895 L.E/1000chickens.

Table (6): Indicators of Efficiency of poultry slaughterhouses in 2021.

Items	Unit	Sample	1000 chickens
Average of slaughtered chicken	Bird/month	52000	1000
Farm price	L.E/Kg	26	26
Chickens purchase cost	L.E	2704000	52000
Fixed costs	L.E/chicken	46291	890
Variable costs	L.E/chicken	3023178	58138
Total costs	L.E/chicken	3069469	59028
Costs per 1 ton (slaughtered)	L.E	29514	
Returns per 1 ton (slaughtered)	L.E	32516	
Net returns per 1 ton (slaughtered)	L.E	3101	
Total revenue	L.E	3381722	65033
Net revenue	L.E	312254	6005
Total revenue/total cost	%	1	1
Total revenue/variable cost	%	1	1
Gross margin	L.E	358544	6895

Source: Collected and calculated from data of the sample in Sharkia Governorate in 2021.

Total cost = fixed cost + variable cost
Net revenue = total revenue – total cost
Gross margin = total revenue – variable cost
Ratio of total revenue to total cost = total revenue ÷ total cost
Ratio of total revenue to variable cost =total revenue ÷ variable cost

Seventh: Statistical analysis of factors affects the operation efficiency of slaughterhouses.

It was found from the field study sample that there are many factors that can measure their impact on the produced quantities of poultry meat in slaughterhouses by construction of structural model to estimate type and size of the relationship between the independent variables and the dependent variable represented in the produced quantities of poultry meat. These factors can be clarified as follows:

Y = produced quantities of poultry meat by tons.
X1 = purchase price per kilogram of live poultry meat
X2 = cost of disinfectants and detergents.
X3 = Energy costs (electricity - solar).
X4 = average weight of the bird
D1 =dummy variable represented the health status of the herd, as if the health condition was satisfied it took value (1) but unsatisfied took value (zero)

D2 = dummy variable represented contracts, as the presence of contracts took the value (1) but absence of contracts took value (zero).
D3 = dummy variable represented type or breed, as the breed that can hoard meat in chests as Cubs or AR breakers, , took value (1), but if the breed hoard meat in the thighs, such as the Hubbard , took value (zero).

It was shown from table (7) that the estimated mathematical relationship is significant at the level of 1% according to the value of calculated f, which were 606.359. In addition, adjusted coefficient of determination was about 0.93, whereas explanatory variables explain about 93% of the change in the quantity produced from poultry meat and about 7% of the changes in production are due to other factors that were not included in the production function.

1- Effect of quantitative variables on producing poultry meat in the slaughterhouses.

The results indicated that there was a statistically positive relationship between the produced quantities of poultry meat and each of energy costs of electricity & solar (x3) and the average weight of the bird (x4), but there was a statistically negative effect between the produced quantities of poultry meat and live chicken purchase price (x1) according to the value of t-calculated. Also the effect of disinfectants and detergents costs (x2) was not proven its significance on the quantity produced of poultry meat.

It was shown from table (6) that an increase in each of cost of energy and the average weight of the bird by 1%, led to increase the quantity produced of frozen and chilled poultry meat in the slaughterhouses by about 63.2 and 1194.6 tons, respectively. In addition, it was also shown that when the purchase price of live kg decreased by 1%, the quantity produced of frozen and chilled meat in the slaughterhouses of the study sample increased poultry meat about 222.6 tons.

2- Effect of dummy variables on producing poultry meat in the slaughterhouses

It was shown the positive effect of the dummy variables on the produced quantity of frozen and chilled meat in the slaughterhouses of the study sample, as it was found that the presence of contracts between slaughterhouses and broiler farms leads to an increase in the quantity produced about 818.7 tons of poultry meat, which helps to increase operational efficiency.

As well as the presence of health problems in the herd leads to an increase in the quantity produced of poultry meat in the sample slaughterhouses about 556 tons of poultry meat in the sample slaughterhouses, which is consistent with the technical aspect, as the breeder prefers to send the birds to the slaughterhouse if there are some sick symptoms before selling, especially respiratory diseases that are difficult to control.

In addition, the effect of the breed type on increase the quantity produced of poultry meat in the sample slaughterhouses, whereas it was found that the species bearing characteristic of hoarding meat in the chest leads to an increase in the quantity about 371.4 tons of poultry meat in the sample slaughterhouses and this was indicated by the relative importance of revenues, as it was found that minced meat and stripes (fillet) meat occupies the second and third rank, representing 44% of the volume of revenues, while revenues of thighs come in the fourth rank, which represents about 8.3%.

Table(7): Statistical analysis of the factors affecting the quantity produced of poultry meat in the slaughterhouses of the study sample in 2021.

Xs	**variables**	**B**	**T**
	(Constant)	1303	1
x1	purchase price of live poultry meat	-223	-8.973**
x2	costs of disinfectants and detergents	63	1
X3	Costs of energy	0	4.191**
x4	average weight	1195	1.861*
D1	health status	556	7.108**
D2	contracts	819	8.185**
D3	Breed	371	5.307**
R2		93	
F		606.359**	

Source: Data of the sample by using spss program.
(*) level of significance (1%), (**) level of significance (5%)

Eighth: Relative importance of problems and proposed solutions for poultry slaughterhouses during 2021.

1- The relative importance of the problems in the sample of poultry slaughterhouses in Sharkia Governorate:

As it was shown from table (8) the relative importance of the production and marketing problems that obstruct the productive efficiency of poultry slaughterhouses in the sample of the study, as it was found that each of : fluctuation of poultry prices, the unavailability of numbers of the required quantities, high costs of electricity, difficulty of recycling waste, and high mortality rate during transport live chickens, occupied the first rank as the number of frequencies in the sample were about 33, 31, 31, 30 and 30 orderly and represented about 92%, 86%, 86% and 83%, respectively.

Other problems followed as: difficulty of obtaining contracts, executing invalid quantities & difficulty in disposing of stock, spread of imported poultry in large quantities, low health status of herds destined to slaughterhouses & the low of its selling prices, and scarcity of technical labor, as their frequencies in the sample were about 29, 27, 25, 25 and 18, and represented about 81%, 75%, 69%, 69%, and 50%, respectively.

In addition, problems that has the least number of frequencies are: the weak role of the state to get rid of some pivotal diseases that affect poultry in Egypt, the decrease in the number of slaughterhouses which specialize in slaughtering birds, the low capacity of the slaughterhouses compared to the number of productive birds, difficulty of dealing with small farms with low production capacity, and the difficulty of getting construction & operational licenses, as their frequencies in the sample were 10, 10, 9, 7 and 7, also represented 28%, 28%, 25%, 19%, and 19% for each of them, respectively.

Also it was shown from table (9) the relative importance of the proposed solutions to the previous problems faced the sample of poultry slaughterhouses in Sharkia governorate, as: establishing a binding contractual system, at least monthly pricing, and tightening control over biosecurity were ranked the first, whereas their frequencies in the sample were about 35, 33, and 30, and their relative importance were about 97%, 92%, and 83%, respectively.

In addition, proposed solutions that have the least number of frequencies are: Imposing protection duties on imported poultry, Establish mobile slaughterhouses, Facilitating licenses for establishing slaughterhouses, whereas their frequencies were 10, 8, and 8 and their relative importance were 28%, 22%, and 22%, respectively.

Table(8): Relative importance of production and marketing problems in a sample of poultry slaughterhouses in Sharkia Governorate during 2021.

Problem	frequency N =36	Relative importance
fluctuation of poultry prices	33	92
unavailability of required quantities	31	86
high costs of electricity	31	86
difficulty of recycling waste	30	83
high mortality rate during transport live chickens	30	83
difficulty of obtaining contracts	29	81
executing invalid quantities & difficulty in disposing of stock	27	75
imported poultry in large quantities	25	69
low health status of herds destined to slaughterhouses	25	69
scarcity of technical labor	18	50
High maintenance costs	17	47
high storage costs	15	42
High transportation costs	15	42
High prices of disinfectants and detergents	12	33
High costs of water	12	33
gain or loss weight than required rates	11	31
Weakness role of getting rid of some pivotal diseases	10	28
decrease in number of slaughterhouses specialize in slaughtering birds	10	28
low capacity of the slaughterhouses compared to the number of productive birds	9	25
difficulty of dealing with small farms with low production capacity	7	19
difficulty of getting construction and operational licenses	7	19

Source: Data of the sample of study in 2021.

Table(9): Relative importance of proposed solutions for production and marketing problems in the sample of poultry slaughterhouses at the Sharkia Governorate in 2021.

proposed solutions	frequency N =36	Relative importance
establishing a binding contractual system	35	97
monthly pricing	33	92
tightening control over biosecurity	30	83
elicit Disease resistant hybrids	22	61
Tighter control on medicines	18	50
Encouraging the use of alternative energy	18	50
Doing guidelines programs for changing the consumption pattern	15	42
Helping the state to recycle waste to generate energy	13	36
Providing operational loans from financing institutions at subsidized interest rates	13	36
Imposing protection duties on imported poultry	10	28
Establish mobile slaughterhouses	8	22
Facilitating licenses for establishing slaughterhouses	8	22

Source: Data of the sample of study in 2021.

Conclusion

Although poultry slaughterhouses are one of the most important ring in the poultry sector that works on a balance between supply and demand, especially after the gradual transformation of consumption patterns from buying live birds to chilled and frozen birds as well as, their production efficiency is very low, ranging between 10% to 24% of the total production.

This research is aimed mainly to study some of the factors affecting the efficiency of automatic poultry slaughterhouses and reached to several results, as follow:

1- There is a deficit in the operating capacity is about 3803, 30628 and 17299 birds per hour, thus the production efficiency decreases by about 76%, 90% and 88% for each of manual, semi-automatic and automatic slaughterhouses, respectively.

2- Costs of operating energy are high, as its represented 3.4% of the total costs, and it ranks the first in operating costs and the second in total costs after purchasing of live chickens. So it is possible to increase the net return to be about 33% if those slaughterhouses are transformed the use of alternative energy represented in solar energy, and the use of slaughterhouses' waste to generate gas and preserve the environment.

3- Consumer tastes are the main factor in revenue items, as it was found that consumption patterns are divided into three sections, as the first prefers whole birds, and occupied the first rank, which represents about 37.9% of the total revenues, and reflects the desire of the largest number of consumers, followed by Minced poultry meat, which reflects the change in consumption patterns, and represented 34.3%, then consumption patterns were formed towards the different parts which represented about 28%.

4- Net return is about 312 thousand L.E which estimated about 6000 L.E/1000chickens, and about 6 L.E/ chicken, also total revenue to total variable costs ratio was about 1.10%, while the ratio of total revenue to variable costs was about 1.12%, and gross margin was about 358.5 thousand L.E and about 6895 L.E/1000chickens.

5- There was a statistically positive relationship between the produced quantities of poultry meat and each of energy costs of electricity and solar (x3) and the average weight of the bird (x4), but there was a statistically negative effect between the produced quantities of poultry meat and live chicken purchase price (x1) according to the value of t-calculated. Also the effect of disinfectants and detergents costs (x2) was not proven on the quantity produced of poultry meat.

6- It was shown from table (6) that an increase in each of cost of energy and the average weight of the bird by 1%, led to increase the quantity produced of frozen and chilled poultry meat in the slaughterhouses by about 63.2 and 1194.6 tons, respectively. In addition, it was also shown that when the purchase price of live kg decreased by 1%, the quantity produced of frozen and chilled meat in the slaughterhouses of the study sample increased poultry meat about 222.6 tons.

7- Increasing in each of cost of energy and the average weight of the bird by 1%, led to increase the quantity produced of frozen and chilled poultry meat in the slaughterhouses by about 63.2 and 1194.6 tons, respectively. In addition, it was also shown that when the purchase price of live kg decreased by 1%, the quantity produced of frozen

and chilled meat in the slaughterhouses of the study sample increased poultry meat about 222.6 tons.

8- The presence of contracts between slaughterhouses and poultry broiler farms leads to an increase in the quantity produced about 818.7 tons of poultry meat, which helps to increase operational efficiency, as well as the presence of health problems in the herd leads to an increase in the quantity produced of poultry meat in the sample slaughterhouses about 556 tons of poultry meat in the sample slaughterhouses, which is consistent with the technical aspect, as the breeder prefers to send the birds to the slaughterhouse if there are some sick symptoms before selling, especially respiratory diseases that are difficult to control, also the species bearing the characteristic of hoarding meat in the chest leads to an increase in the quantity about 371.4 tons of poultry meat in the sample slaughterhouses.

According to the previous results, this study recommended that:

1- Expanding the use of alternative energy that reduces the costs of energy used, such as solar energy and the production of methane and ethanol from recycling slaughterhouses waste.
2- Expanding the recycling of waste and producing organic fertilizers as an alternative to chemical fertilizers.
3- Activating the laws and administrative decisions that limit the spread of the circulation of live birds to limit the spread of epidemics and diseases that hinder the poultry industry, thus facilitating the work of slaughterhouses.
4- Facilitating to procedures for obtaining construction and operating licenses for automatic and semi-automatic slaughterhouses.
5- Establishing a pre-contractual system between slaughterhouses and poultry broiler farms to increase the operational efficiency of the slaughterhouses.
6- Activating extension programs that change consumption patterns from live birds to the circulation of chilled and frozen birds.

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