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Red Meat Supply and Value Chains

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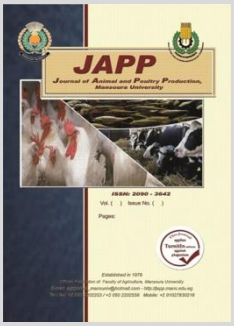

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ABSTRACT

The study aimed to identify value chains of meat production from cattle and buffalo in Monoufia governorate, representing the Nile Delta region of Egypt, conclude factors affect prices balance, and supply meat at reasonable prices to the consumers. A structured questionnaire was developed to gather information of production systems. Using analytical methods, factors affecting meat prices were determined. Total herd size was significantly ($P<0.0001$) affected by producers` education level and farm size, meanwhile producers` experience was non-significant. Profitability was reported at 8816 LE per fattened calf for cattle and 5100 LE for buffalo. Concentrate rations represented the highest cost, reaching 30232 LE during the fattening period. Fattening scheme to produce 450 kg "Kandos" live weight was followed by the producers; it is preferred by the consumer as well sells at an appropriate price for the producer. Meat prices recorded 360 LE/ kg delivered to the consumer compared to an average of 145 LE as live weight of cattle at the producer level. Buffalo meat recorded 360, and 116.25 LE at the consumer and producer levels, respectively. Results of the study proved deficiency in production inputs, and livestock supply leading to high meat prices. The necessity of the private sector to integrate into meat production has been reported; however role of "livestock insurance fund" in finance feed-stuff and animal treatment. Governmental intervention to monitoring livestock markets concerning stabilizing meat prices impacts market infrastructure. Initiating market database to inspect price manipulation implied by traders and intermediaries is extremely recommended.

Keywords: Buffalo, Cattle, Meat production, Supply and value chains

INTRODUCTION

Large discrepancy in meat prices has become clear as a result of the difficulties related to resource availability. In Egypt, cattle and buffalo constitute the basis in red meat production, reported 4.1 million tons of cattle and 1.9 million tons of buffalo. Gross production indices refer to 75 billion LE of cattle and 51 billion LE of buffalo meat production (FAOSTAT, 2022). Cattle and buffalo are raised under Mixed- Agricultural livestock farming systems located along the Nile Delta region. Calves were produced slaughtered or sold directly after weaning, where production systems originated for dairy production to gain return, or fattened at different ages (weights) due to demand. The number of slaughtered heads of cattle and buffalo decreased in the period from 2016 to 2020 by 1.3 to 1.2 million tons from cattle, and from 1.08 million tons to 556 thousand from buffalo (CAPMAS, 2020). In addition to the inability of red meat production to meet increasing demand as population rapidly increases, a food gap is estimated around 6.3% of red meat (CAPMAS, 2020), which explains the increase in red meat prices.

Value and supply chains describe the channels where products are delivered from producer to consumer (supply chains), and values in which the product being delivered (value chains), however, include procuring, producing and marketing phases. Livestock value chains were concerned only with two ends: production or consumption as mentioned in most articles, they discussed different elements of livestock value chains (FAO, 2014). In this regard, Rich *et al*. (2011) reported that livestock value chains integrated long-distance trading and transactions levels creating surplus and services. Urbanization comes as the concept lengthened and complicated value chains, ahead to increasing demand and land scarcity (FAO, 2017). Extensive challenges are faced by producers who demanded by certain production standards depending on the market, to supply chain actors whose livelihoods are threatened, and the consumer in the theme of increasing prices (Shields, 2013).

Egyptian consumption patterns concern meat as a social and economic measure of market status. General levels of prices are exposed by the prices of red meat in the Egyptian public opinion sense. Eventually, increases in red meat prices exceed rates of the other food commodities, which grow attention to the red meat production sector via-sight food security, and address factors influence apparent disparity in red meat prices.

Monoufia governorate was chosen for the study, representing the Nile Delta region of Egypt, where Agriculture- Livestock Production Systems are located, and as the governorate distinguished by availability of numbers of cattle and buffalo heads raised for fattening for meat production. The study aims to define stakeholders' included in meat production supply and value chains, detects factors affecting prices balance, and recommends tracks to offer meat at reasonable prices for the consumer in view of the producer income.

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MATERIALS AND METHODS

Studied area

The study was conducted to assess fattening systems of cattle and buffalo herds raised in Monoufia governorate in north west of the Nile Delta region. The study targeted districts of: Shebin Elkoum, Quwesna, Al Bagour and Menouf (Fig. 1).The issue was to determine strengths and weaknesses of the stalk-holders disturbed value and supply chains of the located production systems. Production systems included in the study area characterize farming systems where farm size is around 5 feddans. Livestock assorted cattle and buffalo by around 5 animals per one farm. Producer income linked to raising animals, mainly for dairy production, along with selling cash crops if capacity of cultivated lands were available.

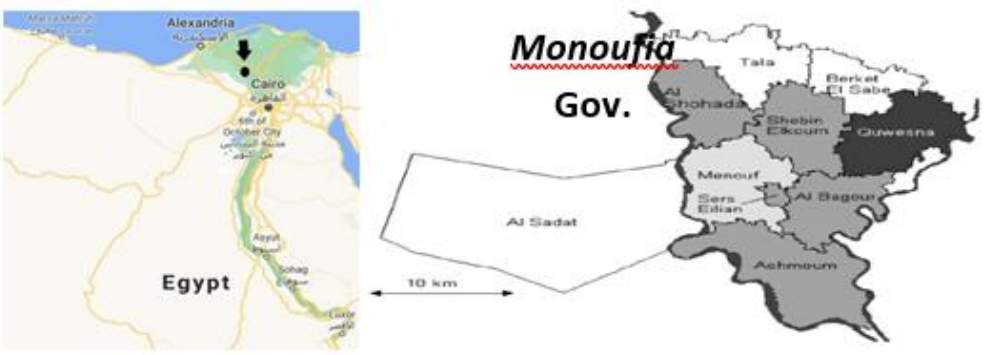

Fig 1. Study area: Shebin Elkoum, Quwesna, Al Bagour and Menouf districts of Monoufia governorate of Nile Delta region.

Data collection

Stratified random methodology was used to differentiate producers` prospective. Indeed, mapping supply and value chains and deducing stakeholder`s benefits and economic performance given production costs. Face to face interviews were followed to collect data of incorporated production systems. A structured questionnaire was developed gathering information as shown in Table 1.

Table 1. Production systems components

Variable	Description
Respondents' characteristics	- Education level, producers` experience, farm size, livestock type and their relation to the total herd size.
Herd composition	- Gender, age structure of each livestock type (cattle and buffalo).
Fattening system	- Fattening scheme applied by the producers estimated: initial weight (kg), final weight (kg) and average body weight gain (ABWG) kg/ day.
Selling and purchasing criteria	- Destinations of selling and purchasing animals, and included prices.
Profitability aspect	- Farm expenses: Average of purchasing price LE, concentrates, veterinary and labor costs. - Total income: Average of selling price LE. - Total profit: calculated total income- total expenses.

Data analysis

Using SAS software (SAS, 2014), Chi-square ($\chi 2$) modeling was designed to test numerical data (Snedecor and Cochran, 1993) as following:

$$Y_{ijk} = \mu + S_i + T_j + e_{ijk}$$

Where;

Y_{ijk} is the total number of herd size,
μ is the general mean,
S_i is the fixed effect of respondents' characteristics (1= education level, 2= producers` experience, 3= farm size) within each livestock type,
T_j is the fixed effect of livestock type (1= cattle, 2= buffalo),
e_{ijk} is a random effect associated with the individual observation and assumed to be NID (0, σ 2 e), and

$$Y_{ijk} = \mu + F_i + T_j + e_{ijk}$$

Where;

Y_{ijk} is the total number of fattened calves,
μ is the general mean,
F_i is the fixed effect of fattening systems (1= scheme.1, 2= scheme.2, 3= scheme.3) within each livestock type,
T_j is the fixed effect of livestock type (1= cattle, 2= buffalo),
e_{ijk} is a random effect associated with the individual observation and assumed to be NID (0, σ 2 e).

RESULTS AND DISCUSSION

Respondents' characteristics

Producers' of the study sample were illustrated according to the traits included education level, experience, farm size, animal type and their integration to the total herd size. Education level and farm size were significantly (P<0.0001) affected total herd size, meanwhile producers` experience was non-significant (Table 2).

Education level

Education was an essential element to the producer's awareness to production systems conception, consequently dealing with advanced technologies. Illiteracy occupied highest percentage of the producers` education level with 28.13% of the herd size kept by illiterate producers. The high school education didn`t exceed 27.50%. Highest level of education at college tends to rear buffalo by 15.94% (Table 2). This is in agreement with what was obtained by Islam *et al*. (2018), who reported that 48% of producers was illiterate, while 38% had primary education in their study on consumers` behavior of buffalo meat marketing prospective. According to CAPMAS (2013) illiteracy was recorded 25.9% of Egypt` population aged above 10 years. Abd-Elmonaime (2014) mentioned that percentage of illiteracy, basic, secondary and high education was 31.4, 9.8, 54.9 and 3.9%, respectively of families in the case study.

Experience

In Table 2, data showed that most of the producers had more than 30 years in activity holding cattle either buffalo herds. Abd-Elrahim *et al*. (2022) mentioned that producers' age explained elders to apply traditional systems.

Younger producers were responded to progressive technologies. The present results revealed that producers exclude following technologies related to feeding systems, and in mating scheme as natural insemination using known sire held by another breeder was followed.

Farm size

Farm size contributes to increasing number of raised herds given animal unit indication. Highest percentage of herd size was recorded by cattle (21.88%) and buffalo (15.31%) in average farm size from 21 to 50 karat (Table 2). According to Elsorougy (2018), production systems efficiency was determined by availability of cultivated lands. Availability of land area on contrary burden production costs due to labor intensity and the optimizing energy use as reported by Cwalina *et al*. (2020). Deficiency of cultivated lands area caused by urban sprawl was reported in last decade. Metawi (2011) reported that average farm size in old cultivated lands (Delta) was 2.7 acres.

Animal type

In general, cattle recorded the highest number of livestock reared by the producers at 58% compared to 42% of buffalo (Table 2), justifying reliance of the producers on cattle for meat production. In Monoufia governorate, it was observed decrease in the number of "Baladi" cattle herds. Productivity and economic performance attributed the reasons of such deficiency that there weren`t association or research development of the local breeds. This is in accordance with Galal (2012) who reported decrease in "Baladi" cattle herds over the period from 1961 to 2010. "Baladi" cattle were reared as draft animals or to sell calves, but for meat production due to low demand for milk from local cattle. Meat production was mainly represented by family consumption or Muslim religious sacrifices "Aladha Aid". Marketing systems were based on direct sales or through brokers supporting markets (Osman *et al*., 2016). Buffalo share in total meat production was decreased by 14.4% (CAPMAS, 2020). Despite of this, buffalo remains advantage in focus of free marketing systems. Regarding feeding aspect, buffalo showed high conversion rate. Buffalo reported increases in their productivity then profitability in case of genetic and crossing programs effectively implemented. In this respect, Elsorougy *et al*. (2022) proved buffalo as main livestock achieved highest income LE/ head/ season in some experimental stations of Egypt.

Table 2. Producers- related characteristics and total herd size

Variable	Total herd size							
	Cattle		Buffalo		Total		Test	
	Frequency	%	Frequency	%	Frequency	%	$\chi 2$	P-value
Education level								
Illiteracy	50	15.63	40	12.50	90	28.13	85.54	<.0001**
Primary	64	20	17	5.31	81	25.31		
Secondary	6	1.88	0	0	6	1.88		
High	64	20	24	7.5	88	27.50		
College	4	1.25	51	15.94	55	17.19		
Experience/ year								
10	14	4.38	12	3.75	26	8.13	0.68	0.7116
From 11 to 30	59	18.44	45	14.06	104	32.50		
>30	115	35.24	75	23.44	190	58.68		
Farm size/ karat								
From 0 to 10	30	9.38	43	13.44	73	22.81	24.44	<.0001**
From 11 to 20	28	8.75	2	0.63	30	9.38		
From 21 to 50	70	21.88	49	15.31	119	37.19		
>50	60	18.75	38	11.88	98	30.63		
Total herd size	564	0.58	396	0.42	960	100		

****=P<000.1**

Herd composition

Data in Table 3 show age structure for each female and male livestock. Lactating (adult) recorded 6.5 of the total herds. Heifer< 1 year, heifer> 1 year recorded 5.57 and 5.45, respectively. Largest number of herd size (8.1) was represented by male calves> 1 year. Calves<1 year recorded 3.9. One sire for each cattle and buffalo herds was represented per farm for breeding.

Table 3. Herd structure and composition

Variable	Cattle	Buffalo	Total
Female			
Average number of lactating (adult)	2.9	3.6	6.5
Average number of heifer < 1year	2.57	3	5.57
Average number of heifer > 1year	2.45	3	5.45
Male			
Average number of calves< 1year	1.76	2.14	3.9
Average number of calves> 1year	4.5	3.6	8.1
Average number of bulls	1	1	2

Number of lactating buffalo increases more than cattle, that buffalo represents livestock for dairy production. Though, producers believe in raising calves from cattle to produce meat, which places a strategic commodity for the consumers. Herd size and composition are affected by different agro- ecological zone (Metawi *et al*., 2021).

Intensification and the capital investment recognized as breeding systems constrain. Livestock production expresses alternative to the producers` livelihood due to decrease in cultivated land area, particularly in areas outskirt the major cities where animal products contributed highly demand. According to Daburon *et al*. (2016), family (rural) impacted 90% of the Egyptian farming systems. Sustainable farming systems described by combination of natural and human capitals, agricultural and livelihood diversification. According to Martin *et al*. (2020), diversification of livestock, cropping and off-farm activities contributes to increase household income. The authors added that figure out socio-economic factors is fundamental to achieve

sufficient inputs and the farm off-take. Smallholders were reported most vulnerable due to their low donations. Value chains assess therefore appears essential in developing strategies, should be prioritized in rural communities.

Fattening systems

Analysis of fattening scheme demonstrates significance on numbers of fattened calves related to cattle and buffalo livestock at $\chi 2$ value 12.56 and probability ($P<0.0019$). Fattening systems to produce 450 kg live body weight (sheme.1) was the foremost strategy followed by the producers being 29.58 % of cattle and 15.49 % of buffalo. Scheme.2 recorded 25.35% of cattle and 8.45% of buffalo. Scheme.3 was represented by16.9 % for buffalo, and 4.23% for cattle (Table 4).

Producers preferred "Fresien" crossbred cattle for meat production because of body conformation, average daily weight gain (AVDWG) and the appropriate occasion for fattening weight (finishing).

"Monouf", "Shebien" (Monoufia) and "Banha" (Qualyobia) governorates reported the markets where the producers purchasing and selling their animals. Livestock value was depended mainly on breed, age and the live weight. After-weaned was the major breeding system among the producers. Calves are kept to age from 1 to 2 years, feed on concentrates for 4 to 6 months and sale at weight from 400 to 450 kg. Another strategy was recorded by Wiyabot (2015) that producers buy beef cattle at ages between 1.5 to 2 years, raise from 8 to 12 months and sale at weight from 300 to 400 kg. Limited area for keeping animals furthermore availability of natural grass proved obstacles of fattening systems. Lack of green fodder, and in contrast, reliance on feeding concentrates affects animal health and productivity.

Table 4. Fattening scheme of cattle and buffalo

Variable	Cattle	Buffalo	Total	Test	
				$\chi 2$	P-value
	Scheme.1				
Number of fattened calves: frequency, (%)	21(29.58)	11(15.49)	32(45.07)		
Average Initial weight/ kg	195	237			
Average final weight/ kg	450	450			
Average body weight gain (ABWG)/kg/ day	0.68	0.48			
	Scheme.2				
Number of fattened calves: frequency, (%)	15(25.35)	6(8.45)	21(33.8)		
Average Initial weight/ kg	250	250		2.56	0.0019
Average final weight/ kg	550	550			
Average body weight gain (ABWG)/kg/ day	0.64	0.46			
	Scheme.3				
Number of fattened calves: frequency, (%)	3(4.23)	12(16.9)	15(21.13)		
Average Initial weight/ kg	310	300			
Average final weight/ kg	600	600			
Average body weight gain (ABWG)/kg/ day	0.50	0.40			

Livestock supply and value chains

As shown in Fig. 2, cattle meat is delivered at 360 LE/ kg (consumer price) compared to an average of 145 LE/ kg live weight (producer price). Buffalo meat recorded 360 LE, 116.25 LE of consumer and producer prices, respectively. Producers deal with market to sell their animals to gain the highest price. Traders and intermediaries try to brook prices to get over bargain. In the same context, butchers buy animals mainly from producers or markets to fix purchasing price. Variability of animal prices as prices vary depending on selling and purchasing timing causes loss in gross margin. Competition among traders and intermediaries negatively affects prices stability.

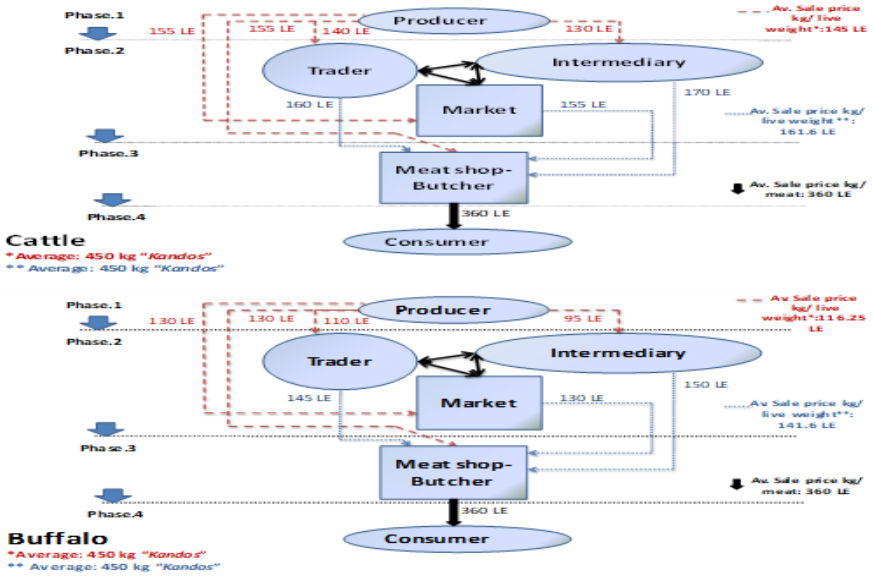

Fig. 2. Cattle and buffalo red meat supply and value chains.

This is in harmony with what was declared by Spies (2011) that variability in prices remains difficulty of livestock trade. Existence of developed market infrastructure helps in performing efficient marketing systems. Market information, including supply, demand and prices reported conflicts as producers obtain market knowledge unsystematically instigates designing polices and officials to overcome perceived inadequate constraints.

Yet, livestock value chains needed focus on intra-linkage "missing middle", benefit distribution and official regulations throughout production and marketing channels (Abu Hatab *et al*., 2019). Linkage of stakeholders has to be addressed from a dynamic sight could attain sustainability of production systems. Value chains analysis should evaluate knowledge and practices across stakeholders, technologies followed and support services. Institution and association extensions take role in guiding producers' capabilities, particularly smallholders towards enhancing livelihood considering competitive with advanced conveniences and market access. Gender equality has to be respected referring to woman participation in "post production" stages which improving household income and facilitating farm resources (Njuki *et al*., 2013).

Profitability aspect

Profitability reported LE per fattened calf by 8816 LE of cattle and 5100 LE of buffalo. The selling price of fattened calf from cattle was 69750 LE. Buffalo calf sells at 58500 LE (Table 5). Concentrate rations recorded the highest cost reached 30232 LE during fattening period. The lowest cost was recorded by animal labor didn`t over 2548 LE. Highly return of cattle than buffalo due to their preference as source of red meat in the local markets. Shorter period of fattening reflects highly return and the significant gross margin. Beef cattle aged 1 to 2 years to finish not more 3 years gained the highest profit (Surawat and Charunee, 2019). Producers acknowledged that seasonal times such as "Aladha Eid", "Ramadan" and transitional periods (periods between fodder cropping) were the optimal times to sell their animals when supply decreases then animal prices being increased. Animal labor reported the lowest cost that the producers rely on family labor. Producers complain unavailability of animal treatment and vaccinations required creation courses to supply veterinary stuff in terms of these medications cost and validity. Producers install concentrate mixtures from soya bean, corn (grain maize) and corn flower to reduce purchasing feed costs. The other part of ration presents fodder and roughages provided inside farm. This is in accord with Elsorougy *et al*., (2023) who reported that concentrates recorded the highest costs in a study of impact of nucleus herds on buffalo production systems in some Upper Egypt governorates. Availability of cultivated lands, accordingly green fodder was an imperative reason to reduce production costs and increase income (Mekdaeng *et al*., 2011). Achieving feed efficiency makes of 10% approximately reduction in the total variable costs (Limsombunchai and Kao-ian, 2010). Poor feed resources, long periods for draft service and elderly age at slaughtering were determined as factors affecting beef cattle production under mixed crop livestock systems. Practices followed by the producers need to be adopted; they contribute to proving the subsistence to market- oriented systems (Yesihak, 2023). Skujina and Pilvere (2024) ascertain reasons of production input prices increase to Russian invasion of Ukraine. Prices have become the key element to the consumers' market choices due to fluctuation and instability of geopolitical situation. Inhibited purchasing power of the consumer prompts decision makers to initiate framework raising production rates, and compensates for steady increase of consumption.

Table 5. Costs, income and profitability of cattle and buffalo meat production

Variable	Cattle	Buffalo
Costs LE/ fattened calf		
Average calf purchasing price	23454	17000
Concentrates	30232	28200
Veterinary	4700	6300
Labor	2548	1900
Income LE/ fattened calf		
Average calf selling price	69750	58500
Total profit LE/ fattened calf	8816	5100

CONCLUSION AND RECOMMENDATION

Results of the study indicated that producers were facing a shortage in production requirements stand for decline of feed resources, animal labor sufficiency and veterinary treatment supplies, a weakness in foundation as producers rely on self- financing to provide their inputs. These features led to a shortage in livestock supply and then high meat prices. Activating role of "livestock insurance fund" appears critical for financing the producers regarding animal health and feed-stuff. Whereas the state is seeking imports from abroad to increase supply of meat, still rates of consumption exceed afforded meat quantities. Egyptian state endeavor to partnership with some central African countries to establish livestock farms to increase meat supply is praiseworthy, although insuring that animals are free from infection and diseases transmission, equally product quality and safety elements. Private sector incorporation on meat production remains necessary through investment in specialized breeds to raise production rates in view of increasing demand for meat. Government intervention to mentoring meat markets and stabilize prices impacts market infrastructure. Providing market database of fading price manipulation implied by traders and intermediaries was extremely recommended.

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سلاسل الإمداد والقيمة للحوم الحمراء

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الملخص

هدفت الدراسة إلى تعريف سلاسل القيمة لإنتاج اللحوم من الأبقار والجاموس بمحافظة المنوفية ممثلة عن منطقة دلتا النيل فى مصر, إستنتاج العوامل المؤثرة فى توازن الأسعار, إمداد اللحوم بأسعار مناسبة للمستهلكين. صممت إستمارة إستبيان لتجميع البيانات الخاصة بنظم الإنتاج القائمة. حددت العوامل المؤثرة فى أسعار اللحوم بإستخدام الطرق التحليلية. كان لمستوى التعليم للمنتجين وحجم المزرعة تأثيرا معنويا ($P<0.0001$) فى حجم القطيع, بينما لم يكن هناك تأثيرا معنويا لعامل الخبرة لدى المنتجين. قدرت الربحية لعجول التسمين ب ٨٨١٦ جنيه للأبقار و ٥١١٠ جنيه للجاموس. مثلت الأعلاف المركزة أعلى تكلفة بواقع ٣٠٢٣٢ جنيه خلال فترة التسمين. نمط التسمين لإنتاج ٤٥٠ كجم وزن حى (كندوز) كان المتبع من قبل المنتجين حيث هو المفضل للمستهلك ويباع بسعر مجزي للمنتج. سجلت أسعار اللحوم ٣٦٠ جنيه/ كجم للمستهلك بالمقارنة بمتوسط ١٤٥ جنيه للكيلوجرام قائم من الأبقار على مستوى المنتج. سجلت أسعار اللحوم من الجاموس ٣٦٠ جنيه, ١١٦,٢٥ جنيه على مستوى المستهلك والمنتج, على الترتيب. أظهرت نتائج الدراسة نقص مدخلات الإنتاج, القطعان الحيوانية ومن ثم إرتفاع أسعار اللحوم. سجلت أهمية دخول القطاع الخاص فى منظومة إنتاج اللحوم, وأيضا دور "صندق التأمين على الماشية" لتمويل الأعلاف والعلاجات الحيوانية. التدخل الحكومى لمراقبة أسواق الماشية بالنظر إلى تثبيت أسعار اللحوم يدعم البنية التحتية للسوق. إنشاء قاعدة بيانات للأسواق لمنع التلاعب فى الأسعار من قبل التجار والوسطاء هو من الأهمية بمكان.

الكلمات الدالة: الأبقار, الجاموس, إنتاج اللحوم, سلاسل الإمداد والقيمة