

## Determination of By-Product Economic Values for Slaughtered Cattle and Sheep

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### Summary

In this study, it is aimed to investigate the economic values of by-products obtained as a result of slaughter and to determine of these values within the purchase of carcass for slaughtered cattle-buffalo and lamb-sheep. Cutting records for the years 2007 and 2008 of a slaughterhouse pertaining to the private sector and the weight and price data concerning the carcass and by-products obtained from the slaughtered cattle-buffalo and the lamb-sheep constitute the material of the study. The average by-product income obtained from a carcass for 2007 and 2008 has been calculated respectively as 117.91 TL and 141.23 TL for cows; 189.59 TL and 237.08 TL for calves-bullocks; 125.31 TL and 173.88 TL for heifers; 107.41 TL and 146.35 TL for buffalos; 14.00 TL and 17.00 TL for lambs; 14.00 TL and 16.00 TL for sheep. Additionally, the share of average incomes of by-products in the average purchase price per carcass has been determined for 2007 and 2008 respectively as 7.30% and 7.78% for cows, 7.86% and 8.24% for calves-bullocks, 7.93% and 8.57% for heifers; 8.08% and 7.67% for buffalos; 11.71% and 13.02% for lambs; 10.15% and 9.56% for sheep. Besides, for the research period the rate of total monetary value of destroyed by-products within the total by-product income has been calculated as average 0.96% for lamb-sheep and 0.89% for cattle-buffalo. Finally, together with the increasing density of slaughter of the industrial meat enterprises in Turkey and as a result of their being operated with efficient and high-capacity utilization, for all species of slaughtered animals, also the possibility of collecting, processing and evaluating economically of all kinds of edible and inedible animal by-products shall be ensured. In the study, it has been determined that a substantial part of the amount the enterprises have paid for the carcass purchase has been obtained as the by-product income.

**Keywords:** Animal by-product, By-product income, Economic loss, Meat industry, Carcass

## Kasaplık Sığır ve Koyunda Yan Ürün Ekonomik Değerlerinin Belirlenmesi

### Özet

Bu araştırmada; kasaplık sığır ve koyunlarda kesim süreci sonucu elde edilen yan ürünlerin ekonomik değerleri ve bu değerlerin karkas alımı içindeki payının tespit edilmesi amaçlanmıştır. Araştırmanın materyalini, özel sektörde ait bir et kombinasının 2007 ve 2008 yıllarına ait kesim kayıtları ile kesimi yapılan küçükbaş ve büyükbaş hayvanlardan elde edilen karkas ve yan ürünlerle ilişkin ağırlık ve fiyat verileri oluşturmuştur. Bir karkastan elde edilen ortalama yan ürün geliri 2007 ve 2008 yıllarında sırasıyla; inekte 117.91 TL ve 141.23 TL; dana-tosunda 189.59 TL ve 237.08 TL; düvede 125.31 TL ve 173.88 TL; mandada 107.41 TL ve 146.35 TL; kuzuda 14.00 TL ve 17.00 TL; koyunda 14.00 TL ve 16.00 TL hesaplanmıştır. Ayrıca, bir karkas ortalama alım bedeli içerisinde yan ürün ortalama gelirinin payı 2007 ve 2008 yıllarında sırasıyla; inekte %7.30 ve %7.78; dana-tosunda %7.86 ve %8.24; düvede %7.93 ve %8.57; mandada %8.08 ve %7.67; kuzuda %11.71 ve %13.02; koyunda %10.15 ve %9.56 olarak tespit edilmiştir. Diğer taraftan araştırmanın yapıldığı dönem için toplam imha edilen yan ürünlerin maddi değerinin, toplam yan ürün içerisindeki oranı küçükbaş hayvanlarda ortalama %0.96, büyükbaş hayvanlarda %0.89 olarak hesaplanmıştır. Sonuç olarak; Türkiye'deki et sanayi işletmelerinin artan kesim yoğunluğu ile birlikte verimli şekilde ve yüksek kapasite kullanımı ile çalışması neticesinde, bütün kasaplık hayvan türlerinde her türlü yenilebilir ve yenilemeyecek hayvansal yan ürünlerin toplanması, işlenmesi ve ekonomik olarak değerlendirilmesi olanağı da sağlanabilecektir. Araştırmada, işletmelerin karkas alımları için ödedikleri meblağın önemli bir kısmının yan ürün geliri olarak elde edildiği saptanmıştır.

**Anahtar sözcükler:** Hayvansal yan ürün, Yan ürün geliri, Ekonomik kayıp, Et sanayi, Karkas

## INTRODUCTION

Animal by-products, along with their consumptions as food directly, are the products processed and evaluated in various ways for human utilization and also constitute an important economic income source for the national economy and livestock enterprises <sup>1,2</sup>.

In cattle 39% of the live weight comprises of organs, fat tissue, bone, and blood <sup>2</sup>. Besides, the average rate of boneless meat and some by-products obtained from the cattle to the live weight has been reported as such: 34-35% for meat, 28-30% for bones, 6-7% for raw hide and semi-processed hide, 2.4-6% for blood, 0.6% for horn and nails, 0.08-0.12% for brain, 0.03% for spinal cord, 0.02% for ears, 0.03-0.32% for cheeks, 0.3% for tongue, 2-3% for rumen, 0.5-1% for small intestine, 0.5-1% for large intestine, 2-3% for other digestive tracts, 1-4.5% for liver, 0.3-0.5% for heart, 0.07% for arteries and veins, 0.14-0.48% for kidneys, 0.4-0.8% for lungs, 0.1-0.27% for spleen, 0.06-0.27% for pancreas, 0.06% for bile, 1-10% for animal fats, 0.18% for penis, 0.9% for hair, tooth, and other by-products <sup>3-6</sup>.

The rates given above are approximate values and can differentiate according to the race, gender, age, live weight, body condition score, and the techniques of care, feed, and slaughter <sup>2,5-9</sup>.

Edible by-products obtained from the slaughtered animals except meat may be classified under the titles of liver, heart, tongue, kidneys, and brain; both edible and inedible by-products may be classified as the headings under lungs, spleen, small and large intestines, rumen, bladder, esophagus, testicles, uterus, bone, blood, pancreas, animal fats, lip, ear, hide; inedible by-products may be classified as horn, nails, teeth, bile, wool, and fetus <sup>3,6</sup>. The edibility of the animal by-products differentiates according to the nutritional habits, traditions, religious beliefs, and cultures of the societies <sup>4</sup>.

At the end of the slaughter process, the products with high economic values that are classified under the main title of by-products and offal including carcass are also obtained from slaughtered animals. Consumable internal organs of the slaughtered animals are called as offal. In Turkey the organs such as brain, tongue, heart, liver, spleen, and kidney obtained from slaughtered animals are intended for fresh human consumption but rumen, trotter, head, and tail fat are intended for the consumption only after these are subject to preliminary processing. The offal may be used as raw material in meat products like it is intended for fresh human consumption <sup>10</sup>.

As a result of technological advances, the use of animal by-products as raw materials and auxiliary products in different areas has resulted in great increase in value of the final products. Today more than twenty industrial branches have been using animal by-products intensively <sup>6</sup>.

In the red meat industry the by-products obtained during carcass production provide input for the industries of pharmacy, cosmetics, food, hygiene, and feed etc. and have important economic values. In order to evaluate these products in economic sense and create efficiently more added value for the concerned industry, increasing the number of the slaughtered animals in the slaughterhouse and making the production of animal by-products economically profitable have a great importance. Thanks to the increase in the profitability of the slaughterhouses that utilize by-products, the investments of the business managers intended for the evaluation of the by-products shall also increase. Moreover, putting the by-products to good use in the slaughterhouses decreases the polluting effects of the by-products on the environment <sup>4,11</sup>.

This research was performed to investigate the economic values of by-products obtained as a result of slaughter and to determine of these values within the purchase of carcass for slaughtered cattle-buffalo and lamb-sheep. Within this scope, according to purchase price of carcass to what extent the sales incomes concerning the by-products of slaughtered animals return to the enterprise was determined. In determining the purchase price of carcass in terms of industry, along with the other market factors, knowing the share of by-product income within the purchase price of carcass is a great significance.

## MATERIAL and METHODS

Cutting records for the years 2007 and 2008 of a slaughterhouse pertaining to the private sector and the weight and the price data concerning the carcass and the by-products obtained from slaughtered cattle-buffalo and lamb-sheep constitute the material of the study. In addition, the records of commodity exchange market and the directorate of agriculture of the province, in which the slaughterhouse is located, have also been utilized.

The slaughterhouse, from which the data have been obtained, has an established slaughtering capacity based on 150 cattle-buffalo/day and 1.500 sheep-goat/day. The slaughterhouse which produces red meat on his own requirement or subcontract in operating the Marmara Region provides the large majority of slaughtered animals from breeders and cattle fattening enterprises in the provinces of Bursa, Balikesir, Sakarya, Ankara, and Afyon.

Within the scope of the research the data concerning carcass weights of the slaughtered animals in the slaughterhouse according to the species, gender, and age group, the purchase prices of carcass, and the sales prices of the by-products utilized and the quantities of the destroyed by-products have been collected.

In the analysis of the research data the Microsoft Excel

2007 program has been used. The monetary values of the animal products in the research have been given with the current prices of the year, in which the research has been done.

## RESULTS

Within the scope of the research, findings concerning total and average carcass weights of the slaughtered animals and the purchase price of carcass are given *Table 1*.

As can be seen in *Table 1*, the slaughterhouse produced a total of 7.347 tons and 7.515 tons of red meat for the years 2007 and 2008 respectively. In the year 2007 92.08% and in the year 2008 95.85% of this production quantity have been obtained from cattle-buffalo. In 2008 the slaughterhouse's purchase price of carcass showed an increase at the rate of 8.89% for lamb, 25% for sheep, 9.33% for cow, 14.94% for calf-bullock, 5.88% for heifer, and 9.33% for buffalo in comparison with the year 2007. The slaughterhouse purchased carcass at the cost of about 62 million TL in the year 2007 and about 68 million TL in the year 2008 from the market.

Findings concerning by-products and incomes to be obtained as a result of the cutting of slaughtered cattle-buffalo are presented in *Table 2*.

As it can be observed in *Table 2*, the average by-product income obtained from a carcass for 2007 and 2008 has been calculated respectively as 117.91 TL and 141.23 TL for cows; 189.59 TL and 237.08 TL for calves-bullocks; 125.31 TL and 173.88 TL for heifers; 107.41 TL and 146.35 TL for buffalos. Again in the same table, the share of average incomes of by-products in the average purchase price per carcass has been determined for 2007 and 2008 respectively as 7.30% and 7.78% for cows, 7.86% and 8.24% for calves-bullocks, 7.93% and 8.57% for heifers; 8.08% and 7.67% for buffalos.

**Table 1.** Findings concerning total and average carcass weights of the slaughtered animals and the purchase price of carcass

**Tablo 1.** Kesimi yapılan kasaplık hayvanlarda toplam ve ortalama sıcak karkas ağırlığı ile karkas alım bedeline ilişkin bulgular

Animal Species	Year	Quantity (Head)	Total Carcass Weight (Kg)	Average Carcass Weight (Kg)	Average Purchase Price of Carcass (Kg/TL)	Total Purchase Price of Carcass (TL)	Average Purchase Price per Carcass (TL)
Lamb	2007	34 234	454 483	13.276	9.00	4 090 347.00	119.48
Sheep		5 532	127 176	22.989	6.00	763 056.00	137.93
Cow		6 575	1 415 005	215.210	7.50	10 612 543.13	1 614.08
Calf-Bullock		18 339	5 083 017	277.170	8.70	44 222 247.90	2 411.38
Heifer		1 424	264 795	185.952	8.50	2 250 757.50	1 580.59
Buffalo		12	2 128	177.333	7.50	15 960.00	1 330.00
Lamb	2008	12 910	171 875	13.313	9.80	1 684 375.00	130.47
Sheep		6 270	139 485	22.246	7.50	1 046 137.50	166.85
Cow		14 055	3 112 114	221.424	8.20	25 519 334.80	1 815.68
Calf-Bullock		11 405	3 282 939	287.851	10.00	32 829 390.00	2 878.51
Heifer		3 518	792 693	225.325	9.00	7 134 237.00	2 027.92
Buffalo		67	15 656	233.672	8.20	128 379.20	1 916.11

On the other hand, the average by-product incomes obtained from cattle-buffalo over the years are constituted as follows: 47.48% offal, 31% hide and 21.52% fat and other by-product incomes.

Findings concerning by-products and incomes to be obtained as a result of the cutting of slaughtered lamb-sheep are showed in *Table 3*.

As it can be observed in *Table 3*, the average by-product income obtained from a carcass has been calculated for 2007 and 2008 respectively as 14.00 TL and 17.00 TL for lambs; 14.00 TL and 16.00 TL for sheep. The share of average by-product incomes within the average carcass purchase price for 2007 and 2008 has been determined respectively as 11.71% and 13.02% for lambs; 10.15% and 9.56% for sheep.

On the other hand, the average by-product incomes obtained from lamb-sheep over the years are constituted as follows for lambs as 44.96% hides, 35.50% offal and 19.54% intestines and fats. For sheep it has been constituted in this manner: 40.18% fats, 29.91% offal and 29.91% hides and intestines.

The rate of destroyed by-products at slaughterhouse and the total by-product loss over by-product incomes (%) are presented in *Table 4*.

As it can be seen in *Table 4*, the monetary value of destroyed by-products in 2007 was calculated as 5.343 TL for lamb-sheep and 45.086 TL for cattle-buffalo and in 2008 it was calculated as 2.813 TL for lamb-sheep and 48.006 TL for cattle-buffalo. In other words, the total economic loss resulting from the by-product disposal of the enterprise was 50.429 TL in 2007 and 50.819 TL in 2008.

Furthermore, the rate of the monetary value of the total disposed by-products in the total income of by-

**Table 2.** Findings concerning some by-products and incomes to be obtained as a result of the cutting of slaughtered cattle-buffalo**Tablo 2.** Kasaplık büyükbaş hayvanların kesimi sonucu elde edilen bazı yan ürünler ve gelirlerine ilişkin bulgular

Parameters			Offal (kg)*1	Hide (kg)*2	Intestines (Head)	Bones (kg)*3	Kidney Fat (kg)*4	Pelvic Fat (kg) *5	Internal Fat (kg)*6	Edible Tail Vertebra (kg)*7	Penis (Pieces)	Total (Head)	By-Product Income/ Average Carcass Purchase Price (%)
Cow	2007	A	0.28	1.50	5.25	0.09	1.60	1.60	1.60	2.00	-	-	-
		B	60.26	38.74	5.25	0.36	6.40	4.80	1.60	0.50	-	117.91	7.30
		C	51.11	32.85	4.45	0.31	5.43	4.07	1.36	0.42	-	100.00	
	2008	A	0.30	1.60	7.50	0.09	3.20	3.00	2.00	2.50	-	-	-
		B	66.43	42.51	7.50	0.36	12.80	9.00	2.00	0.63	-	141.23	7.78
		C	47.04	30.10	5.31	0.25	9.06	6.37	1.42	0.44	-	100.00	-
Calf-Bullock	2007	A	0.33	1.50	5.25	0.09	1.60	1.60	1.60	2.00	0.50	-	-
		B	91.47	62.36	5.25	0.54	16.00	6.40	6.40	0.67	0.50	189.59	7.86
		C	48.25	32.89	2.77	0.28	8.44	3.38	3.38	0.35	0.26	100.00	-
	2008	A	0.36	1.60	7.50	0.09	3.20	3.00	2.00	2.50	0.50	-	-
		B	103.6	69.08	7.50	0.54	32.00	15.00	8.00	0.83	0.50	237.08	8.24
		C	43.71	29.14	3.16	0.23	13.50	6.33	3.37	0.25	0.21	100.00	-
Heifer	2007	A	0.33	1.50	5.25	0.09	1.60	1.60	1.60	2.00	-	-	-
		B	61.36	41.83	5.25	0.36	9.60	4.80	1.60	0.50	-	125.31	7.93
		C	48.97	33.39	4.19	0.29	7.66	3.83	1.28	0.40	-	100.00	-
	2008	A	0.36	1.60	7.50	0.09	3.20	3.00	2.00	2.50	-	-	-
		B	81.12	54.08	7.50	0.36	19.02	9.00	2.00	0.63	-	173.88	8.57
		C	46.65	31.10	4.31	0.21	11.04	5.18	1.15	0.36	-	100.00	-
Buffalo	2007	A	0.28	1.00	5.25	0.09	1.60	1.60	1.60	2.00	-	-	-
		B	49.65	35.47	5.25	0.54	9.60	4.80	1.60	0.50	-	107.41	8.08
		C	46.23	33.02	4.89	0.50	8.94	4.47	1.49	0.47	-	100.00	-
	2008	A	0.30	0.80	7.50	0.09	3.20	3.00	2.00	2.50	-	-	-
		B	70.10	37.39	7.50	0.54	19.20	9.00	2.00	0.63	-	146.35	7.64
		C	47.90	25.55	5.12	0.37	13.12	6.15	1.37	0.43	-	100.00	-

A=Unit Price (TL); B=Average By-product Income Per Carcass (TL); C=Share within Total By-product Income (%)

\*1=Average Carcass Weight x Unit Price; \*2=for Cow, Average Carcass Weight x 0.12 x Unit Price; for Calf-Bullock and Heifer, Average Carcass Weight x 0.15 x Unit Price; for Buffalo, Average Carcass Weight x 0.20 x Unit Price; \*3=Total Weight on all Four Limbs for Cows and Heifer, 4 kg; Calf-Bullock and Buffalo, 6 kg; \*4=Kidney Fat for Cow, 4 kg; for Calf-Bullock, 10 kg; for Heifer and Buffalo, 6 kg; \*5=Pelvic Fat for Cow, Heifer and Buffalo, 3 kg; for Calf-Bullock, 4 kg;

\*6=Internal Fat for Cow, Heifer and Buffalo, 1 kg; for Calf-Bullock, 4 kg; \*7=for Males, 1/3 kg; for Females 0.250 kg

**Table 3.** Findings concerning by-products and incomes to be obtained as a result of the cutting of slaughtered lamb-sheep**Tablo 3.** Kasaplık küçükbaş hayvanların kesimi sonucu elde edilen bazı yan ürünler ve gelirlerine ilişkin bulgular

Parameters			Offal (Head)	Hide (Head)	Intestine (Head)	Fat (Head)	Total (Head)	By-product Income/ Average Carcass Purchase Price (%)
Lamb	2007	A	5.00	6.00	2.00	1.00	14.00	11.71
		B	35.71	42.86	14.29	7.14	100.00	-
	2008	A	6.00	8.00	2.00	1.00	17.00	13.02
		B	35.29	47.06	11.76	5.88	100.00	-
Sheep	2007	A	4.00	2.00	2.00	6.00	14.00	10.15
		B	28.57	17.29	14.29	42.86	100.00	-
	2008	A	5.00	3.00	2.00	6.00	16.00	9.56
		B	31.25	18.75	12.50	37.50	100.00	-

A=Average By-product Income per Carcass (TL); B=Share within Total By-product Income (%)

**Table 4.** The rate of destroyed by-products at slaughterhouses and the total by-product loss over by-product incomes (%)**Tablo 4.** Kombinada imha edilen yan ürünler ve toplam yan ürün kaybının yan ürün gelirine oranı (%)

Parameters			Liver	Heart	Kidney	Rumen	Intestines (Head)	Head *3	Value of Total Destroyed By-products -X (TL)	X/By-Product Income (%)
Lamb and Sheep*1	2007	A	7.00	4.00	7.00	1.00	3.25	1.00	-	-
		B	0.500	0.150	0.200	0.700	-	-	-	-
		C	1 346	149	16	33	153	0	-	-
		D	4 711	89.40	22.40	23.10	497.25	0	5 343	0.96
	2008	A	7.00	4.00	7.00	1.00	3.25	1.00	-	-
		B	0.500	0.150	0.200	0.700	-	-	-	-
		C	415	96	26	23	383	6	-	-
		D	1 452.50	57.60	36.40	16.10	1244.75	6.00	2 813	0.96
Cattle and Buffalo*2	2007	A	6.00	3.00	2.00	0.80	5.25	2.25	-	-
		B	6.000	1.350	0.600	6.000	-	14.000	-	-
		C	802	388	310	348	1 656	124	-	-
		D	28 872	1 571.40	372.00	1 670.40	8 694.00	3 906	45 086	0.88
	2008	A	6.00	3.50	2.00	0.80	7.50	2.25	-	-
		B	6.000	1.350	0.600	6.000	-	14.000	-	-
		C	1 040	273	125	111	982	39	-	-
		D	37 440	1 289.93	150	532.80	7 365	1 228.50	48 006	0.90

A=Unit Price (Kg/TL); B=Average Weight Per Carcass (Kg); C=Quantity (Pieces); D=Total (TL); \*1=Lamb and Sheep; \*2=Cow, Calf-Bullock, Heifer and Buffalo, \*3=Head of Lamb and Sheep

products was calculated as 0.96% in 2007 and 2008 for lamb-sheep and 0.88% and 0.90% for cattle-buffalo in 2007 and 2008 respectively.

## DISCUSSION

The slaughterhouse performed 1.28% of the red meat production in Turkey in 2007 and 1.56% in 2008. On the other hand the slaughterhouse performed 0.68% of lamb-sheep and cattle-buffalo slaughtering in Turkey in 2007 and 0.60% in 2008<sup>12</sup>. When the facts that the economic loss of the slaughterhouse from by-product disposal is 50.819 TL and it has performed 0.60% of official slaughters is taken into consideration, it can be estimated that economic losses determined by the study due to the disposal of by-products for the whole of Turkey is 8.469.833 TL.

However, when the high rate of unrecorded slaughters, the fact that the meat slaughtering firm covered by the study only obtains slaughtered animals from certain provinces and the prevalence of animal diseases vary regionally and locally are taken into account, it can be considered that the total economic losses in relation to destroyed by-products calculated for Turkey are far higher across the country.

The study performed by Terry et al.<sup>2</sup>, it has been put forward that the economic values of edible and inedible by-products, constitute 9% to 12% of the live value of

cattle and Apple et al.<sup>7</sup>, expressed that edible by-product incomes constitute 6% to 8% of the live value of cattle.

Okerman and Hansen<sup>5</sup>, expressed in their study that a portion of 7% to 12% of slaughterhouse incomes were obtained from by-products.

In the study it has been determined that the share of average by-product incomes within the average purchase price in 2007 and 2008 was respectively 7.30% and 7.78% for cows, 7.86% and 8.24% for calves and bullocks, 7.93% and 8.57% for heifers 8.08% and 7.67% for buffalos, 11.71% and 13.02% for lambs and 10.15%, and 9.56% for sheep. When it is taken into consideration that some by-products such as blood, bile, glands etc. have not been assessed, it can be observed that the findings of the study overlap with the values put forward by Terry et al.<sup>2</sup>, Apple et al.<sup>7</sup> and Okerman and Hansen<sup>5</sup>.

The important aim in livestock production is to get maximum income response to minimum cost with optimum size and capacity usage<sup>13</sup>. When days of operation is considered to be 300 days<sup>6</sup>, the capacity utilization rate of the slaughterhouse in 2007 was 8.84% for lamb-sheep, 58.55% for cattle-buffalo and in 2008 it was 4.26% for lamb-sheep and 64.54% for cattle-buffalo.

The low capacity utilization ratio and the high cost of establishing and operating a rendering plant can be pointed out as the basic reasons for the absence of

a rendering plant at the slaughterhouse where the study was conducted and most private sector industrial meat enterprises in Turkey. Rendering plants enable the utilization of some inedible by-products, prevent the pollution impact of these by-products on the environment, and reduce the operation load of waste-water treatment plants.

In the slaughterhouse where the research has been conducted, whilst the share of the average by-product income within the average purchase price of carcass was 10.93% for lamb-sheep and 7.79% for cattle-buffalo in average for the year 2007, it was 11.29% for lamb-sheep and 8.06% for cattle-buffalo for the year 2008. This situation asserts that the rate of by-product income to the average purchase price of carcass is higher proportionately in lamb-sheep than in the cattle-buffalo.

Finally, together with the increasing density of slaughter of the industrial meat enterprises in Turkey and as a result of their being operated with efficient and high-capacity utilization, for all species of slaughtered animals, also the possibility of collecting, processing and evaluating economically of all kinds of edible and inedible animal by-products shall be ensured. Thereby, both the income of the meat industry enterprises obtain from the animal by-products shall increase and the share of this income within the total operating income shall rise proportionately. In the study it has been determined that a substantial part of amount the enterprises have paid for the carcass purchase has been obtained as the by-product income.

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