Study on some economic indicators, characterizing the production efficiency of raising Ile de France sheep
I. Comparative analysis of economic results in different production units

Stanimira Slavova[1] and Evgeniya Achkakanova[2]

[1]*Agricultural Institute, 6000 Stara Zagora, Bulgaria*
[2]*Institute of Animal Science, 2232 Kostinbrod, Bulgaria*
[*]*Corresponding author:* mirka_sl@abv.bg

Abstract

Slavova, S. & Achkakanova, E. (2021). Study on some economic indicators, characterizing the production efficiency of raising Ile de France sheep. I. Comparative analysis of economic results in different production units. *Bulg. J. Agric. Sci., 27 (5)*, 838–845

The object of research was to estimate the main economic indicators related to production efficiency – revenues, costs, profit and profitability of Ile de France sheep farms in three different regions of Northern Bulgaria for a 3-year period (2018-2020). Production system was semi-intensive, stable-pasture, with feeding in winter and grazing in summer. Profit was calculated as a difference between total revenues and total costs, and profitability rate as a ratio between profit and total costs. Data were processed using a mathematical-statistical model and Excel computer program. Profit and profitability were calculated negative on Farm 2 – BGN -51.62 and -8.97%, respectively, and positive on Farm 1 (BGN 250.27 and 57.28%) and Farm 3 (BGN 59.83 and 23.98%). Based on the obtained results, it can be summarized that the farm size does not determine the amount of revenues, but rather animal productivity, applied technologies and management strategy. The availability of pastures and feed self-production also contribute to higher economic results on farms. In order to achieve economically efficient production, it is necessary to find the optimal ratio between the costs of purchasing and raising highly productive animals and the revenues from sales, taking into account the risk of investment as well.

Keywords: Ile de France sheep; revenues; costs; profit; profitability

Introduction

Meat sheep breeds stand out with their early-maturity, high prolificacy and out-of-season mating ability, which play a crucial role for an efficient selection (Bromley et al., 2001). A main biologic and economic advantage of breeding sheep for meat is the high growth intensity of lambs associated with the genetic ability of the animals for better absorption of nutrients from feed.

Breeding meat sheep in most European countries relies mainly on grazing pastures and high prolificacy of the ewes to achieve a favorable ratio of income to production costs,

having in mind that profitability of meat sheep farms is often lower that of the dairy farms (Cabaret et al., 2017). Due to the extremely good climatic conditions and the availability of pastures almost all year round, the United Kingdom is the leader in the number of meat sheep and Ireland is the largest net exporter of sheep meat in the European Union (SheepNet, European Knowledge Exchange).

In the Mediterranean countries, economic efficiency of meat farms is mainly due to the high performance of the animals and to a large extent to own feed production, as the role of the rearing system, which is in most cases extensive, should not be neglected too (Ripoll-Bosch et al., 2012). Sub-

sidies also play a significant role for the final economic outcome, as trying to compensate for the price of lambs and difficulties in their production in disadvantaged areas (Benoit & Laignel, 2007). However, farmer income is still among the lowest in the sector, and increasing farm size is not able to increase it significantly (Benoit & Laignel, 2011).

The French meat sheep breed Ile de France is one of the most widespread in Europe. According to Harcsa et al. (2004), the animals of the breed show very good results in terms of their reproductive characteristics, due to their poly-cyclicity and ability to lamb more than once a year, which guarantees higher revenues and efficient production. In France, the breed is usually bred under intensive conditions in the plains where cereals are grown. It provides farmers with excellent opportunities to realize an added value of grain production by fattening lambs. The ability of females to reproduce more than once a year also unlocks opportunities to apply different lambing systems /1 or 2 lambing campaigns per year/ to meet market demand (France Génétique Elevage).

The Ile de France breed was imported to our country in the 70s of the last century and is currently pure or crossbred. In 2005, the "Ile de France Breeding Association in Bulgaria" (www.iledefrance-bg.com) was established, as its main function up to now is to support the efforts of its members to increase the economic efficiency of their farms, to contribute to increasing genetic progress and to ensure breed purity (www.iledefrance-bg.com). By 2021, the number of Ile de France sheep in the country exceeds 8 000, and under selection control, entered in the Register of the Executive Agency for Selection and Reproduction in Animal Husbandry are 6 593 heads /"Ile de France Breeding Association in Bulgaria"/.

In recent years, a number of authors have studied the productive traits and meat qualities of the breed (Bonev et al., 2001; Slavov et al., 2004; Raycheva et al., 2004; Raycheva & Ivanova, 2005; Laleva et al., 2006; Metodiev et al., 2008; Ivanova & Raicheva, 2015; Dimova, 2019; Laleva et al., 2020; Achkakanova & Staikova, 2019 a, b; Staikova & Achkakanova, 2019; Achkakanova et al., 2020), as well as the economic efficiency of breeding purebred animals (Popova et al., 2007a, b; Slavova, 2020; Stankov, 2020) and crossbreeds (Popova et al., 2013; Ivanov, 2019).

Despite the value and importance of the research carried out, more extensive biological and economic information is needed to establish the economic efficiency of breeding Ile de France sheep under current market conditions and productive performance levels.

Thus, the purpose of the present research was to estimate the value of the main economic indicators related to production efficiency – revenues, costs, profit and profitability, of Ile de France sheep farms in Bulgaria.

Material and Methods

The study was conducted on Ile de France sheep farms in three different regions of Northern Bulgaria. Production system on the farms was semi-intensive, stable-pasture, with feeding in winter and grazing in summer. The three farms studied had a membership in a breeding organization – "Association for breeding of the Ile de France breed in Bulgaria". Data on the production system adopted, on the animal performance and on the financial issues were provided by the owners and the accounting for a period of 3 years (2018-2020).

Tables 1, 2 and 3 present, respectively, the total number of animals in flock by categories, their productive characteristics and the main production indicators by farms and years.

Based on the financial data provided, revenues, costs, profit and profitability before and after subsidies were calculated. Profit was calculated as the difference between total

Table 1. Number of animals on the farms

Categories	Farm 1			Farm 2			Farm 3		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
Lambs	397	426	298	590	460	420	420	290	290
Ewe and ram lambs	30	15	20	70	90	70	0	41	0
Ewes	239	240	191	530	410	390	500	305	305
Rams	23	11	11	25	20	20	32	15	14

Table 2. Productive characteristics of the animals on the farms

Productive traits	Farm 1			Farm 2			Farm 3		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
Live weight, kg	75	75	75	75	75	75	65	68	70
Lambs born per ewe	1.66	1.78	1.56	1.2	1.2	1.2	1.25	1.25	1.25
Wool production, kg	3.7	3.8	3.8	4	4	4	3.5	3.6	3.3

Table 3. Basic parameters of production

Parameters	Farm 1	Farm 2	Farm 3
Live weight of lambs at birth, kg	5-6	4	3-3.5
Live weight of lambs at weaning, kg	27	28	13-15
Weaning age, days	60	75-80	30-40
Annual repair of the flock, %	20	20	15
Intensity of breeding process	once per year	twice per 3 years	once per year
Artificial insemination	yes	no	no
Hormonal treatment	yes	no	yes
Conception rate, %	96	85-90	90
Feed self-sufficiency	yes	yes	yes
Purchase of feed	no	yes	no
Number of workers	3	6	2
Purchase of female animals	From France and own replacement	no	no
Purchase of male animals	From France at the age of 10 months	From outside flocks in Bg	From outside flocks in Bg

revenues and total costs, and profitability as a ratio between profit and total costs. Data were processed with a mathematical-statistical model and Excel computer program. Economic indicators were reported in total per farm and per ewe.

Results and Discussion

Revenues on farms were from the sale of lambs, ewe and ram lambs, ewes and rams, wool and subsidies (Table 4).

The price of lambs for slaughter per kg of live weight varied from BGN 5.50 to BGN 8 (without VAT incl.) depending on various factors – season, production volume and specifics of the sale and customer. Revenues from breeding lambs were reported only on Farm 1 and Farm 2. On Farm 3 female breeding animals were sold at older ages. Within the "Association for Breeding of the Ile de France breed in Bulgaria", purchase prices of breeding progeny have been adopted and approved to BGN 10 and BGN 12 per kg live weight, respectively for female and male lambs. In the calculation, the first farm reported the highest income from lambs, which was associated with the higher level of fertility, prolificacy and growth intensity.

Farms sold breeding lambs, ewes and rams, which indicated for the increased market demand of animals of the breed. Farm 1 generated the most significant income from breeding rams, given the fact that the males used on the farm for reproduction were imported from France, with pedigrees and certificates guaranteeing their high genetic value.

Incomes from wool were small, mainly due to the low price, ranging from BGN 0.84 per kg to BGN 1.40 per kg.

Revenues from sales were the highest in Farm 1 – BGN 162 154.33, followed by Farm 2 and Farm 3 with BGN 113 400.66 and BGN 99 568, respectively. This was due both to the higher productivity of the animals and to the applied

methods for intensification of the breeding process. Farmer's marketing strategy and the purchase price of production also played an important role to the obtained results.

Farms received subsidies for ewes under selection control, "De minimis" state aid, payments for pastures and agri-environment payments (only for Farm 2).

Total revenues, on average for the analyzed period, was the highest for the first farm – BGN 193 818.06, with a not significant advantage over the second farm (BGN 188 500.25). On the third farm incomes were BGN 121 353.66. Revenues per ewe were much higher for the first sheep farm – BGN 871.04, compared to the others – BGN 426.96 (Farm 2) and BGN 335.72 (Farm 3).

Fixed costs included costs for selection, accounting and pasture rent. They were significantly higher for Farm 2 (BGN 17 000 – 18 000 per year), mainly due to the larger amount, paid for pastures (Table 5).

Animal feeding and maintenance costs usually have the highest relative share in the structure of variable costs. The value of the feed costs significantly prevailed in the second farm, amounted to BGN 259.74 per ewe, as feed was partially purchased. Labour costs were the highest in Farm 1 – BGN 181.86 per ewe, being lower for Farm 2 (BGN 118.21) and Farm 3 (BGN 78.19).

Breeding animals were purchased on the farms – both males and females on Farm 1, and only males on the rest farms. Thus, the value of the costs for purchasing animals on the first farm was significantly higher – BGN 81 502.20.

Total costs were estimated the lowest for Farm 3 – BGN 98 697.53, and the highest for Farm 2 – BGN 226 371.96. However, the total costs per ewe were most significant for the first farm – BGN 620.77.

Profit and profitability before subsidies were negative for Farm 2, meaning that the farm was unprofitable, based on

Table 4. Revenues on farms

Revenues, BGN/EUR	Farm 1						Farm 2						Farm 3					
	2018		2019		2020		2018		2019		2020		2018		2019		2020	
	BGN	EUR	BGN	EUR	BGN	EUR	BGN	EUR	BGN	EUR	BGN	EUR	BGN	EUR	BGN	EUR	BGN	EUR
1. From sold animals, BGN/EUR	170390.00	87119.02	170640.00	87246.85	141585.00	72391.26	119905.96	61306.94	88987.46	45498.57	124693.28	63754.66	122990.00	62883.79	42320.00	21637.87	131110.00	67035.48
– lambs for slaughter	35640.00	18222.44	64860.00	33162.39	22785.00	11649.79	21916.80	11205.88	22727.60	11620.44	37844.96	19349.82	61060.00	31219.48	40850.00	20886.27	43030.00	22000.89
– breeding lambs	74550.00	38116.81	53580.00	27395.02	69600.00	35585.91	44061.88	22528.48	24048.00	12295.55	33931.20	17348.75						
– ewe lambs and ewes for breeding	43200.00	22087.81	37000.00	18917.80	36200.00	18508.77	34294.94	17534.72	22750.00	11631.89	40950.28	20937.55	52930.00	27062.68	870.00	444.82	81680.00	41762.32
– ewe lambs and ewes for culling		0.00	1200.00	613.55			4466.95	2283.92	4658.54	2381.87	5416.84	2769.59						
– rams for breeding	17000.00	8691.96	14000.00	7158.09	13000.00	6646.79	14632.07	7481.26	14400.00	7362.60	6300.00	3221.14	9000.00	4601.63	600.00	306.78	6400.00	3272.27
– rams for culling							533.32	272.68	403.32	206.21	250.00	127.82						
2. From sold wool, BGN/EUR	1200.00	613.55	1400.00	715.81	1248.00	638.09	2848.48	1456.40	2058.80	1052.65	1708.00	873.29	1019.00	521.01	500.00	255.65	765.00	391.14
3. From own production sold (1+2), BGN/EUR	171590.00	87732.57	172040.00	87962.66	142833.00	73029.35	122754.44	62763.35	91046.26	46551.21	126401.28	64627.95	124009.00	63404.79	42820.00	21893.52	131875.00	67426.62
4. From subsidies, BGN/EUR	31134.40	15918.77	31886.40	16303.26	31970.40	16346.21	99669.40	50960.16	56604.58	28941.46	69024.80	35291.82	21825.00	11158.95	20670.00	10568.40	19814.00	10130.74
– for selection	17208.00	8798.31	17760.00	9080.54	16044.00	8203.17	59452.34	30397.50	32381.78	16556.54	30000.00	15338.76	16590.00	8482.33	20670.00	10568.40	22862.00	11689.15
– "Agroecology and climate"							10000.00	5112.92	8108.18	4145.65	7000.00	3579.04						
– "De minimis"	1200.00	613.55	1400.00	715.81	3200.00	1636.13	8220.00	4202.82			3653.00	1867.75	5235.00	2676.61				
– for pastures	12726.40	6506.90	12726.40	6506.90	12726.40	6506.90	21997.06	11246.92	16114.62	8239.27	28371.80	14506.27						
5. TOTAL (3+4), BGN/EUR	202724.40	103651.34	203926.40	104265.91	174803.40	89375.56	222423.84	113723.50	147650.84	75492.68	195426.08	99919.77	145834.00	74563.74	63490.00	32461.92	154737.00	79115.77
6. TOTAL/ewe	848.22	433.69	849.69	434.44	915.20	467.93	419.67	214.57	360.12	184.13	501.09	256.20	291.67	149.13	208.16	106.43	507.33	259.39
- on average (BGN)	871.04						426.96						335.72					
- on average (EUR)*	445.36						218.30						171.65					

*EUR=1.95583BGN

Table 5. Costs on farms

Costs. BGN/EUR	Farm 1						Farm 2						Farm 3					
	2018		2019		2020		2018		2019		2020		2018		2019		2020	
	BGN	EUR	BGN	EUR	BGN	EUR	BGN	EUR	BGN	EUR	BGN	EUR	BGN	EUR	BGN	EUR	BGN	EUR
1. Fixed costs. BGN/EUR	6192.00	3165.92	6300.00	3221.14	5851.00	2991.57	41708.00	21324.96	41708.00	21324.96	42694.00	21829.10	2983.00	1525.18	2328.00	1190.29	2354.00	1203.58
– For membership in a breeding organization	1692.00	865.11	1800.00	920.33	1351.00	690.76	2708.00	1384.58	2708.00	1384.58	3694.00	1888.71	1603.00	819.60	948.00	484.70	974.00	498.00
– accounting costs	1500.00	766.94	1500.00	766.94	1500.00	766.94	1200.00	613.55	1200.00	613.55	1200.00	613.55	1380.00	705.58	1380.00	705.58	1380.00	705.58
– rent for pastures	3000.00	1533.88	3000.00	1533.88	3000.00	1533.88	37800.00	19326.83	37800.00	19326.83	37800.00	19326.83						
2. Variable costs. BGN/EUR	101830.38	52065.05	101654.00	51974.86	177608.20	90809.63	186588.25	95401.06	202713.78	103645.91	165803.87	84774.17	108947.00	55703.72	93669.50	47892.45	85811.10	43874.52
– Feeds	44700.00	22854.75	42500.00	21729.90	37300.00	19071.19	125263.44	64046.18	123338.36	63061.90	94392.57	48262.15	49370.00	25242.48	48150.00	24618.70	46000.00	23519.43
– per ewe	187.03	95.63	177.08	90.54	195.29	99.85	236.35	120.84	300.83	153.81	242.03	123.75	98.74	50.48	157.87	80.72	150.82	77.11
– Labour	38000.00	19429.09	40000.00	20451.68	42000.00	21474.26	38173.42	19517.76	57509.43	29404.10	55514.04	28383.88	38550.00	19710.30	28180.00	14408.21	19880.00	10164.48
– per ewe	159.00	81.30	166.67	85.22	219.90	112.43	72.03	36.83	140.27	71.72	142.34	72.78	77.00	39.37	92.39	47.24	65.18	33.33
– Veterinary costs	8500.00	4345.98	8300.00	4243.72	7000.00	3579.04	5929.69	3031.80	5068.98	2591.73	5472.49	2798.04	7500.00	3834.69	6300.00	3221.14	6500.00	3323.40
– Electricity	2100.00	1073.71	2040.00	1043.04	2000.00	1022.58	1261.76	645.13	1162.09	594.17	1042.83	533.19	1450.00	741.37	1478.00	755.69	1346.00	688.20
– Water	600.00	306.78	640.00	327.23	700.00	357.90	2595.47	1327.04	2143.28	1095.84	2662.13	1361.13	1995.00	1020.03	2443.50	1249.34	2523.10	1290.04
– Transport	900.00	460.16	1000.00	511.29	1000.00	511.29	1540.00	787.39	1200.00	613.55	1180.00	603.32	1018.00	520.50	1850.00	945.89	1438.00	735.24
– External service	1890.19	966.44	1887.00	964.81	1403.00	717.34	2079.19	1063.07	1684.36	861.20	2615.88	1337.48	2060.00	1053.26	2900.00	1482.75	2500.00	1278.23
– Fuels	1000.00	511.29	1100.00	562.42	1050.00	536.86	2342.15	1197.52	1768.41	904.17	1543.57	789.21	1570.00	802.73	900.00	460.16	1129.00	577.25
– Repairs	520.00	265.87	500.00	255.65	480.00	245.42	418.89	214.18	599.66	306.60	315.52	161.32	285.00	145.72	437.00	223.43	346.00	176.91
– Consumables	180.00	92.03	200.00	102.26	240.00	122.71	694.52	355.10	472.21	241.44	470.84	240.74	387.00	197.87	456.00	233.15	490.00	250.53
– Mechanization	350.00	178.95	300.00	153.39	280.00	143.16	750.00	383.47	480.00	245.42	432.00	220.88	432.00	220.88	475.00	242.86	389.00	198.89
– Animals for breeding					81502.20	41671.41	5000.00	2556.46	5000.00	2556.46			4000.00	2045.17			3000.00	1533.88
– Others	230.00	117.60	200.00	102.26	200.00	102.26	539.72	275.95	187.00	95.61	162.00	82.83	330.00	168.73	100.00	51.13	270.00	138.05
3. TOTAL (1+2). BGN/EUR	108022.38	55230.97	107954.00	55196.00	183459.20	93801.20	203696.25	104148.24	219821.78	112393.09	183897.87	94025.49	111930.00	57228.90	95997.50	49082.74	88165.10	45078.10
4. TOTAL/ewe	451.98	231.09	449.81	229.98	960.52	491.11	384.33	196.50	536.15	274.13	471.53	241.09	223.86	114.46	314.75	160.93	289.07	147.80
– on average (BGN)	620.77						464.01						275.89					
– on average (EUR)	317.39						237.24						141.06					

Table 6. Economic results

Economic indicators	Farm 1						Farm 2						Farm 3					
	2018		2019		2020		2018		2019		2020		2018		2019		2020	
	BGN	EUR	BGN	EUR	BGN	EUR	BGN	EUR	BGN	EUR	BGN	EUR	BGN	EUR	BGN	EUR	BGN	EUR
Profit before subsidy. BGN/EUR	63567.62	32501.61	64086.00	32766.65	-40626.20	-20771.85	-80941.82	-41384.90	-128775.52	-65841.88	-57496.59	-29397.54	12079.00	6175.89	-53177.50	-27189.22	43709.90	22348.52
per ewe. BGN/EUR	265.97	135.99	267.03	136.53	-212.70	-108.75	-152.72	-78.08	-314.09	-160.59	-147.43	-75.38	24.16	12.35	-174.35	-89.14	143.31	73.27
Profit after subsidy. BGN/EUR	94702.02	48420.37	95972.40	49069.91	-8655.80	-4425.64	12060.91	6166.65	-77576.40	-39664.18	4528.21	2315.24	33904.00	17334.84	-32507.50	-16620.82	66571.90	34037.67
per ewe. BGN/EUR	396.24	202.59	399.89	204.46	-45.32	-23.17	22.76	11.64	-189.21	-96.74	11.61	5.94	67.81	34.67	-106.58	-54.49	218.27	111.60
– on average (BGN)	250.27						-51.62						59.83					
– on average (EUR)	127.96						-26.39						30.59					
Profitability before subsidy. %	58.85		59.36		-22.14		-39.74		-58.58		-31.27		10.79		-55.39		49.58	
Profitability after subsidy. %	87.67		88.90		-4.72		5.92		-35.29		2.46		30.29		-33.86		75.51	
– on average	57.28						-8.97						23.98					

the difference between sales revenues and production costs (Table 6). On Farm 1 and Farm 3, indicators were positive only for a part of the studied period.

The addition of subsidies changed the values of profit and profitability on Farm 2, so that a negative result / BGN -189.21 and -35.29%/ was obtained only for 2019, confirming the stated by Connolly (2000) that subsidies were crucial for the financial viability of farms. However, on average for the study period, both indicators were calculated negative – BGN -51.62 per ewe and -8.97%, respectively. The owner of the farm and breeders should pay attention to increasing the productive performance of the animals and optimizing fixed and variable costs. In respect to cost optimization, Lobo et al. (2011) pointed out that feed self-sufficiency was crucial for the efficiency of meat production. Olaizola et al. (2008) added that the introduction of new feeding technologies could increase the final economic effect of production, but only if it reduces the cost for labour and increase technical efficiency. According to Pérez et al. (2007), the optimal income for meat farms can be achieved by rationalizing the basic raw materials, used in the production process and adapting them to the real needs and stocks. In this way, the maximum efficiency will be determined not as much by the type of production system applied, but by the technical security and management in the flocks.

On Farm 1 and Farm 3, profit and profitability after subsidies remained negative for 2020 and 2019, respectively, but on average for the studied period turned to positive. Therefore, both farms were profitable and cost-effective. However, the significant difference in the indicators' values was impressive, coming mainly from the higher productivity of the animals on the first farm.

Economic efficiency of two Ile de France sheep flocks was studied by Slavova (2020), and profitability after subsidies was estimated to 11.9% and -32.2%, respectively. Stankov (2020) also found a positive value for profitability with subsidies – 29.14% on Ile de France sheep farm and recommended to increase lambing frequency to get higher income. Popova et al. (2007a) reported a profitability of 36.53% for meat-producing sheep farms in the intensive regions of Bulgaria, and Popova et al. (2013) estimated 27.95% profitability for crossbreds of Ile de France and Mouton Charolais sheep in the mountainous and semi-mountainous areas of the country. Popova et al. (2019) indicated higher economic efficiency in fattening F1 lamb crosses of Bulgarian dairy synthetic population ewes and Ile de France rams, compared to F1 lambs of Bulgarian dairy synthetic population ewes and Mouton Charolais rams and F1 lambs of ewes and rams of Bulgarian dairy synthetic population.

Conclusions

Based on the obtained results, it could be summarized that the farm size /number of ewes on the farm/ does not determine the amount of revenues, but rather animal productivity, applied technologies and management strategy /including the possibilities to participate for the support schemes provided by the state/. Therefore, the role of the assets, owned by farmers should not be neglected. The availability of own pastures does not require rental costs and indirectly leads to a more favorable financial result, and own feed production is associated with optimization of food costs. Important for the financial result is also self-production of young breeding female animals for flock repair and purchase of only males in order to avoid inbreeding, which could reduce total costs and increase profits. However, this should not be on the account of productive performance, which in turn would have a negative impact on revenues. In order to achieve economically efficient production, it is necessary to find the optimal ratio between the costs of purchasing and raising highly productive animals and the revenues from sales, taking into account the risk of investment as well.

References

Achkakanova, E. & Staikova, G. (2019a). Effect of Different Sources of Specific Variance on Live Weight and Daily Gain of Ile de France Sheep in Bulgaria. *Journal of Mountain Agriculture on the Balkans, 22 (2),* 37-40.

Achkakanova, E. & Staykova, G. (2019b). Evaluation of the main productive traits of Ile de France sheep in Bulgaria, *Bulgarian Journal of Agricultural Science, 25 (Suppl.I),* 69-72.

Achkakanova, E., Minkova, T. & Nikolov, V. (2020). Growth of Lambs of the Ile-de-France Breed from Birth to Weaning and Factors Affecting it. *Scientific Papers. Series D. Animal Science, LXIII (1),* 13-18.

Benoit, M. & Laignel, G. (2007). Meat-producing sheep farms in lowland areas: diversity and trends in the last 16 years in France. *Sheep Breeding in Bulgaria and in Europe*, Collection of scientific reports, 95-112.

Benoit, M. & Laignel, G. (2011). Long term analysis of meat sheep farming systems in France. Which dynamics of evolution and which factors can explain the economic performance? *Productions Animales*, Institut National de la Recherche Agronomique, Paris, *24 (3),* 211-220.

Bonev, G., Laleva, S., Slavova, P. & Ivanov. I. (2001). Hormonal schemes for induction of estrus in non-cycling sheep of the Ile de France breed. *Journal of Animal Husbandry, 3-4,* 186-188 (Bg).

Bromley, C. M., Van Vleck, L. D. & Snowder, G. D. (2001). Genetic correlations for litter weight weaned with growth, prolificacy, and wool traits in Columbia, Polypay, Rambouillet, and Targhee sheep. *Journal of Animal Science, 79 (2),* 339–346.

Cabaret, J., Benoit, M. & Laignel, G. (2017). Sustainability of meat sheep production in relation to health and reproduction traits. *Journal of Dairy, Veterinary & Animal Research, 5(1),* 6-11.

Dimova, N. (2019). Opportunities for improving the productivity of sheep from different productive directions. Dissertation, Agricultural Institute, Stara Zagora, 156 (Bg).

Harcsa, A., Pál, G., Komlósi, I. & Jávor, A. (2004). Lambing Frequency in the Ile de France, Suffolk and Babolna TETRA Stocks of Babolna c.o., Szendrő. *Acta Classica Universitatis Scientiarum Debreceniensis, 13,* 1-4 (Hg).

Ivanov, N. (2019). Increasing the lamb production efficiency. PhD Thesis, Agricultural Institute – Stara Zagora, Academy of Agriculture, 123 (Bg).

Ivanova, T. & Raicheva, E. (2015). Weight growth of Ile de France lambs according to the genealogy line. *Bulgarian Journal of Agricultural Science, 21(2),* 409-412.

Laleva, S., Slavova, P., Ivanova, T., Kalaydzhiev, G., Popova, Y., Ivanov N. & Metodiev, N. (2020). Phenotypic characteristics of breeding traits in sheep of the Ile de France breed. *Journal of Animal Science, LVII, 3,* 23-30 (Bg).

Laleva, S., Slavova, P., Popova, J., Boykovska G. & Krastanov. J. (2006). Study of fertility and live weight in lambs Mouton Charolais, Ile de France, Thracian fine-wool breed and their crosses. In: Proceedings of International Scientific Conference of the Union of scientists – Stara Zagora, Volume II, Veterinary Medicine. Livestock, 384-387 (Bg).

Lobo, R. N. B., Pereira, I. D. C. & Facó, O. (2011). Economic values for production traits of Morada Nova meat sheep in a pasture based production system in semi-arid Brazil. *Small Ruminant Research, 96,* 93–100.

Metodiev, N. & Raicheva, E. (2008). Research on the fertility of Ile de France sheep. In: Proceedings of a scientific conference *"Traditions and Modernity in Veterinary Medicine"*, University of Forestry, Sofia, 48-54 (Bg).

Olaizola, A. M., Chertouh, **T. & Manrique, E.** (2008). Adoption of a new feeding technology in Mediterranean sheep farming systems: Implications and economic evaluation. *Small Ruminant Research 79,* 137–145.

Pérez, J. P., Gil, J. M. & Sierra, I. (2007). Technical efficiency of meat sheep production systems in Spain. *Small Ruminant Research, 69 (1–3),* 237-241.

Popova, Y., Ivanov, N., Slavova, P., Laleva, S., Slavova, S., Kalaydzhiev, G. & Achkakanova, E. (2019). Efficiency of fattening lambs from Bulgarian dairy synthetic population and its F1 crosses with meat sheep breeds. *Bulg. J. Agric. Sci., 25 (Suppl. 1),* 78-81.

Popova, Y., Laleva, S., Slavova, P., Krastanov, J. & Stanev, S. (2007a). Economic efficiency of dairy and meat-producing sheep farms in the intensive regions of the country, *"Sheep Breeding in Bulgaria and in Europe",* Collection of Scientific Reports, 245-249 (Bg).

Popova, Y., Laleva, S., Kirilova, S., Slavova, P., Kalaydzhiev, G. & Karabashev, V. (2013). Efficiency of crosses with meat-sheep breeds in the mountainous and semi-mountainous regions of Bulgaria. *On-line journal "Science & Technologies",* "Union of Scientists – Stara Zagora", Bulgaria, Volume III, №

5, Animal studies & Veterinary medicine, 78-81 (Bg).

Popova, Y., Laleva, S., Slavova, P., Krastanov, J. & Stanev, S. (2007b). Economic efficiency of fattening lambs of the Ile de France Thracian fine-wool and Stara Zagora breeds. *"Sheep Breeding In Bulgaria and in Europe",* Collection of Scientific Reports, 250-255 (Bg).

Raicheva, E., Ivanov, I., Slavova, P. & Laleva, S. (2004). Comparative study on quality of the carcass of lambs of the Thracian fine-wool and Ile de France breeds. In: Proceedings of a Scientific conference with international participation of Union of Scientists – Stara Zagora, volume 3, Animal Husbandry and Veterinary Medicine, 197-203 (Bg).

Raicheva, E. & Ivanova, T. (2005). Effect of lambing season, type of birth and sex on live weight and weight gain of lambs of the Ile de France breed. *Journal of Animal Husbandry, 5,* 222-226 (Bg).

Ripoll-Bosch, R., Diez-Unquera, B., Ruiz, R., Villalba, D., Molina, E., Joy, M. & Olaizola, A. (2012). An integrated sustainability assessment of Mediterranean sheep farms with different degrees of intensification. *Small Ruminant Research, 105 (1),* 46-56.

Slavov, R., Slavova, P. & Laleva, S. (2004). Genetic structure of Ile de France sheep breed in Bulgaria according to the transferrin and haemoglobin polymorphous genetic system. *Trakia Journal of Sciences, 2(2),* 38-40.

Slavova, S. (2020). Economic efficiency in breeding sheep of different productivity directions and selection levels. PhD Thesis, Agricultural Institute – Stara Zagora, Academy of Agriculture, 176 (Bg).

Staikova, G. & Achkakanova, E. (2019). Effect of Different Sources of Specific Variance on fertility of Ile de France Sheep in Bulgaria. *Journal of Mountain Agriculture on the Balkans, 22 (3),* 1-10.

Stankov, K. (2020). Economic efficiency of local, merino and meat-type sheep breeds raised in Bulgaria without milking. *Agricultural Science and Technology, 12 (1),* 37-41.

France Génétique Elevage. http://en.france-genetique-elevage.org/Diversity-of-meat-sheep-breeds.html

SheepNet, European Knowledge Exchange. http://www.sheepnet.network/node/303