ARISTOTELIAN UNIVERSITY OF THESSALONIKI
DEPARTMENT OF AGRICULTURAL ECONOMICS RESEARCH
HEAD : PROFESSOR **GEORGE I. KITSOPANIDIS**

ECONOMICS OF PRODUCTION AND MARKETING OF SHEEP FARMING

BY

G. KITSOPANIDIS, M. MARTIKA and B. MANOS

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INTRODUCTION ***

Sheep farming was in the past and it continues to be nowadays one of the most important branches of our farm economy and especially of our livestock industry. This is true taking into account that sheep farming contributes more (28.3%) than any other livestock enterprise to the gross return of the livestock industry.

Sheep farming represents special interesting for our country, because it produces various livestock products (milk, meat, wool, skin, etc.),utilizing on the one hand land area unfavourable for profitable crops, and on the other by - products of cereals. In other words, sheep farming has adapted successfully to the prevailing physical conditions of our country.

There are nowadays about 260.000 farm families who achieve a part or the total of their income from sheep farming. If we take into account that there are 8.000.000 sheep in our country, it can be said that correspond about 30 sheep per sheep farm family, producing 2,600 kgs. of milk, 250 - 300 kgs. of lamb meat and 30 kgs. of wool. Of the total number of sheep, 80% are pastural, while the remainder are home - fed and migratory. On the

other hand, of the total number of sheep, 40% are found on low land areas, while the remainder are found on semimountainous and mountainous areas.

The marked lack of shepherds connected with the great increase of their wages have contributed to the decrease of the number of the small and medium size of sheep farms, while it is noted increase of the number of the large size of sheep farms in the regions where there are abundant and suitable pasture for better utilization of the high wages of hired shepherds. On the other hand, there is a tendency of increasing the number of the family sheep farms, as home-fed or semihome-fed, based on sheep of high milk yield and large number of born and sold lambs. Thus, there are nowadays two tendencies, of which the one refers to the creation of large size (number of sheep) sheep farms of low or medium productivity and extensive type for utilizing the semimountainous pasture, while the other refers to the creation of medium size but high productivity and intensive type of sheep farms, based on concentrates and fodders produced on the farm.

Of the above mentioned two tendencies, it is concluded that there are three factors affecting profitability of sheep farming: a) the size (number of sheep) of farms, b) the milk yield per sheep, and c) the number of lambs born and sold per sheep. In addition to these factors, the profitability of sheep farming is affected by the source of providing the feedingstuffs, e.g. from the market or from the farm. The economic significance of each of the forementioned factors makes up the purpose of this investigation, based on a sample of sheep farms in Central and Northern Greece.

EVOLUTION OF SHEEP FARMING

Sheep farming is one of the most old and important branches of our livestock industry, because there is as pastural and migratory type from hundred years ago and it contributes essentially to the livestock income of our country.

The development of sheep farming, as mentioned above, was based on the favourable physical conditions of our country connected with the abundant of semimountainous and mountainous pasture, the surplus labour of the sheep farm families and the by - products of cereals.

In the past, the needs of greek people in milk, cheese and meat was satisfied by sheep farming because there was not cow milk farming as well as cow meat farming, pig farming and poultry meat farming in a systematic type. Later with the rapid development of cow milk farming for covering the continuously increasing needs in milk of cities and towns and the unwillingness of the young farmers to be occupied with sheep farming as pastural

and migratory type, sheep farming is continuously restricted in number and it changes type. At present, there is a tendency sheep farming to be maintained as migratory or home-fed type by sheep of high milk yield and large number of lambs born and sold. This type of sheep farming there is still in Greece, because it is supported by Ministry of Agriculture with special funds for establishing modern sheep buildings, for buying high productivity sheep and for providing cheap maize and barley through Agricultural Bank.

The expecting abolition of various forms of subsidies and the increasing limitation of the available area of pasture connected with the lack of shepherds lead to sheep farming based exclusively on feedingstuffs (maize, barley, lucerne) produced on the farm and on own meadow. This type of sheep farming is independent from shepherds, but it requires on the one hand land area for producing maize, barley, lucerne and for providing own meadow, and on the other large quantities of money for establishing modern sheep buildings and for buying special machinery. This type of sheep farming is necessary, from an economic standpoint, to be based on high productivity sheep and on a large number of born and sold lambs per sheep.

Taking into account the very good quality of the sheep milk, cheese and meat and the special preference of our people to the sheep products, it is believed that this type of sheep farming (based on home grown maize, barley and lucerne, and on own meadow) can be increased by increasing prices of sheep products.

WORK PLANNING AND RESEARCH METHODOLOGY

This investigation was undertaken by the Department of Agricultural Economics Research of the University of Thessaloniki in collaboration with the Livestock Production Service of the Ministry of Agriculture and it refers to the Central and Northern Greece. This region represents the 40,8 % of the total sheep milk and meat produced.

The research undertaken refers to the study, by using records and accounts, of a sample of 81 sheep farms, belonging to 57 villages situated in 15 sheep farming distrists for the two year period 1978 - 79. In addition to the forementioned 81 sheep farms, in this investigation were analysed and physical data of 566 individual ewes, which were withdrew from production because of age and because of unsuitability.

The analysis of the physical and economic data was based: a) on the size (number of sheep) of farms, b) on the milk yield per sheep and not only per ewe, c) on the number of lambs born and sold per 100 sheep and not only per 100 ewes.

The estimation of the annual expenses of the fixed capital is based on its average value for the years 1978 and 1979. The same is true for the estimation of milk, meat, feedingstuffs, drugs and wages of hired shepherds. The apportionment of the total costs of sheep production between milk and lamb meat was based on the contribution of the value of milk and lamb to the total gross return per sheep.

The economic data used and the financial results estimaled are expressed in greek money, known as drachmas (drs.). The readers can convert drachmas into U.S. $, English £, French F. and German D.M. as follows: $ 1 = 37 drs., £ = 80 drs., F = 8,8 drs, and D.M. = 20,6 drs.

This paper is a summary of a large bulletin published in greek under the same title about 75 pages.

In this work farm income includes land rent, remuneration of labour used, interest of capital invested and profits achieved irrespective of all or some of the above resources belonging to the sheep farmers or to other persons or institutions.

Table 1
Number of districts, villages and sheep farms studied,

Farm regions studied	Number of districts	Number of villages	Number of sheep farms
Thessaly	4	10	15
Central and western Macedonia	6	34	51
Eastern Macedonia and Thrace	5	13	15
Total	15	57	81

Table 2
Number of sheep farms studied according to farm size, milk yield and number of lambs born and sold.

Classes of farm size (number of sheep per farm)	Number of farms	Classes of milk yield (kgs./sheep)	Number of farms	Classes of lambs born and sold (number of lambs/100 sheep)	Number of farms
Up to - 100	13	Up to - 60,0	11	Up to ~ 80	23
101 — 200 »	29	60,1 — 80,0 »	25	81 — 100 »	26
201 — 300 »	27	80,1 — 100,0 »	26	101—120 »	21
301 — over »	12	100,1 — over »	19	121 — over »	11
Total	81	Total	81	Total	81

ECONOMICS OF PRODUCTION

I. PRODUCTION FACTORS

A. Land

Table 3

Land area required by 10 sheep according to farm size, milk yield and number of lambs born and sold.

Classes of farm size, milk yield and number of lambs born and sold	Land area in stremmas used by			
	Lucerne	Maize	Barley	Total
A. Farm size				
Up to 100 sheep	0.7	0.7	1.0	2.4
101 — 200 »	0.6	0.7	0.9	2.2
201 — 300 »	0.5	0.6	0.9	2.0
301 — over »	0.4	0.7	0.8	1.9
B. Milk yield				
Up to 60,0 kgs./sheep	0.4	0.6	0.8	1.8
60,1 — 80,0 »	0.5	0.6	0.8	1.9
80,1 — 100,0 »	0.5	0.7	0.9	2.1
100,1 — over »	0.6	0.7	0.9	2.2
C. Number of lambs born and sold per 100 sheep				
Up to 80 lambs	0.4	0.6	0.8	1.8
81 — 100 »	0.5	0.6	0.8	1.9
101 — 120 »	0.5	0.7	1.0	2.2
121 — over »	0.6	0.7	1.0	2.3

B. Labour

Table 4
Average labour required in man equivalent hours per sheep annually according to farm size, milk yield and number of lambs born and sold.

Classes of farm size, milk yield and number of lambs born and sold	Labour required in hours per sheep and per 10 kgs. of milk when feedingstuffs are based on			
	the market price per		the production costs per	
	sheep	10 kgs. of milk	sheep	10 kgs. of milk
A. Farm size				
Up to 100 sheep	28.1	2.6	31.2	2.9
101 - 200 »	24.7	2.9	27.8	3.3.
201 - 300 »	21.1	2.4	23.8	2.7
301 - over »	17.0	2.4	19.5	2.7
B. Milk yield				
Up to 60.0 kgs./sheep	20.0	3.6	22.5	4.0
60.1 - 80.0 »	20.0	2.7	22.6	3.1
80.1 - 100.0 »	22.2	2.5	25.1	2.8
100.1 - over »	23.7	1.9	26.6	2.1
C. Number of lambs born and sold per 100 sheep				
Up to 80 lambs	20.6	2.7	23.1	3.1
81 - 100 »	20.4	2.5	23.0	2.8
101 - 120 »	21.9	2.6	24.8	2.9
121 - over »	24.2	2.3	27.3	2.6

$$Y = \alpha X^b$$
$$\hat{Y} = 130,02\ X^{-0,3399}$$
$$r = -0,5750 \qquad r^2 = 0,3306$$
$$Sy = 0,1086 \qquad S_b = 0,0544$$

Ἐπίπεδον σημαντικότητος διά Z:

$$0 < \alpha < 10^{-9}$$

Number of sheep per farm.
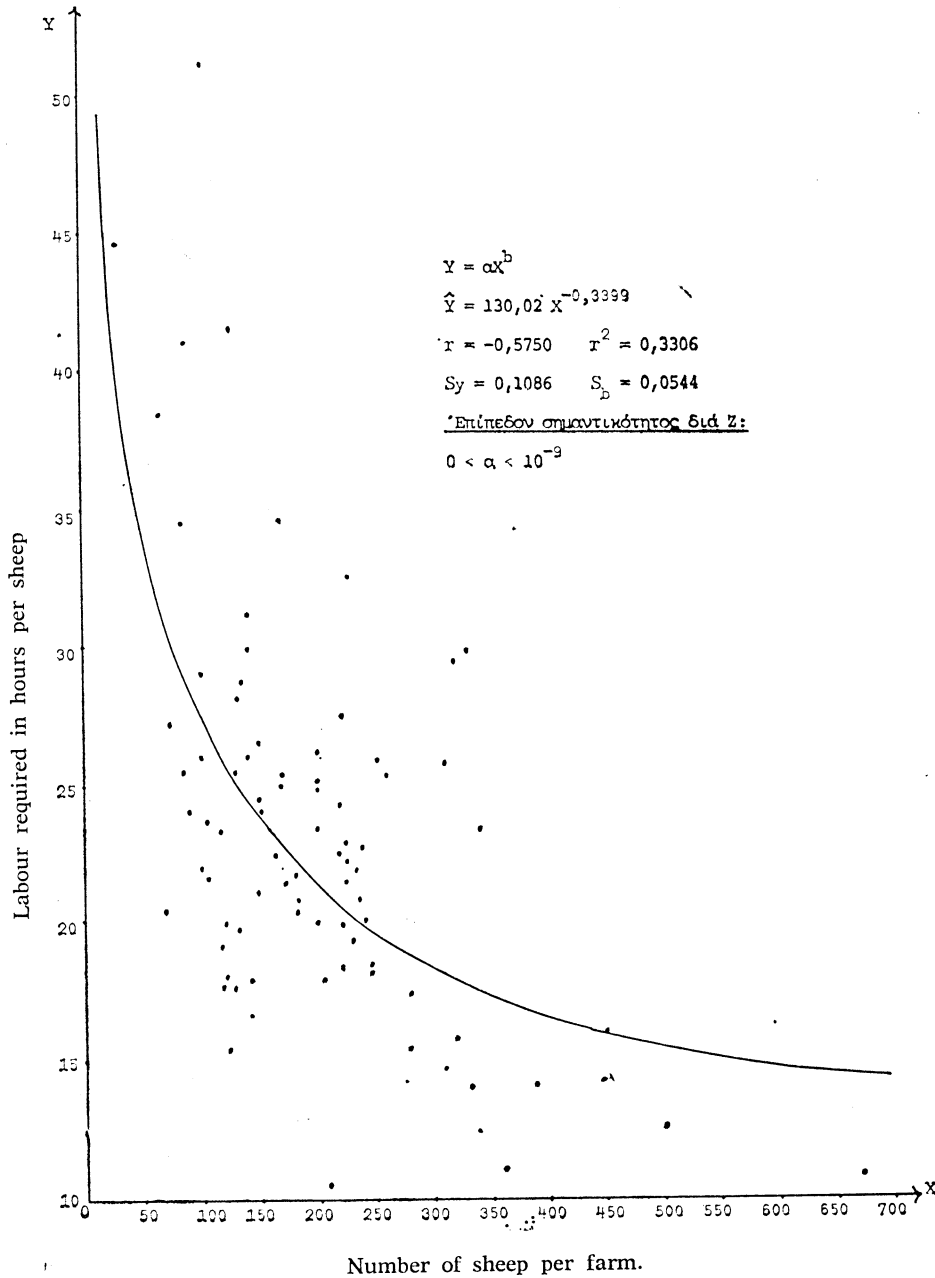
Chart 1. Regression and correlation analysis between farm sheep size and labour required per sheep.

C. Capital

Table 5

Capital needed per sheep according to farm size,
milk yield and number of lambs born and sold.

Classes of farm size, milk yield and number of lambs born and sold	Variable and fixed capital needed when feedingstuffs are based on					
	the market price			the production costs		
	Variable [1] (drs./sheep)	Fixed [2] (drs./sheep)	Total (drs./sheep)	Variable [3] (drs./sheep)	Fixed [4] (drs./sheep)	Total (drs./sheep)
A. Farm size						
Up to 100 sheep	1,389	5,732	7,121	583	9,010	9,593
101 - 200 »	1,197	5,085	6,282	375	8,084	8,459
201 - 300 »	1,026	3,662	4,688	344	6,217	6,561
301 - over »	1,035	3,296	4,331	352	5,864	6,216
B. Milk yield						
Up to 60,0 kgs./sheep	941	3,141	4,082	335	5,185	5,820
60,1 - 80,0 »	1,013	3,848	4,861	323	6,402	6,725
80.1 - 100,0 »	1,156	4,561	5,720	369	7,342	7,711
100,1 - over »	1,358	4,738	6,096	452	7,726	8,178
C. Number of lambs born and sold per 100 sheep						
Up to 80 lambs	954	3,705	4,659	338	6,049	6,387
81 - 100 »	1,125	3,820	4,945	344	6,374	6,718
101 - 120 »	1,101	4,948	6,049	329	6,782	7,111
121 - over »	1,359	3,832	5,191	497	6,900	7,397

1. Variable capital includes the value of concentrates, fodders, grazing, drugs, etc.

2. Fixed capital includes the value of buildings, livestosk and machinery.

3. Variable capital includes the value of produced (seed, fertilizers, pesticides) and purchased feed.

4. Fixed capital includes the value of the land area cultivated, buildings, livestock and machinery.

Table 6
Certain basic physical data connected with profitability and productivity of sheep farming.

Classes of farm size, milk yield and number of lambs born and sold	Average farm size and percentage of milk producing sheep			Average milk yield		Average number of lambs born and sold per 100 sheep
	Average number of sheep	Milk producing sheep %	Non milk producing sheep %	per sheep (kgs./head)	per sheep producing milk (kgs./head)	
A. Farm size						
Up to 100 sheep	85	82	18	105.9	129.3	107
101 — 200 »	144	83	17	85.1	102.5	94
201 — 300 »	228	82	18	87.4	106.4	87
301 — over »	398	87	13	71.1	81 2	94
B. Milk yield						
Up to 60 kgs./sheep	298	84	16	55.0	65.3	82
60.1 — 80,0 »	219	79	21	73.3	87.6	90
80.1 — 100,0 »	183	82	18	89.3	112.9	95
100.1 — over »	141	85	15	127.4	149.0	105
C. Number of lambs born and sold per 100 sheep						
Up to 80 lambs	217	80	20	74.9	93.9	71
81 — 100 »	199	84	16	81.3	96.7	89
101 — 120 »	189	86	14	84.8	103.5	103
121 — over »	186	87	15	105.5	120.8	131
Average	200	83	17	83	100.7	92

Table 7
Number of ewes and lambs born as well as duration of milk period and milk yield according to number of litters achieved by each ewe during its productive life.

Litters	Ewes		Lambs born per litter	Lambs born per Ewe	Duration of milk period in days	Milk yield sold in kgs. per sheep producing milk
	Number	%				
1ος	460	95	552	1.20	167	106
2ος	376	77	490	1.30	170	138
3ος	293	60	431	1.47	179	162
4ος	238	49	328	1.38	182	159
5ος	175	38	241	1.38	182	162
6ος	132	27	175	1.33	150	143
7ος	64	13	96	1.50	140	132
8ος	24	5	38	1.58	233	257
9ος	9	2	14	1.55	238	276

III. ECONOMIC ANALYSIS

A. Gross return

Table 8

Gross return per sheep and contribution to this return of the value of milk, lamb and wool according to farm size, milk yield and number of lambs born and sold.

Classes of farm size, milk yield and number of lambs born and sold	Gross return						
	Milk		Lamb		Wool		
	drs./sheep	%	drs./sheep	%	drs./sheep	%	Total drs./sheep
A. Farm size							
Up to 100 sheep	1,775	55	1,347	42	77	3	3,199
101 - 200 »	1,334	50	1,273	48	63	2	2,670
201 - 300 »	1,370	53	1,129	44	64	3	2,563
301 - over »	1,139	46	1,307	52	57	2	2,503
B. Milk yield							
Up to 60,0 kgs./sheep	870	44	1,076	54	48	2	1,994
60,1 - 80,0 »	1,174	48	1,216	50	62	2	2,452
80,1 - 100,0 »	1,386	50	1,309	47	66	3	2,761
100,1 - over »	2,060	60	1,326	38	76	2	3,462
C. Number of lambs born and sold per 100 sheep							
Up to 80 lambs	1,176	53	1,003	45	60	2	2,239
81 - 100 »	1,278	51	1,151	46	58	3	2,487
101 - 120 »	1,322	48	1,383	50	64	2	2,769
121 - over »	1,789	50	1,715	48	77	2	3,581

B. Production costs

Table 9

Production costs per sheep and per kg. of milk and meat according to farm size, milk yield and number of lambs born and sold.

Classes of farm size, milk yield and number of lambs born and sold	Production costs per sheep and per kg. of milk and meat when feedingstuffs are based on					
	the market price			the cost of production		
	Production costs (drs./sheep)	Production costs of		Production costs (drs./sheep)	Production costs of	
		milk (drs./kg)	meat (drs./kg)		milk (drs./kg)	meat (drs./kg)
A. Farm size						
Up to 100 sheep	3,509	18.6	189	2,972	15.4	158
101 — 200 »	2,956	17.5	187	2,409	14.2	154
201 — 300 »	2,554	15.5	171	2,108	12.8	140
301 — over »	2,399	15.4	164	1,951	12.6	132
B. Milk yield						
Up to 60,0 kgs./sheep	2,397	19.3	204	2,022	16.2	171
60,1 — 80,0 »	2,493	17.5	172	2,039	13.4	143
80,1 — 100,0 »	2,803	15.8	171	2,275	12.7	138
100,1 — over »	3,167	14.7	158	2,536	12.0	124
C. Number of lambs born and sold per 100 sheep						
Up to 80 lambs	2,463	18.2	186	2,066	14.6	158
81 — 100 »	2,646	17.3	185	2,101	13.2	144
101 — 120 »	2,766	15 5	169	2,168	12.3	133
121 — over »	3,099	14.8	151	2,519	11.9	120
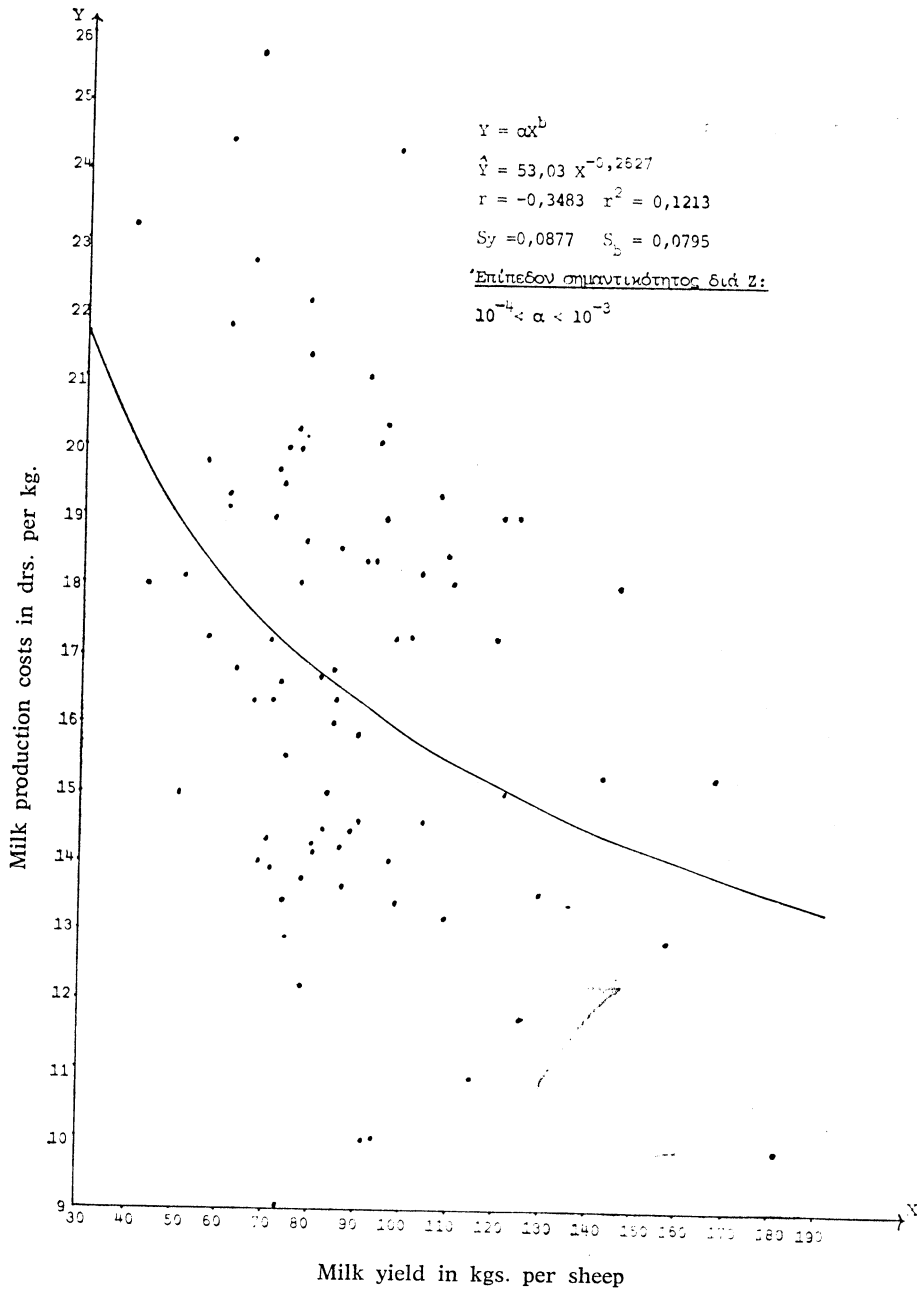
Chart 2. Regression and correlation analysis between milk yield
and production costs of milk.

Table 10

Participation of each kind of expenses to the total production costs per sheep according to farm size, milk yield and number of lambs born and sold when feedingstuffs are based on the market price.

Classes of farm size, milk yield and number of lambs born and sold	Participation of each kind of expenses to the total costs in drs./sheep and in %											
	Labour		Feed [1]		Annual expenses of livestock		Annual expenses of buildings and machinery		Others [2]		
	drs.	%	drs.	%	drs.	%	drs.	%	drs.	%	
A. Farm size											
Up to 100 sheep	1,224	35	1,254	36	429	12	467	13	135	4	3,509
101 - 200 »	1,008	34	1,090	37	460	15	291	10	107	4	2,956
201 - 300 »	860	34	935	37	464	17	204	8	91	4	2,554
301 - over »	723	31	915	38	463	19	178	7	120	5	2,399
B. Milk yield											
Up to 60,0 kgs./sheep	840	35	834	35	456	19	160	7	107	4	2,397
60,1 - 80,0 »	820	33	910	36	443	18	217	9	103	4	2,493
80,1 - 100,0 »	909	32	1,054	37	467	17	271	10	102	4	2,803
100,1 - over »	1,030	32	1,242	38	491	16	288	10	116	4	3,167
C. Number of lambs born and sold per 100 sheep											
Up to 80 sheep	845	34	849	35	456	19	208	8	105	4	2,463
81 - 100 »	853	32	1,019	38	447	17	221	9	106	4	2,646
101 - 120 »	910	31	1,015	38	478	18	186	7	86	3	2,766
121 - over »	1,014	33	1,225	39	472	15	254	9	134	4	3,099

1. Feed includes the expenses for concentrates, fodders and grazing.

2. Others: include the expenses for drugs, electricity, water, telephone and petroleum.
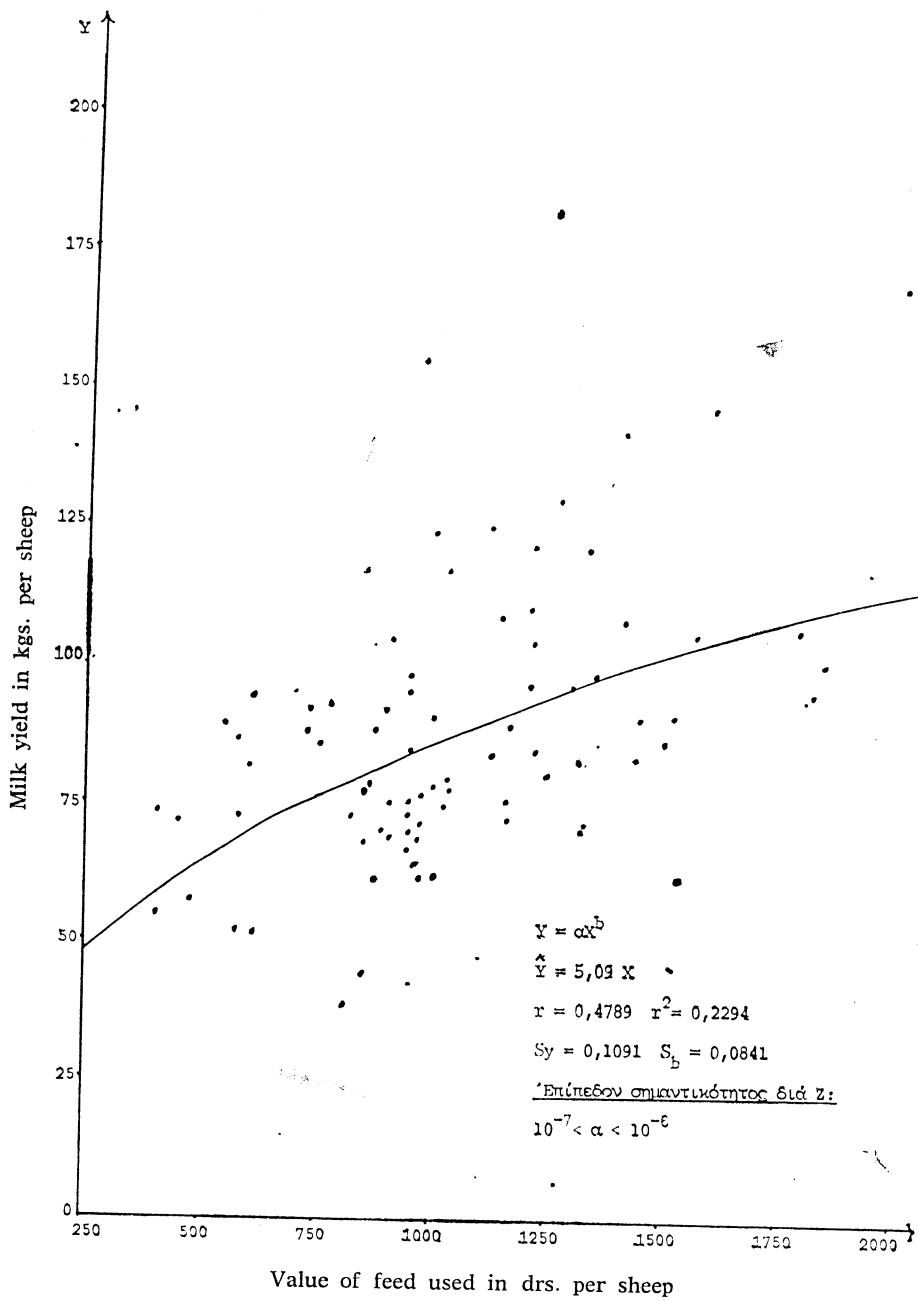
Chart 3. Regression and correlation analysis between feed used and milk yield.

Table 11

Participation of each kind of expenses to the total production costs per sheep according to farm size, milk yield and number of lambs born and sold when feedingstuffs are based on the cost of production.

Classes of farm size, milk yield and number of lambs born and sold	Participation of each kind of expenses to total costs in drs. per sheep and in %												Total drs./sheep
	Land rent		Labour		Feed [1]		Annual expenses of livestock		Annual expenses of buildings and machinery		Others [2]		
	drs.	%	drs.	%	drs.	%	drs.	%	drs.	%	drs.	%	
A. Farm size													
Up to 100 sheep	164	6	1,359	46	279	9	429	14	467	16	304	9	2,972
101 — 200 »	149	6	1,134	47	116	5	460	19	291	12	259	11	2,409
201 — 300 »	128	6	968	46	124	6	464	22	204	10	220	10	2,108
301 — over »	128	6	830	43	105	5	463	24	178	9	247	13	1,951
B. Milk yield													
Up to 60,0 kgs./sheep	117	6	942	47	111	5	456	23	160	8	224	11	2,022
60,1 — 80,0 »	128	6	928	45	91	5	443	22	217	11	232	11	2,039
80,1 — 100,0 »	139	6	1,029	45	128	6	467	20	271	12	241	11	2,275
100,1 — over »	149	6	1,156	46	184	7	491	19	288	11	268	11	2,536
C. Number of lambs born and sold per 100 sheep													
Up to 80 sheep	117	6	947	46	116	6	456	22	208	10	222	10	2,066
81 — 100 »	128	6	961	46	108	6	447	21	221	10	236	11	2,101
101 — 120 »	143	6	1,032	48	99	5	478	22	186	8	230	11	2,163
121 — over »	153	6	1,143	46	207	8	472	19	254	10	290	11	2,519

1. Feed includes the expenses for purchased feedingstuffs.
2. Others include the value of seed, fertilizers, pesticides etc. for producing certain feedingstuffs and the expenses for petroleum, water, electricity, telephon etc.

C. Profit

Table 12

Profit or loss according to farm size, milk yield and number
of lambs born and sold.

Classes of farm size, milk yield and number of lambs born and sold	Profit or loss when feedingstuffs are based on					
	the market price			the cost of production		
	Sheep (drs./head)	Milk (drs./kg.)	Meat (drs./kg.)	Sheep (drs./head)	Milk (drs./kg.)	Meat (drs./kg.)
A. Farm size						
Up to — 100 sheep	−310	−1.7	−19	227	1.5	12
101 — 200 »	−286	−1.7	−18	261	1.6	15
201 — 300 »	9	0.2	− 1	455	2.9	30
301 — over »	104	0.6	6	552	3.4	38
B. Milk yield						
Up to — 60.0 kgs./sheep	−403	−3.5	−36	− 28	−0.4	− 3
60.1 — 80.1 »	− 41	−1.0	− 2	413	3.1	27
80.1 — 100.0 »	− 42	0.5	− 2	486	2.6	31
100.1 — over »	295	1.5	13	926	4.2	47
C. Number of lambs born and sold per 100 sheep						
Up to — 80 lambs	−224	−2.5	−16	173	1.1	12
81 — 100 »	−159	−1.6	−14	386	2.5	27
101 — 120 »	3	0.1	−0,5	601	3.3	36
121 — over »	482	2 1	19	1.062	5.0	50

Y

2500
2250
2000
1750
1500
1250
1000
750
500
250
0
-250
-500
-750
-1000
-1250
-1500

Profits in drs. per sheep.

$Y = \alpha + bX$

$\hat{Y} = -1032,16 + 10,19\ X$

$r = 0,3921 \qquad r^2 = 0,1538$

$Sy = 64,9435\ S_b = 2,6883$

'Επίπεδον σημαντικότητος διά Ζ:

$10^{-5} < \alpha < 10^{-4}$

30   50   70   90   110   130   150   170   190   X
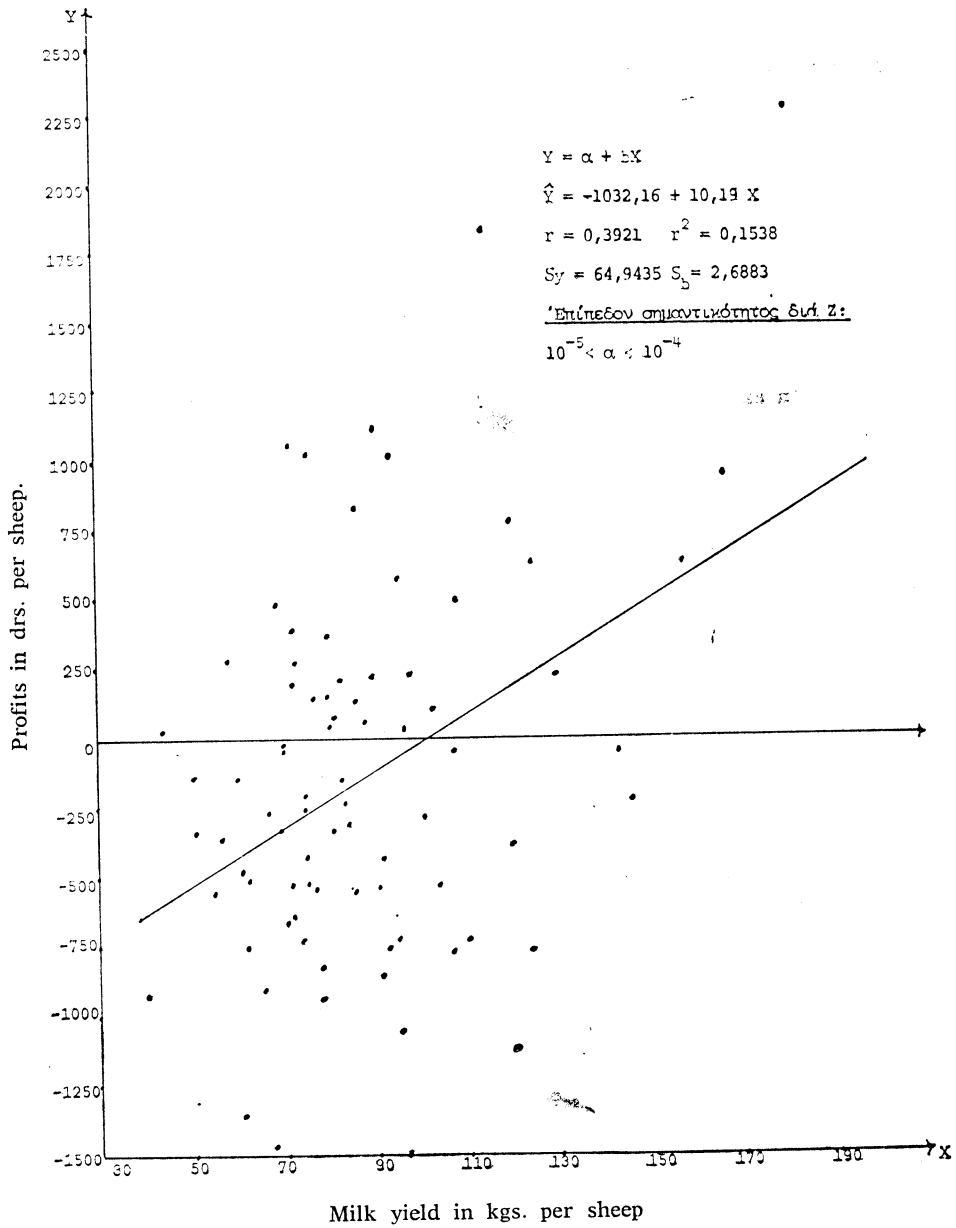
Milk yield in kgs. per sheep

Chart 4. Regression and correlation analysis between milk yield and profits.

D. Returns and incomes

Table 13

Returns and incomes of sheep farming according to farm size,
milk yield and number of lambs born and sold.

| Classes of farm size, milk yield and number of lambs born and sold | Returns and incomes when feedingstuffs are based on | | | | | | | |
| | The market price | | | The cost of production | | | | |
	Return to labour (drs./8hours)	Return to capital (%)	Farm income (drs./sheep)	Return to land (drs./str.)	Return to labour (drs./8hours)	Return to capital (%)	Farm income (drs./sheep)	Farm income (drs./str.)
A. Farm size								
Up to 100 sheep	261	0.9	1,291	910	405	8.0	2,087	8,703
101 — 200 »	234	0.6	1,015	941	401	8.5	1,833	8,340
201 — 300 »	329	6.0	1,158	1.127	478	12.9	1,797	9,452
301 — over »	389	8.6	1,104	1.194	567	15.0	1,745	8,725
B. Milk yield								
Up to 60,0 (kgs./sheep)	175	-3 0	714	624	325	6.1	1,256	6,983
60,1 — 80,0 »	312	4.8	1,060	1.085	475	11.9	1,717	9,031
80,1 — 100,0 »	312	4.6	1,180	1.147	483	11.9	1,935	9,211
100,1 — over »	417	9.9	1,651	1.606	618	16.4	2,519	11,461
C. Number of lambs born and sold per 100 sheep								
Up to 80 lambs	241	1.3	906	825	353	8.7	1,483	8,245
81 — 100 »	272	2.4	975	1.058	469	11.6	1,724	9,068
101 — 120 »	334	5.1	1,229	1.281	527	14.7	2,052	9,337
121 — over »	494	15.2	1,824	1.729	646	20.3	2,644	11,501

E. Technical and economic comparison of sheep farms of various simultaneously farm size, milk yield, and number of lambs born and sold

Table 14

Comparison of physical and economic data among sheep farms
of various simultaneously size (number of sheep), milk yield and
number of lambs born and sold

Physical and economic data	A	B	Γ
1. Number of sheep farms	81	4	12
2. Average farm size (number of sheep)	200	267	145
3. Average milk yield (kgs./sheep)	83	115	74
4. Average number of lambs born and sold per sheep	0.92	1.16	0.86
5. Average labour required (hours per sheep)	21.3	18.7	23.9
6. Average variable capital needed (drs./sheep)	1 035	1 242	1 082
7. Average fixed capital needed (drs./sheep)	4 063	4 544	4.831

A = Average of the total sheep farms studied.

B = Average of sheep farms, each of which is simultaneously of larger size, of higher milk yield per sheep and of greater number of lambs born and sold per sheep in relation to the average of the total sheep farms sturied.

C = Average of sheep farms, each of which is simultaneously of smaller size, of lower milk yield per sheep and of smaller number of lambs born and sold per sheep in relation to the average of the total sheep farms studied.

Table 15

Comparison of returns, production costs, profits and incomes among sheep farms of various simultaneously size (number of sheep), milk yield and number of lambs born and sold.

Returns, production costs, profits and incomes	A	B	C
1. Gross return			
Value of milk (drs./sheep)	1 320	1 923	1 150
Value of lambs (»)	1 233	1 575	1 038
Value of wool (»e)	67	65	55
Total	2 620	3 563	2 243
2. Production costs			
Labour (drs./sheep)	885	847	958
Feed (»)	991	1 226	1 095
Annual expenses of capital (»)	761	845	785
Others (»)	46	38	52
Total	2 683	2 956	2 890
3. Profit or loss (drs./sheep)	— 63	607	— 647
4. » » (drs./Kg. milk)	— 0,3	2.9	— 3,8
5. » » (drs./Kg. meat)	— 5.1	29.5	— 50
6. Return to labour (drs./8hours)	309	622	104
7. Return to capital (%)	3,9	15.5	— 4,0
8. Farm income (drs./sheep)	1 095	1 805	705

A = Average of the total sheep farms studied.

B = Average of sheep farms, each of which is simultaneously of larger size, of higher milk yield per sheep and of greater number of lambs born and sold per sheep in relation to the average of the total sheep farms studied.

C = Average of sheep farms, each of which is simultaneously of smaller size, of lower milk yield per sheep and of smaller number of lambs born and sold per sheep in relation to the average of the total sheep farms studied.

F. Technical and economic comparison of sheep farms of various successively farm size, milk yield and number of lambs born and sold

Table 16

Comparison of physical and economic data among sheep farms of various successively farm size, milk yield and number of lambs born and sold.

Physical and economic data	A	B	C	D
1. Number of sheep farms	81	39	45	32
2. Average farm size (number of sheep)	200	280	165	188
3. Average milk yield (kgs./sheep)	83	80	103	92
4. Average number of lambs born and sold per sheep	0.92	0.90	0.99	1.12
5. Average labour required (hours/sheep)	21.3	19.3	22.8	22.7
6. Average variable capital needed (drs./sheep)	1 035	969	1 164	1 127
7. Average fixed capital needed (drs./sheep)	4 063	3 502	4 628	4 568

A = Average of total sheep farms studied.

B = Average of sheep farms, each of which is greater only in relation to size (number of sheep) compared with total farms studied.

C = Average of sheep farms, each of which is greater only in relation to milk yield per sheep compared with total farms studied.

D = Average of sheep farms, each of which is greater only in relation to the number of lambs born and sold per sheep compared with total farms studied.

Table 17

Comparison of returns, production costs, profits and incomes among sheep farms of various successively farm size, milk yield and number of lambs born and sold.

Returns, production costs, profits and incomes	A	B	C	D
1. Gross return				
Value of milk (drs./sheep)	1 320	1 269	1 630	1 481
Value of lambs (»)	1 233	1 207	1 315	1 496
Value of wool (»)	67	61	69	68
Total	2 620	2 537	3 014	3 045
2. Production costs				
Labour (drs./sheep)	885	804	952	945
Feed (»)	991	926	1 122	1 087
Annual expenses of fixed capital »)	761	691	807	804
Others (»)	46	45	42	35
Total	2 683	2 466	2 923	2 871
3. Profit or loss (drs./sheep)	— 63	71	91	174
4. Profit or loss (drs./Kg. milk)	— 0.3	0.43	0.50	1,12
5. Profit or loss (drs./Kg. meat)	— 5.1	2,40	3.70	7.20
6. Return to labour (drs./8 hours)	309	363	366	394
7. Return to capital (%)	3.9	7.1	6.6	8.2
8. Farm income (drs./sheep)	1 095	1 144	1 350	1 431

A = Average of total sheep farms studied.

B = Average of sheep farms, each of which is greater only in relation to size (number of sheep) compared with total farms studied.

C = Average of sheep farms, each of which is greater only in relation to milk yield per sheep compared with total farms studied.

D = Average of sheep farms, each of which is greater only in relation to the number of lambs born and sold per sheep compared with total farms studied.

G. Technical and economic analysis of sheep farming with own meadow and home grown feedingstuffs

Table 18

Physical and economic data of sheep farming of 200 sheep according to milk yield.

Physical and economic data	Milk yield in Kgs. per sheep and corresponding physical and economic data		
	150	200	250
1. Land			
a. For permanent artif. meadow (m²/sh.)	200	200	200
b. For. producing maize, barl. and luc. (»)	260	340	400
Total	460	540	600
2. Labour required for producing feeding-stuffs, grazing and care sheep (hours/sheep)	16.2	16.5	16.7
3. Labour wages (drs./hour)	60	60	60
4. Capital			
a. Annual expenses of meadow)(without land) (drs./sheep)	334	334	334
b. Variable capital (»)	1 100	1 275	1 410
c. Fixed capital (»)	15 500	16 500	17 500
5. Average number of lambs born and sold	1.5	1.5	1.5
6. Price of milk (drs./Kg.)	17.5	17.5	17.5
7. Meat yield (Kgs./lamb)	10	10	10
8. Price of meat (drs./Kg.)	200	200	200

Table 19
Returns, production costs, profits and incomes of sheep farming
of 200 sheep according to milk yield

Returns, production costs, profits and incomes		Milk yield in Kgs. per sheep and corresponding financial results		
		150	200	250
1. Gross return				
a. Value of milk	(drs./sheep)	2 625	3.500	4.375
b. Value of lambs	(»)	3 000	3.000	3.000
c. Value of wool	(»)	80	80	80
Total		5 705	6.580	7.455
2. Production costs				
a. Land rent	(drs./sheep)	920	1 080	1 200
b. Labour wages	(e»)	972	990	1 002
c. Feed[1]	(»)	1 030	1 200	1 320
d. Annual exp. of meadow (without land)		334	334	334
e. » » » livestock (»)		840	1 095	1 350
f. » » » buildings (»)		680	680	680
g. » » » milking machine (»)		355	355	355
h. Others	(»)	70	75	90
Total		5 201	5 809	6 331
3. Profit or loss	(drs./sheep)	504	771	1 124
4. » »	(drs./Kg.milk)	1.55	2.05	2.64
5. » »	(drs./Kg. meat)	17.67	23.47	30.13
6. Return to land	(drs./str.)	3.096	3.428	3 873
7. Return to labour	(drs./8 hours)	728.8	853.6	1 018.4
8. Return to capital	(%)	7.2	7.9	8.7
9. Farm income	(drs./sheep)	3 073	3 558	4 083
10. Farn income	(drs./str.)	6 680	6 589	6 805

1. Feed includes the value of produced (seed, fertilizers, pesticides, etc.) and purchased feed.

IV. MARGINAL PRODUCTIVITY ANALYSIS

A. Marginal value products of production factors used

Table 20

Marginal productivity analysis of sheep farming for the total farms studied and according to farm size, milk yield and number of lambs born and sold.

Elasticities of production Marginal value products	Marginal productivity analysis and corresponding results						
	Total farms studied	Classes of farm size		Classes of milk yield		Classes of number of lambs born and sold per 100 sheep	
		Up to 200 sheep	201 - over sheep	Up to 100 kg./sheep [1]	100.1 - over kgs./sheep	Up to 100 lambs	101 - over lambs
1. Number of sheep farms	81	42	39	51	19	49	32
2. Average farm size (no. of sheep)	200	126	280	201	141	207	188
3. Average milk yield (kgs./sheep)	83.2	91.5	82.4	81.5	127.4	78.3	91.9
4 Average number of lambs born and sold per 100 sheep	92.0	98.0	89.2	92.5	105.0	80.6	112.6
5. Average labour required (hours/sheep)	22.9	25.8	19.8	21.1	23.7	20.5	22.7
6. Elasticities of production							
a. Livestock	0.3544	0.2182	0.3500	0.4770	0.4109	0.4992	0.3303
b. Labour	0.2014	0.2441	0.0727	0.1323	0.3485	0.0944	0.2266
c. Feed	0.4056	0.4253	0.3722	0.3567	0.4649	0.3824	0.3794
Total	0.9614	0.8876	0.7949	0.9660	1.2243	0.9760	0.9363
7. R^2 (coef. of. mult. determination)	0.7767	0.6001	0.5324	0.8122	0 7934	0.7975	0.82 12
8. R (coef. of correlation)	0.8813	0.7746	0.7279	0.9012	0.8907	0.8930	0.9062
9. Marginal value products							
a. Livestock (%)	51.2	33.8	48.8	68.2	79.2	66.1	54.2
b. Labour (drs./8hours)	192.0	208.0	73.6	127.4	374.4	83.2	233.6
c. Feed (drs./drs.)	1.07	1.05	1.02	0.95	1.30	0.97	1.06
10. Opportunity costs							
a. Livestock (%)	23.0	23.0	23 0	23.0	23.0	23.0	23.0
b. Labour (drs./8hours)	320.0	320.0	320.0	320.0	320.0	320.0	320.0
c. Feed (drs./drs.)	1.10	1.10	1.10	1.10	1.10	1.10	1.10
11. Marginal return to opportunity cost ratios							
a. Livestock	2.23	1.47	2.12	2.97	3.44	2.87	2.36
b. Labour	0.60	0.65	0.23	0.40	1.17	0.26	0.73
c. Feed	0.97	0.95	0.93	0.86	1.18	0.88	0.96

1. From this class of milk yield have been excluded 11 cases of 39.4 - 55.4 kgs./sheep.

B. Actual and optimum combination of production factors

Table 21
Gross return and participation of each production factor to the actual and optimum combination of production factors of the same size (number of sheep) of farm.

Combination of production factors	Achieved and estimated gross return (Y) drs.	Participation of each production factor		
		Number of sheep (x_1)	Labour in hours (x_2)	Feed in drs. (x_3)
Actual combination	524 010	200	4 425	198 311
Optimum »	536 123	200	3 113	250 788
Increase or decrease	+ 2.3	—	— 29.6	+ 26.5

C. Actual and optimum combination of concentrates and fodders

Table 22
Actual and optimum or least cost combination of concentrates and fodders per sheep annually for the total sheep farms studied.

Combination of concentrates and fodders	Combination of feedingstuffs per sheep				Feeding costs in drs. per sheep annually	Economies per sheep	
	Concentrates		Fodders and grazing				
	drs.	%	drs.	%		drs.	%
Actual combination	437.8	44.2	553.7	55.8	991.5	113.0	11.4
Optimum »	217.8	24.8	660.7	75.2	878.5		

V. LINEAR PROGRAMMING AND LEAST COST RATIONS

Table 23

Annual quantities of dry matter, digestible protein and starch equivalent needed for each sheep of live weight of 50 Kgs and various milk yield and received on the one hand by grazing, and on the other by produced or purchased feed.

Nutritive components	Quantities of nutrients needed and received											
	Up to 60 kgs./sheep			60.1 - 80 kgs./sheep			80.1 - 100 kgs./sheep			100.1 - over kgr./sheep		
	Needed	Received by		Needed	Received by		Needed	Received by		Needed	Received by	
		grazing %	produced or purchased feed %		grazing %	produced or purchased feed %		grazing %	produced or purchased feed %		grazing %	produced or purchased feed %
Dry matter (gr./sheep./year)	481700	61.8	38.2	481700	61.7	38.3	481700	54.5	45.5	481700	49.5	50.5
Digestible protein (»)	27888	38.2	61 8	29715	38.6	61.4	31290	31.8	68.2	31290	14.9	85.1
Starch equivalent (»)	201825	52.4	47 6	209945	50.7	49.3	216945	43.0	57.0	216945	38.1	61.9

Table 24

Comparison between actual and recommended by linear programming
combination of feed and cost of annual ration (except grazing)
of a sheep according to milk yield.

Feedingstuffs and cost of ration	Classes of milk yield in kgs. per sheep and corresponding quantities of feed (except grazing) of actual and recommended rations, and cost of rations.							
	Up to 60,0		60,1 - 80,0		80,1 - 100,0		100,1 - over	
	actual	recommended	actual	recommended	actual	recommended	actual	recommended
A! Feedingstuffs								
1. Maize (grain)	31.94	17.93	44.86	10.67	53.97	27.13	47.52	—
2. Barley »	20.72	3.68	22.86	17.24	27.78	6.17	25.90	45.50
M. Wheat »	5.81	7.20	8.58	9.30	6.94	11.10	4.19	15.15
4. Bran	3.29	2.40	2.46	3.10	2.06	3.70	2.65	20.20
5. Cotton cake	14.67	4.80	3.86	6.20	9.28	7.40	25.69	20.20
6. Soya beans	1.50	—	0.69	—	—	—	1.14	—
7. Lucerne hay	56.52	17.56	77.96	12.28	83.12	14.52	87.96	23 23
8. Meadow green	—	533.98	—	550.17	—	655.02	107.69	596.79
9. Straw	28.36	35.13	14 84	24.55	17.50	29.05	12.58	33.00
10. Pulp of sugar beet	34.91	12 00	18.95	15.50	29.05	18 50	33.87	—
11. Barley green	51.41	—	80.95	—	107.23	—	70.58	—
12. Maize green	—	—	2.00	—	—	—	—	—
13. Ground limestone	1.15	—	1.25	0.84	1.50	0.51	1.59	0 87
14. Diculcium phosphate	0.76	—	0.83	—	1.00	—	1.06	—
15. Salt	0.76	0.76	0.83	0.83	1.00	1.00	1.06	1.06
B! Cost of ration (drs./sheep/year	891.4	698.2	976.3	748.0	1,147.7	890.5	1,270.6	1,053.6

Table 25

Fluctuation limits of the basic feed prices of the recommended by linear programming combination of various feed for the class of milk yield 80.1 - 100.0 kgs. per sheep, in which the combination of feed remains unchanged and it is, of course, the most economical combination.

No	Feedingstuffs	Price (drs./kg.)	Deviation from average price		Fluctuation limits of price
1	Maize (grain)	5.75	— 0.11	+ 0.07	5.64 — 5.82
2	Barley »	5.75	— 0.07	+ 0.11	5.68 — 5.86
3	Wheat »	5.75	— 0.13	0	5.62 — 5.75
4	Bran	3.40	— 1.53	+ 0.16	1.87 — 3.56
5	Cotton cake	5.60	— 1.15	+ 1.99	4.45 — 7.59
6	Lucerne hay	4.50	— 3.10	+ 1.50	1.40 — 6.00
7	Meadow green	0.65	— 0.14	+ 0.24	0.51 — 0.89
8	Straw	0.80	— 0.27	0	0.53 — 0.80
9	Pulp of sugar beet	3.40	— 0.16	0	3.24 — 3.40

Table 26

The necessary decrease of the price and consequently the most economical price of the excluded from the combination of the least cost feed for the class of milk yield 80.1 - 100.0 kgs. per sheep.

No	Feedingstuffs	Price (drs./kg.)	The necessary decrease of the price		The most economical price drs./kg.
			(drs./kg.)	%	
1	Soya beans	11.50	5.98	52.0	5.52
2	Barley green	0.70	0.12	17,1	0.58
3	Maize green	0.90	0.23	31,1	0.62

CONCLUSIONS

The modern sheep farming is expected to operate successfully on the one hand by the type pastural (carrying sheep to the extensive semimountainous and mountainous pasture since April until October of each year), and on the other by the type semihome - fed (based on home grown feeding-stuffs and own meadow). The successive operation of the first type of sheep farming will be based on the large size e.g. large number of sheep grazing for a long period per year in extensive pasture, while the other type of sheep farming will be based on high productivity sheep (high milk yield and high number of lambs born and sold per sheep) in order to be considered more profitable the utilization of land by sheep farming than by other crop or livestock enterprises. The profitability of the first type of sheep farming depends on the low wages of hired shepherds and on the low price of the maize, barley and lucerne for feeding sheep during the winter months, and also by better organization of milk and meat marketing cooperatives for achieving higher milk and meat prices. On the contrary, the profitability of the second type of sheep farming depends on the best combination of the available production factors (land, labour, capital) for achieving the cheapest ration connected with the best organization of the marketing of the produced sheep products (milk and meat).

It is not known yet what influence may have on sheep products and espesially on lamb meat the complete joining of Greece with European Economic Community, because sheep products are not included yet in the Common Market policy. Independently of the Common Market policy for the sheep products (milk and meat), the profitability of both types of sheep farming will be based on the best organization of the production factors and especially on the least cost ration, and on the better organization of milk and meat marketing. It is believed that there is still room for increasing profits through these directions.