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SOCIO-ECONOMIC AND TECHNICAL EVALUATION OF SHEEP AND GOAT FARMS IN NORTH WEST COAST OF EGYPT

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ABSTRACT

The main objective of this study was to analyze the socio-economic situation of small ruminant farms at mixed farming system of different farm sizes in North West Coast of Egypt (NWCE). Ninety eight sheep and goat farms under mixed farming system were randomlyselected. The selected farms were divided into three categories according to flock size holding; small ≤185 animals (49 farms), medium > 185 ≤ 383 animals (31farms) and large > 383 animals (18 farms). Questionnaire was designed and pre-tested on limited numbers of farms who have good experience in crops, sheep and goat production. Primary data were collected by interviewing selected farmers plus secondary data were used from the Economic Affairs Sectors belonging to the Ministry of Agriculture and Land Reclamation.

Results show that average cultivated areas are 58.66, 96.36 and 116.63 feddan for the three farm sizes, respectively. Five crops were commonly cultivated in the studied areas: barely and wheat as winter crops, watermelon as summer crop and two types of fig and olive trees. Average gross margin/animal/year for male sheep and goat were L.E. 478, 676 and 722 for sheep and 388, 452 and 403 for goat in small, medium and large farm sizes, respectively, whichdenote that farm gross margin was increased as farm size increased. Illiteracy level decreased with the small farm size whereas large farmers are focusing on trading with farm business.

It can be concluded that special attention would be paid to improve revenue from sheep and goat production among small farms. This can be implied by introducing fertile males (rams) with superior genetic potential accompanied by improving feed. Farmers educations have to be improved as disseminate of new technologies would be much easier for educated farmer.

Keywords: *mixed farming systems, crops, milk, gross margin, manure and education*

INTRRODUCTION

Sheep and goat production on range constitute a major part of the Bedouin's income. The native rangelands are deteriorating due to environmental and human reasons **(El-Shaer, 1996).** The reduction in rain falling rates and overgrazing represent the most important factors affecting the extensive animal production system in the North West Coast of Egypt. Appropriate range rehabilitation, grazing management policies and range-users awareness about the benefits of long-term range improvement plans would prevent further deterioration and allow optimum utilization of available feed resources. Improving the extensive animal production system cannot be achieved through the old traditional systems but only through several approaches and measures, which together would set in motion the expected and necessary process of development (**El-Shaer,1996)**.

In Egypt, there are about 5.6 and 4.13 million heads of sheep and goats. Matruh governorate has 6.82 and 3.92% of total sheep and goat population, respectively. **(Egyptian Ministry of Agriculture, economic statistic book, 2009).** At family level, small ruminants serve as investment and insurance due to high fertility, short generation interval, ability to produce under limited feed resource and adaptation to harsh environment **(Tsedeke 2007).** The productivity of sheep and goat was reported to be low due to a number of factors, i.e., feed shortage either in quality or quantity

and health constraints **(Tsedeke 2007).** Constraints also include low genetic potential of animals, policy issues and seasonality of marketing.

The basic production characteristics of small ruminant include flock management system, size of the flock, feeding regime, labor use for production and reproduction. Though small ruminants are important, they are neglected as animal wealth resource in developing countries. **Lapar et al. (2003)** stated that smallholders generally have inadequate capital resources (physical, financial resources and intellectual capital resources such as experience, education and extension). There is a need for good understanding of small ruminant production characteristics in the desert farms if effective intervention would be targeted. Therefore the main objectives of this work were:

1. Socio-economic analysis of small ruminant farms at mixed farming systems for different farm sizes in North West coast of Egypt.
2. Identifying small ruminant production problems and suggesting possible ways of improvement.

MATERIALS AND METHODS

This study was conducted based on data obtained from Ministry of Agriculture and Land Reclamation, Economic Affairs Sector and primarily on data collected by interviewing Bedouins raising sheep and goat under mixed farming systems (livestock/crops) in North West Costal of Egypt (NWCE). The study was conducted from December 2008 to April 2009, on 98 farms in four districts in Matruh Governorate. Four districts were randomly selected (Matruh, Dabaa, Sidi Barini and El-Nigala), two villages in each district were also selected randomly. The collected farms' data were divided into three categories of farm and flock sizes. The first category was small farms that comprises of ≤185 sheep and goat (49 farms), medium farms >185 ≤ 383 animals (31 farms) and large farms > 383 animal/farm (18 farms). The average cultivated areas are 58.66, 96.36 and 116.63 feddan in the three farm categories, respectively. Thus, the selected samples can be classified among the multi-stage sample or cluster sample.

The questionnaire was designed and pre-tested for clarity on limited numbers of farms who have good experience in sheep and goat breeding under mixed farming system. The questions were formulated in such way that farmers could provide the most recent and easy to recall information. The questions covered various aspects of sheep and goat production, crops production, farm economics, family size, farm labor, animal feeding and home consumption of crops. Livestock extension staffs in the studied area were intensively trained and administered the questionnaire. Ninety eight farmers who have sheep and goat with cultivated land were selected for interviewing. Descriptive and quantitative analysis were used to calculate economic efficiency measures, average and percentage (%) of different technical and economic variables.

Statistical analysis using SAS program (SAS, 2004) was applied to calculate economical efficiency, measures, averages and percentages of different technical and economical variables. Statistical Model was used to study impact of family size on production and reproductive parameter for sheep and goat. The degrees of significance among means were performed through Duncan Multiple Range Test (Duncan 1955).

Statistical Model

$$Y_{ij} = \mu + S_i + e_{ij}$$

Where:

Y_{ij} = any observations (Family size, farm labor, production and reproductive parameters)

μ= overall mean S_i = the effect of farm size

i = 1, 2 and 3 where: 1= Small, 2= Medium and 3= Large

e_{ij} = the residual effect.

RESULTS AND DISCUSSION

Effect of flock sizes on utilization of farm labor

Table 1 shows the number of farmers, sons and daughters less and more than 15 years old. Average farmers ages of the selected samples were around 51 years old in the three

tested farm sizes. The younger sons and daughters were in a lesser extent involved in farm activities whether for animal or crops. In fact, as young sons and daughters still in the schools they have no power to do farm activities or primarily able to gain the experiences from their parents for farm activities. While, older sons have more power to be involved in the farm activities as family workers. The numbers of sons older than 15 years old have positive role with farm sizes. This might be attributed to the need for more members to increase farm income as noticed in large farm.

Scanning levels of education show that the highest percentage of farmers can read and write are in small size farms followed by medium and large ones. It might be attributed to involving of men in agricultural and trading activities after primary school instead of completing the formal education. It may possibly due to limitations of educational facilities in the villages or of jobs opportunities in most cases. Low percentage of family members are learnt in technical high school which noticed in small and medium farms, to reach about 3 & 11%, respectively. Results also indicate that the percent of uneducated males of the family members rises with increasing farm size.

Daughters in the three tested farm sizes had the highest formal education schools as compared to sons. The recent trend of high percentage of female education adds more social value to girls in family. The low rates of family education, to a great extent, could adversely influence the adoption of innovations in livestock/crops production. **Sarker, (1995)** reported that the relationship between adoption of dairy production technologies and formal education of household was positive in general for most technologies and significant for feeding technologies in particular. The study also showed that 61, 59 and 50% of the family were involved in sheep and goat rearing as sole business. It indicates that animal rising is considered the main activity for the farm' family especially the small sizes. Whereas, the large farmers are depend on non- agricultural activities as permanent jobs or trading plus farming business.

Labor costs for crops and animal production are presented in table 2. Family labor for crops and animals showed a positive relationship with farm size whether in winter or summer. This relationship may be referring to seasonality of crop production and that small farm families are sharing the work with each other. While in large farm size the hired workers play important role because crops areas are bigger and need more workers especially in sowing and harvesting season. Family labor is essential for livestock since daily management work needed throughout the year. Differences were significant ($P < 0.05$) in family labors parameters measured among the three farm sizes tested which mostly related to increasing labor needs with increasing herd's sizes.

Labours hired for crops production also significantly differed ($P \leq 0.05$) among farm sizes. The difference may be due to the larger cultivated areas that need more paid workers with less family contribution. There are significant differences ($P \leq 0.05$) among farm sizes in labouring period (man/days) in winter. The greater farm size is concomitant with more labours needed for cultivation.

The significant differences ($P \leq 0.05$) in wages/day between the three farms sizes might regard that large farms size increase wage to attract more labour in peak season of cultivation which develop competition on labour. Working period (man/day) was differ significantly ($P \leq 0.05$) according to farm size, being less in small farms in comparison with both medium and large farms.

The total number of sons & daughters of the three classes seems dependant of size of herds owned. However, possibility of receiving false numbers due to afraid of invidiousness is also possible.

The hired labors are not so important for small farms since the family cover the farm work beside that neighbors share in the peak of cultivation season to reduce hired labor. Permanent labor and wages/months increase as much as farm size increase due to that in large farms more work and efforts are needed.

Table 1. Number and percentages of family members of different missions.

	Small farms		Medium farms		Large farms	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**
Bedouin age	50.90 ± 2.13	-	51.44 ± 2.79	-	51.40 ± 4.21	-
Av. Son and Daughters < 15 years old	3.83 ± 0.68	1.00 ± 0.0	3.71 ± 0.23	3.30 ± 3.87	2.81 ± 2.35	3.21. ± 6.21
Av. Son and Daughters >15 years old	1.50 ± 0.28	1.80 ± 26	2.10 ± 5.0	2.73 ± 7.50	2.79 ± 3.20	1.79 ± 4.7
Total number of sons	8.13		11.84		10.6	
Family Education level (%)						
Read & write	70	-	61	-	42	-
Diploma	3	-	11	-	-	-
uneducated	21	9	28	29	58	-
Different schools	6	91	-	71	-	100
Family main activity (%)						
Agricultural + animal grazing	61	-	59	-	50	-
Other work (%)						
Employee	17	-	22	-	25	-
Trader	22	-	19	-	25	-

Barley and wheat as winter crops and watermelon as summer crop and two types of trees (fig and olive) in the three tested farm sizes are presented in Table 3. Areas cultivated with barley and fig differed significantly ($P \leq 0.05$) between small and large farms, while the difference was not significant for medium farm size than both of them.

Areas cultivated by different vegetation and classified according to herd sizes (Table 3) indicate that Barley occupy 63-68% of cultivated lands, followed by wheat, fig, olive and lastly watermelon.

These results indicated a positive relationship between crops areas and capacity of animals holding. Animal production plays a big role in reducing risk especially in low rainy seasons to compensate revenue losses of crops. Animal manure can be considered as added value as organic fertilizer. The present results agree with those found by **(El-Ashmawy *et al*., 2011**) that flock size increased as cultivated land increased. **Khalil *et al*. (2008)** found positive relationship between cultivated area and number of animal unit/farm in irrigated areas.

Fig and olive areas seem more related to total owned land (the same ratio of total land) than to flock sizes (ratio decreased with increasing flock size). This is mostly due to that horticulture is dependant than livestock in all input/output factors.

Tables 4.1 and 4.2 display crops production and their use in the three herd sizes classes. The present results show that barely production was increased as much as farm sizes increased which might be because barley not only used for HC but also could be used for animal feeding according to the prices of feed mixtures in the market. Wheat is mainly cultivated for HC and the rest is sold or used for animals feeding only when ration price goes up. Significant difference was noticed ($P \leq 0.05$) on barley used for HC and sold. A significant difference ($P \leq 0.05$) was observed only between small and medium farms for sold and HC of wheat. Watermelon is only summer crop mainly cultivated as cash crop and suitable to soil in that area as well. The difference between small and medium farms for watermelon HC is very small while small farm sold more quantity because the cultivated land of this crop in small farm sizes is bigger.

Table 2. Family, rented and permanent labors for cultivation and sheep & goat raising distributed according to farms size (wage/year)

Items	Small farms		Medium farms		Large farms	
	Summer	Winter	Summer	Winter	summer	winter
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Family labor for Crops						
Hours/day	7.69 ± 2.33	6.70 ±3.56	7.51 ±4.24	6.20 ±1.56	7.45 ±2.45	6.43 ±1.26
Man/day	70.40 ±2.58	30.40 ±1.49	80.60 ±2.4	35.20 ±1.22	95.80 ±2.43	38.00 ±1.29
Wages/day	33.10 ± 2.57	36.05 ± 3.00	31.95 ± 1.0	38.21 ± 0.0	32.58 ± 2.69	43.64 ± 3.33
Family labor cost	2330.24	1095.24	2575.17	1345.00	3121.16	1658.32
Hired labor for crops production						
Hours/day	6.81^{b} ± 0.19	7.05^{b} ± 0.22	7.59^{a}± 0.15	7.91^{a} ± 0.0	7.87^{a}± 0.0	7.90^{a} ± 0.0
(man/ day)	72.5^{b} ± 6.8	17.00 ± 1.35	121.25^{a}±5	27.00± 2.5	131.25^{a}± 9.8	37.00±2.64
Wages/day	33.10± 2.57	36.05± 3.00	31.95± 1.0	38.21± 0.0	32.58± 2.69	43.64± 3.33
Hired labor costs	2399.80	612.85	3873.94	81031.67	4276.13	1614.68
Family labor%	49.3	64.1	39.9	56.6	42.1	50.7
Hired labor %	50.7	35.9	60.1	43.4	57.9	49.3
Family labor for animal raising						
Hours/day	8.24± 0.23	8.40±0.32	8.22± 0.56	8.81± 0.45	8.26± 0.0	8.17± 3.2.
(man/ days)	20.00^{b}± 5.35	11.00^{b}± 3.79	50.0^{a} ±9.33	30.0^{a}± 5.9	60.00^{a}± 6.87	35.0^{a} ±7.51
Wages/day	21.76± 0.85	21.00± (0.72)	20.14± 0.0	20.08±0.0	20.01± 0.0	20.01± 0.0
Family labor cost	435.20	231	1007.00	602.40	1200.60	700.36
Hired labor for animal raising						
Hours/day	8.11± 0.23	8.50± (0.29	8.25± 0.25	8.41± 0.25	8.16± 0.0	8.16± 0.0
Labor (man/ days)	40.00^{b}± 3.48	21.00^{b}± 2.59	90.00^{a} ±7.2	90.0^{a}± 3.7	90.00^{a}± 4.95	90.0^{a} ±6.5
Wages/day	21.76± 0.85	21.00± (0.72)	20.14± 0.0	20.08± 0.0	20.01± 0.0	20.01± 0.0
Hired labor cost	870.4	441.0	1812.6	1807.2	1800.9	1800.9
Permanent labor	1		1.18		2	
Monthly wages	583		652		750	
Permanent labor cost/year	6996		9232		18000	
Total labor costs	8973.2		14261.4		23502.95	

Man/day means: Numbers of men are needed to achieve summer or winter work
^{abc} means within a column with different superscript differ significantly (P<0.05).

Table 3: Cultivated areas (in feddan) for each crop with stander error for the three farm sizes

	Small farms	(*)	Medium farms	(*)	Large farms	(*)
Crops	areas± SE	%	areas ± SE	%	Areas ± SE	%
Barley	40.23^{b}± 5.1	68	64.55^{ab}±14.3	66	73.75^{a} ±14.4	63
Wheat	5.22^{c} ± 1.1	9	12.47^{b}±1.8	13	21.23^{a} ±5.0	18
Fig	6.44^{b} ± 0.9	11	9.29^{ab}±2.0	10	12.38^{a} ±2.2	11
Olive	4.67^{b} ±1.0	8	8.27^{a}± 2.0	9	9.27^{a}± 1.9	8
Watermelon	2.10 ± 0.3	4	1.78 ± 0.1	2	-	0
Average total land	58.66	100	96.36	100	116.63	100

Means bearing difference superscripts in the same raw are significantly different (P≤0.05)
(*): Percentage of total land

It is clear that the relative importance of wheat for HC decreased with the increase of farm size, while it increases for the sold quantities. Small and medium farms cultivate wheat to cover HC whereas, large farms aimed to increase farm revenue by selling most of wheat production.

The sold quantities of fig and olive as fruit crops are also increased by increase of the herd size. The importance of these two crops was as main monetary crops to achieve a higher income for Bedouins. Families have small herds are more able to cultivate watermelon, for its need to more care and labor hours, as a source of additional income compared to families owned medium and large herds. Olive quantities sold from medium and large herds classes were significantly more ($P \leq 0.05$) than that sold from small herds class.

Regarding fig, HC of the medium farms recorded significantly ($P \leq 0.05$) more quantity compared to small and large farm sizes. Sold quantity of fig was significantly differ ($P \leq 0.05$) among the three farm sizes.

Generally, it could be recognized that crops and horticulture production are more compatible with available cultivated areas rather than the sizes of herds assigned. Home consumption of barley is more related to herd sizes than wheat as it consumed for family and animals. Watermelon' home consumption is similar for small and medium herds' classes while it seems that large herds' owners have no interest to cultivate it. Olive home consumption is similar among all herds' classes as it represent essential component of home food since families sizes are nearly similar. Fig HC is differing but independent of herds' sizes and major part of it is for selling.

Effect of farm and flock/herd size on costs of animal feeding

As shown in table 5, feeding concentrate increased per animal as farm size increased. Concentrate feeding pattern may be attributed to the more attention paid to animals that have more daily gain or lactation length in the larger farms. In addition owners of large farms feed more concentrate as they consider animal holding as commercial oriented enterprise so that proper inputs will gain accepted output. Moreover the large farm income in the last years is depending mainly on animals because the animal raising is safer and grantee the enterprise in such mixed farming system when compared with crops in studied area.

Uncertainty in crop production may refer to fluctuation in rain fall rates among years. It was noticed that amounts of concentrates offered to sheep and goat increased by increasing herd sizes. This mostly refer to the expected more finance potential related to size of flocks owned and consequently more ability to cover needs of animals. Animal supply from straws had an opposite trend to concentrate feeding as it decreased by increasing herd sizes. This is ordinary trend as poorer people depend on bread not meat to fill gut, yet animals of the poorer do too.

In wet seasons, the major feed resource is the communal grazing, where most households depend on it. In the dry seasons, the households either stay in the region and feed their animals on concentrate, available crop residuals and purchased roughages or migrate with flocks to neighbor cultivated regions to consume crop residuals and minimal concentrate supplement.

Effect of farm and flock/herd size on revenues of animal raising

Table 6.1 shows female animals' revenues from milk, wool and manure for the three farm sizes. There were significant differences ($P \leq 0.05$) among the three farm sizes in sheep holding capacity while, goats in the small farms had significantly ($P \leq 0.05$) less holding than both medium and large farms. The differences between milking females were significant ($P \leq 0.05$) for sheep and goat.

In fact selling rate of females in the small farms was greater than that in the other two farms sizes. This is probably due to limitation in finance to compensate feed shortage yet they sell from the basic flock. The result indicated that percentage of milking animals was low compared to total number of females of sheep and goats. The low number of milking ewes might due to the short duration of

Table 4.1 Crops production, home consumption, sold crop and total revenue.

Crops	Small farms			Medium farms			Large farms		
	Quantities (ton)	Price/ ton (LE)	Total revenue (LE)	Quantities (ton)	Price/ ton (LE)	Total revenue (LE)	Quantities (ton)	Price/ ton (LE)	Total revenue (LE)
Barely									
HC ±SE	3.62^{C} ± 0.75			9.29^{b} ± 2.07			15.45^{a} ± 0.91		
Sold ±SE	22.27 ± 1.1	1156	25748	31.34^{b}±0.5	1311	53266	40.35^{a}±0.3	1240	50040
Per Fed.	0.664		640.02	0.629		825.19	0.757		678.51
Wheat									
HC ±SE	3.51^{b}±0.66			5.93^{a}±1.41			4.20^{ab}±0.73		
Sold ±SE	0.15^{c}±0.2	1405	5142	7.75^{b}±0.04	1462	20000	20.0^{a} ±4.56	1416	20107
Per Fed.	0.701		985.06	1.097		1603.8	1.140		947.10
Watermelon									
HC ±SE	0.25±0.09			0.23±0.18			-	-	
Sold ±SE	12.24±0.57	1040	12990	9.53±0.74	1033	10082	-	-	
Per Fed.	5.948		6185.7	5.483		5664.0			
Olive									
HC ±SE	0.55±0.13			0.56±0.25	2688		0.60±0.04		
Sold ±SE	6.43^{b}±1.66	2488	17366	9.21^{a}±2.67		26262	10.22^{a}±2.24	2417	23735
Per Fed.	1.495		3718.63	1.181		3175.57	1.168		2560.41
Fig									
HC ±SE	0.54^{b}±0.20			1.00^{a}±0.0			0.10^{c}±0.0		
Sold ±SE	9.60^{c}±1.97	1374	13932	18.71^{b}±5.6	1857	36601	25.93^{a}±3.87	1786	28630
Per Fed.	1.576		2163.35	2.122		3939.83	2.103		2312.60
Total									
HC ±SE	11486.63	14.47%		32524.48	19.58%		26734	15.18%	
Sold ±SE	67872.71	85.53%		133574.8	80.42%		149366.7	84.82%	
T R (LE)	75178			146211			176101		

H. C.: Home Consumption, (for family and gifts to some neighbors) TR : Total revenue

Table 4.2 Relative importance (%) of the sold and home consumed (HC) crops in the sample farms distributed according to the different herd sizes.

Crops	small farms		Medium farms		large farms	
	HC	sold	HC	Sold	HC	Sold
Barely	13.98	86.02	22.86	77.14	27.69	72.31
Wheat	95.90	4.10	43.35	56.65	17.36	82.64
Watermelon	2.00	98.00	2.36	97.64	--	--
Olive	7.88	92.12	5.73	94.27	5.55	94.45
Fig	5.33	94.67	5.07	94.93	0.38	99.62

Table 5: Quantity of concentrate and straw per farm and per animal and its cost.

Farm sizes	Average Animal No./ farm		Total tons of conc./farm /year		Total tons of straw./farm /year		Total conc. Cost L.E./animal /year		Total straw. cost L.E. animal /year	
	sheep	Goat	Sheep	Goat	Sheep	Goat	Sheep	Goat	Sheep	Goat
Small/farm	76	42	18.49	10.19	10.83	4.31	-	-	-	-
Feed /animal	-	-	0.243	0.243	0.143	0.103	365	364	57	41
Medium/farm	196	84	58.28	21.11	19.60	7.14	-	-	-	-
Feed /animal	-	-	0.297	0.251	0.100	0.085	446	377	40	34
Large/farm	419	113	128.77	29.46	33.52	8.48	-	-	-	-
Feed /animal	-	-	0.307	0.261	0.080	0.075	461	391	32	30

Conc.: concentrate feed mixture L.E. 1500/ ton Straw price L.E. 400/ ton

lactation, while for milking does it might due to keen to have more kidding seasons from does and leaving milk for suckling. Milk production of both ewes and does are quite comparable among the three herd sizes classes which due to that all herds in the region have the same genotypes. Milk price was estimated as cow milk price as sheep and goat milk not marketed and used for suckling and home consumption. Wool production not differs significantly among the three farm sizes. Manure production is mostly not measurable under grazing system, however the increase of sheep manure with medium flock sizes ($P \leq 0.05$) might express more staying time in yarns.

Twinning rate are decreased by the rise of the farm size of sheep and goats. These suggest that smaller flocks holders are more selective in performance of animals they raise. Meanwhile, the twining reported for goats seems quite low than known for the breed.

Litter size for sheep were close to 65-200% for tropical hairy sheep **(Ketema 2007)**, 87% in Menz and 81% in Horro ewes and for goat results were agreed with **(Mukasa *et al.* 2002**), who found that litter size between 120.1 and 133.6 for sub-Saharan Africa goat flocks **(FAO, 2000)**. Total revenue of the adult females (sheep and goat) represents the revenue of milk, value of new born at weaning age, manure and wool. The total revenue was slightly decreased by the rise of the farm sizes while, for growing female the total revenue was slightly increasing with farm size increase because large farms pay more attention to adult females. In other word, in large farms sheep and goat oriented as commercial enterprise, therefore, concentrate feed cost was increased as farm size increase. It can be noticed that revenue from the growing females of sheep and goat were better than that of milking females. It is remarkable that revenue from growing and fattened females included those which were culled due to low productivity of milk and low sexual potency, so they were fattened in order to be sold. The adding value of females during their growth in their first two years of age was also included. Large farms surpassed the medium and small farms as they achieved higher growth rates and revenues from raising female of sheep and goats, and it is also remarkable that Bedouins keep good females while sell culled females beyond the productive age and those had low productivity.

As shown in table (6.2), the total revenues achieved at the farm level from fattening of male sheep and goats were L.E 27799, 91916 and 198419 for sheep and L.E. 13163, 28626 and 34378 for goats (which includes revenues from animal body weight gain in one year, manure, changes in value of adult males by end of the year, which estimated as +15%, and wool for sheep).

The results clarified a relative importance of revenues from the weight gain of males for a year which came in the first place among items of the total revenues and also represented the greatest part among them as they ranged between 96.11 - 97.52% for male sheep, while goat male's revenues of weight gain were 95.24 ranged between and 97.01%.

Table (6.1) Female animal revenues from milk, wool, and manure and body weight gain according to farm size.

Items	Small farms		Medium farms		Large farms	
	Sheep	goat	Sheep	goat	Sheep	Goat
Av. No. animals/farm	76^{c}±8.6	42^{b}±4.0	196^{b}±15	84^{a}±6.4	419^{a}±23	113^{a}±9.0
Percentage of total animals	63.2	64.3	62.8	64.3	64.2	67.3
Av. No. Female	48^{c}± 4.7	27^{c} ±3.2	123^{b} ± 7.0	54^{b} ± 4.5	269^{a} ± 24	76^{a} ± 7.9
Av. No. Milking female	20^{c} ± 2.9	16^{c}± 2.2	44^{b}± 5.5	24^{b} ± 2.9	95^{a} ± 0.2	27^{a} ±3.6
% Milking animals/total female	41.7	59.3	35.8	44.4	35.3	35.5
Milk production:						
Av. Milk /head/day	0.35± 0.01	0.47± 0.0	0.35± 0.0	0.51± 0.1	0.34± 0.0	0.45± 0.0
Av. Lactation length (days)	82±4.70	108± 5.3	84± 6.1	108± 6.6	95± 8.9	118± 7.7
Price of 1kg milk (LE)	2.50	2.50	2.50	2.50	2.50	2.50
1- Total revenue of milk (LE)	71.8	126.9	73.5	137.7	80.8	132.8
Twinning %	110	133	103	118	103	116
2-Revenue from new born (LE)	275	266	258	236	258	232
Wool production (kg) / head/year	2.31±0.1	-	2.35±0.1	-	2.50± 0.1	-
Price of wool LE/kg	1.38±0.0	-	1.37± 0.1	-	1.33±0.1	-
3-Female wool revenue	3.19	-	3.22	-	3.33	-
Manure quantity(M^3/head/year)	1.14^{b}±0.1	0.91± 0.1	1.43^{a}± 0.1	0.89±0.1	1.15^{b}±0.0	0.76±0.1
Price of manure (LE/M^3)	18.43	18.43	18.29	18.29	18.39	18.39
4- Revenue from manure (LE)	21.01	16.77	26.15	16.28	21.15	13.98
5- change values of adult female revenue (L.E.)	90.5	118.7	90.7	123	87.4	118.6
Total lactating Female revenue	461.5	528.37	451.57	512.98	450.68	497.38
Revenues from body gain						
Growing female No.	23	13	68	32	186	52
Av. Daily gain (kg/day) + SE	0.092± 0.10	0.079^{b}± 0.07	0.095± 0.13	0.088^{ab}± 0.10	0.098± 0.17	0.094^{a}± 0.10
Price/kg live weight	25	25.5	25	26.5	25.5	26
Growing female revenue (L.E.)	839.5	735.3	866.9	851.2	912.1	892.1

Change values: Adult female change of body weight revenue was calculated as 15% of the present value according to inflation rate of study year

Daily gain Estimated according farmers monthly measurements maintained by farmer

Price of new born sheep and goat were L.E. 250 and 200. The prices were calculated according to year 2009

Table (6.2) Male animal revenue from wool, manure and body weight gain according to the three farm sizes

	Small farms		Medium farms		Large farms	
	Sheep	**goat**	**Sheep**	**goat**	**Sheep**	**Goat**
1- Body weight gain						
Av. number of male/farm	28	15	73	30	150	37
Growing male No.	24	14	66	27	135	30
Adult male No.	4	1	7	3	15	7
Av. Daily gain (kg/day) + SE	0.122^{b} ±0.15	0.098^{b}± 0.10	0.148^{a} ± 0.17	0.106^{ab}± 0.11	0.154^{a}± 0.18	0.115^{a}± 0.10
Price/kg live weight	25	25.5	25	26.5	25.5	26
Growing male revenue (L.E.)	26718	12769.89	89133	27682.7	193502.9	32740.5
Growing male revenue %*	96.11	97.01	96.97	96.70	97.52	95.24
Adult male revenue (L.E.)	403	142	639	455	1245	1120
Adult male revenue %	1.45	1.08	0.70	1.59	0.63	3.26
2-Male wool revenue	89.26	-	235.02	-	498.75	-
Male wool revenue %*	0.32	0.00	0.26	0.00	0.25	0.00
3-Male manure revenue	588.29	251.57	1909.29	488.34	3172.28	517.13
Male manure revenue %*	2.12	1.91	2.08	1.71	1.60	1.50
Total male revenue	27799	13163	91916	28626	198419	34378
Male revenue/animal	993	878	1259	954	1323	929
Total animal revenue	65168	34049	194370	75498	458856	105889

Adult male body weight gain revenue was estimated as 15% of the present value

* Percentages were calculated in proportion of total male revenues

Manure came in the second place among the revenues items (except for the large goat's farms) then revenues from change in the adult male's value while wool revenues from sheep came in the last place. The total revenue for fattened male sheep was increased by rising farm size. While total revenue for fattened male goat, indicated that the medium farms surpassed large and small farms L.E. 954, 929 and 878 in medium, large and small farms, respectively.

There were significant differences ($P \leq 0.05$) in daily gains of male sheep. Differences among treatment means were tested and found that the small farms recorded less daily gain than both medium and large farms. While, for goat whether male or female show significant differences. However, difference was only significant ($P < 0.05$) between small and large farms. These differences may be attributed to differences in management practiced, the large farms have invested more money in feeding, labor and veterinary care because these enterprises have been commercial orientated. It might be also due to the quality and quantity of concentrate feed as most large and medium farms use home formulated ration and fed low quantity of straw.

Effect of farm and flock/herd size on economic efficiency of animal production

Table (7) points to the variable cost items and the total revenue of sheep and goats and the main economic efficiency measures estimated for the three farm sizes and for the total herds of sheep and goats. Variable cost items included feeding (concentrates and straws), labor, veterinary services and dead animals' values. Mortality rate of sheep was significantly ($P \leq 0.05$) higher in small farms than large farms while, there were no significant differences between medium and both small and large ones. The veterinary care and kids rearing systems may play important role to reduce mortality rate.

Table 7. Important measures of economic efficiency for animals according to farm and flock size

Items	Small farms		Medium farms		Large farms	
	Sheep	goat	sheep	goat	Sheep	Goat
Average animals costs per farm (L.E.)						
Concentrate costs	27705	15270	87435	31740	193080	45135
By produces costs	4320	1720	7857	2854	13437	3400
Total feeding cost	32025	16990	95292	34594	206517	48535
Animal labor cost	3800	2100	9408	4032	21788	5876
Veterinary cost	2280	1260	7644	3276	20112	5424
Mortality %	5.09[a]	2.67	4.18[ab]	2.09	3.17[b]	2.25
Mortality cost	672	192	1324	266	2196	397
TVC for animals	38777	20542	113668	42168	250613	60232
TR for animals	65168	34049	194370	75498	458856	105889
TR/ TVC for animals	1.68	1.66	1.71	1.79	1.83	1.76
Total animals GM	26391	13507	80702	33330	208243	45657
GM/TVC for animals	0.68	0.66	0.71	0.79	0.83	0.76

Grazing feed cost was not considered in feeding cost because it is varied over the year in the study area.
TVC: Total variable costs TR: total revenues GM: gross margin

The total variable costs and total revenue of sheep herds increases by the rise of farm size owing to increase number of males and females with the rise of farm size. Relative measures of economic efficiency were used, to compare the economic efficiency in farms of different sizes and different productive activities. The ratios TR/TVC and measures GM/TVC increased by the rise of farm size. It could be concluded that superiority was for large farms of sheep and for medium farms of goats. Also, the values of this measure clarifies that the pound spent on the variable costs items have achieved net revenue about L.E. 0.68, 0.71 and 0.83 for the different farm sizes of sheep, and L.E. 0.66, 0.79 and 0.76 of goat in the same farm sizes.

Table (8) shows the relative importance of variable costs per head of sheep or goat, and the main measures of economic efficiency. It is clear that the total variable costs for fattened females or males increased by the rise of the farm size as they reached about L.E. 515, 583 and 601 for sheep, and L.E. 490, 502 and 526 for goat. Also, it was noticed that total feeding costs (concentrates and straws) and veterinary services for sheep and goat increased by the rise of the farm size. The relative importance of feeding costs came in the first place with a percentage between 80-84% for sheep farms and between 80-83% for goat farms. However, under commercial dairy production system, feeding costs accounted for 87-90 % of total variable costs **(Ahmed et al., 2002**). The relative importance of labor costs came in the second place with a percentage between 8-10% for sheep and goat for the three farms sizes. The third place was taken for veterinary costs with a percentage between 6-9% for sheep and goat in the mentioned farms. The relative importance of dead animals with a percentage not exceeding 1% for goats and 2% for sheep comes at the end. Costs of feeding is considered the most important element of variable costs; thus, sheep and goat producers in these farms should have enough and balanced feed to achieve higher productivity of their animals. More attention should be paid to veterinary care (treatment and vaccination against predominant diseases) for sheep and goat that will reflect on the improvement of animal health and consequently increase productivity. Veterinary service costs were low, ranging between L.E. 30-48/head of sheep and goat/year. Percentage of mortality cost was low (between 1-2%) which reflect better environment in the studied area with no epidemical diseases and good grazing system that maintain good animal health.

On the other side, the total revenue from lactating heads of sheep and goats decreased by

Table 8. Relative importance of variable costs items and economic efficiency per animal according to farm and flock size.

Items	Small farms		Medium farms		Large farms	
	Sheep	goat	sheep	goat	Sheep	Goat
Average animal costs (LE)						
By-products/animal	57	41	40	34	32	30
Concentrate//animal	365	364	446	377	461	391
Total feeding cost /animal	422	405	486	411	493	421
Feeding cost%	82	83	84	81	80	80
Labor cost/animal	50	50	48	48	52	52
Labor cost %	10	10	8	10	9	10
Veterinary costs /animal	30	30	39	39	48	48
Vet. Cost%	6	6	7	8	9	9
Mortality cost	13	5	10	4	8	5
Mortality cost %	2	1	1	1	2	1
TVC/LA (L.E./year)	515	490	583	502	601	526
Total LA revenues	462	528	452	513	451	497
GM/LA /year	-53	38	-131	11	-150	-29
TR/TVC /LA	0.9	1.08	0.78	1.02	0.75	0.94
TR/male L.E./year	993	878	1259	954	1323	929
GM/male/year	478	388	676	452	722	403
TR/TVC male	1.93	1.79	2.16	1.90	2.20	1.77

LA: Lactating animal

TVC is the same for lactating female and grower male because animals are in the same group feeding

the rise of farm size. Using the gross margin (GM) to measure the economic efficiency of lactating animals, made it clear that GM shows negative values that increased by the rise of farm size of sheep (L.E. -53, -131 and -150 /head /year) indicating that variable costs of lactating ewes was greater than the total revenue they achieved, which led to negative GM. The lactating female goats, showed positive values of GM that decreased with small and medium farms, whereas it had a negative value in large farms and reached about L.E. 38, 11 and -29 /head, respectively.

Measure of GM indicated that lactating female sheep accomplished losses for the three farm sizes, whereas the female goats achieved low net revenues in small and medium farms, and losses in large ones. By using the TR /TVC measure per head, results showed that the values of this measure decreased by the rise of farm size. Values also indicated that each pound spent on variable costs achieved losses about L.E. 0.10, 0.22 and 0.25 for lactating sheep in the three farm sizes, respectively. Each pound spent on variable costs for lactating goat achieved low net revenue of about LE 0.08 and 0.02 for the small and medium farms, while losses in large farms was about L.E. 0.06. Low revenues and losses attained by lactating female sheep and goats are probably due to low productivity of these animals and for the short duration of lactation length.

The decrease of twinning rate (ranged between 103 -110% for sheep, and between 116- 133% for goats) which led to decrease in value of the new born of sheep and goats. Low productivity of these animals is probably due to unavailability of adequate fodder for grazing (surface area of grazing lands and plants intensity) due to low rate of rain fall in these areas during the last years. Consequently many Bedouins turned to feed their animals on high-priced concentrated feeds.

The measure of GM increased by the rise of the farm size for fatting male sheep, being L.E. 478, 676 and 722/head/years for the three farm sizes, respectively. Whereas the medium farms surpassed large and small farms for GM of male goats which had values of LE 452, 403 and 388/head/years, respectively.

These results agree with **Sammour et. al., (2006)** who reported that total revenue increased by the increase of farm size. Using TR/TVC measure, confirmed the superiority of large farms over small and medium farms. The ratios were 1.51, 1.43 and 1.61 for sheep, and 1.58, 1.73 and 1.79 for male goats, in the mentioned farms respectively.

The measure TR/TVC took the same trend of the gross margin as the values were 1.93, 2.16, and 2.20 /heads/year in the three farm sizes respectively. Whereas the medium farms surpassed their equivalents of small and large farms as the values were 1.90, 1.79, and 1.77 for goat' head per year respectively. The results of this measure points that the pound spent on the items of variable costs for the head of sheep of fattened male achieves net revenue about L.E. 0.93, 1.16 and 1.20 and in case of goat, about L.E. 0.90, 0.79 and 0.77.

CONCLUSION

In general, it is clear from the previous results of the economic efficiency measures that sheep production in large sheep farms is considered more efficient than small and medium farms, whereas medium goat farms achieved more efficiency of production than the other two farms sizes. The value of the measures of economic efficiency G.M. and TR/TVC increased for fattening male sheep and goats more than lactating female sheep and goats at the level of the three farm sizes.

Under crop-livestock production conditions, small ruminants compete for the available resources (land, capital and labor) with the other farm investment. Until now, implementation of technological development studies of small-ruminant production is limited as it relates to other farming systems. Therefore, the target, in terms of research, has to integrate production systems rather than isolate sheep and goat components. By using a multidisciplinary research approach, the problem can be addressed in realistic and practical way. Problems of sheep and goat production can neither be efficiently nor successfully solved until research concentrates on studying all of related and interrelated components involved. For too long, research has focused on one discipline at a time, ignoring the developing country's culture, environment, educational level of producers. Feeding costs is one of the main limiting factors that can affects profitability of small ruminant farms; it represented around 85% of total variable costs for all farm sizes. Using the availability and dependability of local feed technologies, crops by-products treatment, hay making from new green fodders varieties suitable to low rain areas and least cost ration formulation techniques can reduced animal feeding costs.

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