A whole farm analysis of goat production systems in north Sinai, Egypt

Alsheikh S.M., El Shaer H.

in

Pacheco F. (ed.), Morand-Fehr P. (ed.).
Changes in sheep and goat farming systems at the beginning of the 21st century : research, tools, methods and initiatives in favour of a sustainable development

Zaragoza : CIHEAM / DRAP-Norte / FAO
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 91

2009
pages 307-311

A whole farm analysis of goat production systems in north Sinai, Egypt

S.M. Alsheikh and H. El-Shaer

Desert Research Center, P. O. Box 11753, Mataria, Cairo (Egypt)

Abstract. The present study was carried out in North Sinai region. Data were collected as part of the project "Multinational approaches to enhance goat production in the Middle East" sponsored by MERC, USAID. Three goat production systems were identified according to water source and type of feeding or grazing: (i) the extensive rain fed one (S1); (ii) the semi intensive rain fed one with animals receiving supplementary feeding besides grazing (S2); and (iii) the intensive irrigated one (S3). The study was carried out on 234 farms during the agriculture year 2001-2002. Data were statistically analyzed to test the effect of production systems on two economic indicators: Internal Rate of Return (IRR, %) and return per animals (RPA) per LE. Statistical analysis showed significant (P<0.01) effect of production systems on these economic indicators. A Linear Programming (LP) model was used to optimize gross margin of each system. The optimal LP suggested for S1 system an increase grazing area from 18 to 24 feddans (1 feddan = 4 200 m^2) and herd size from 20 to 30 heads. In S2 the suggested increases in these two parameters were respectively from 8 to 12 feddans and from 29 to 40 heads. The largest income was noted when the herd size was maintained at 70 heads in S3. It could be concluded from the LP model that both grazing area and available cash resources were the limiting factors rather than labor. Goat activities contribute substantially (14-25%) to the total farm gross margin.

Keywords. Production systems – Linear programming – Goat – Gross margin.

Analyse à l'échelle de toute l'exploitation des systèmes de production caprine dans le Nord du Sinaï, Egypte

Résumé. *La présente étude a été réalisée dans le Nord du Sinaï. Les données ont été recueillies dans le cadre du projet « Approches multinationales pour améliorer la production caprine au Moyen-Orient », sponsorisé par le MERC, USAID. Trois systèmes de production caprine ont été identifiés au Nord du Sinaï selon l'origine de l'eau disponible et le type d'alimentation ou de pâturage : (ii) système extensif d'alimentation exclusive au pâturage (S1) ; (ii) système semi-intensif, pâturage + supplémentation alimentaire (S2) (dans S1 et S2 la source aqueuse est la pluie) ; et (iii) système intensif en irrigué sans pâturage (S3). L'étude a été réalisée sur 234 fermes durant l'année agricole 2001-2002. Les données ont été analysées statistiquement en testant l'effet système de production sur les 2 indicateurs économiques : taux interne de recettes (IRR%) et recettes par animal (RPA) et par LE. L'analyse statistique a montré un effet significatif (P<0,01) du système de production basé sur les 3 indicateurs économiques. Un modèle de programmation linéaire (LP) a été utilisé pour optimiser la marge brute de chaque système. Le modèle LP optimal suggère pour S1 une augmentation de la surface de pâturage de 18 à 24 feddans (1 feddan = 4 200 m^2) et de la taille du troupeau de 20 à 30 têtes. Pour le S2, les augmentations suggérées pour ces deux paramètres ont été respectivement de 8 à 12 feddans et de 29 à 40 têtes. D'autre part, le revenu le plus élevé pour le modèle LP a été observé quand la taille du troupeau se maintenait à 70 têtes dans le système S3. On peut conclure à partir du modèle LP qu'à la fois, la surface de pâturage et l'argent disponible sont les 2 facteurs limitants, plus que la main-d'œuvre. Les systèmes de production caprine ont une grande importance (14 à 25%) pour la marge brute totale de la ferme.*

Mots-clés. *Système de production – Programmation linéaire – Chèvre – Marge brute.*

I – Introduction

In Egypt, raising livestock is an important component of the agricultural sector. Among livestock types, small ruminants contribute a greater share in numbers and output compared to the rest of the world. In addition, the total number of goats in Egypt is about 5 millions heads and there

were 59 heads of goats per 100 feddans (MOALR, 2004**;** El-Shaer, 1999). Goats constitute an important animal resource under arid and semi-arid conditions. Owners, looking for the best possible way for handling and allocating their resources, usually use their experience for maximizing their farm income. However, sometimes, their experience does not guarantee optimal results. Accordingly, linear programming (LP) could be used as an effective technique to address the limited production resources among different agricultural (cultivation and livestock) activities to provide optimal results for these owners (Alsheikh *et al.*, 2002).

This study adopted LP technique to determine the optimum situation of the different three goat production systems in North Sinai of Egypt. In addition, comparison was made between the suggested structure obtained from the LP model and the actual structure in the three studied systems.

II – Material and methods

1. Data, technical coefficients and economic indicators

The present study was carried out at the North Sinai region, 320 km North East of Cairo. The target area extends about 150 km in length with approximately 50 km width. The annual rainfall ranges from 100-200 mm (winter season) during October to March (Galal *et al.*, 2002). The questionnaire data were collected during 2001-2002 as a part of the USAID/Middle East Regional Cooperation (MERC) program project "Multinational approaches to enhance goat production in the Middle East". A total of 234 owners were involved in a specific questionnaire sheet covering all possible agricultural, social and economic information. Three goat production systems were identified according to water source and the type of feeding and (or) grazing:

(i) System-1: extensive rain fed (feeding requirements completely covering through grazing) (S1);

(ii) System-2: semi intensive production where water source is the rain and animals received supplementary feeding besides grazing (S2);

(iii) System-3: intensive irrigated production system (no grazing) (S3).

Technical coefficients of the three goat production systems are presented (Table 1).

Two economic indicators were considered. The first was the internal rate of return (IRR), defined as the rate of return that would be achieved on all farm resource costs, where all benefits and costs are measured in economic prices and calculated as the rate of discount for which the present value of the net benefit stream becomes zero, or at which the present value of the benefit stream is equal to the present value of the cost stream at interest rate of 10%. The second economic indicator considered was return per animal (RPA) defined as the gross margin divided by number of animals.

2. Statistical analysis

Data were analyzed using SAS system for Windows (1998). The models used to study different factors potentially affecting IRR and RPA. The mathematical details of the model are shown below.

$Y_{ij} = \mu + S_i + F_{j(i)}$, where:

Y_{ij} = the observation on the j^{th} farm, within the i^{th} production system;
μ = overall mean;
S_i = the effect of the production system, i =1-3;
$F_{j(i)}$ = the effect of farm within the production system, j =1,…234.

The farm was considered as the model error, assumed to be normally and independently distributed with mean 0 and variance σ^2_F.

Table 1. Technical coefficients of the three goat production systems in North Sinai

Items	System		
	S1	**S2**	**S3**
Biological coefficients			
Av. herd size (head)	20	29	45
Av. litter size (kids / doe / kidding)	1	1.2	1.6
No. weaned kids / doe / year	1	1.14	1.24
Yearling rate (no. of kids alive at yearling / doe)	0.9	1.22	1.90
Average weaning weight of kid (kg)	10	9	8
Average kg weaned / doe / year	10	13	18
Average kg sale / kid	15	21	30
Average kg sale / doe / year	13.5	25.6	57
Replacement rate (yearling does)	0.15	0.2	0.25
Saleable kid / doe / year	0.75	1.02	1.65
Net doe production at sale (kg / doe / year)	11	21	50
Kg live body weight of fattened kids / doe / year	NP	15	35
No. of kg of concentrate/ kg live body gain	4	5	6
No. of kg of concentrate for fattened kids / doe / year	NP	50	150
Economic coefficients per farm (LE)			
Gross output (GO)	3200	9000	21000
Variable costs (VC)	2400†	5600	12500
Gross margin (GM)	1200	3400	9500

NP: Not practical.
†Variable cost in S1 was assumed that one shepherd obtained 200 LE as monthly salary.
LE: Egyptian Pound (1 US$ = 5.75 LE and 1 Euro = 7.5 LE; March, 2007).

3. Mathematical LP

LP model was done using General Algebra Modelling System (GAMS, 2000) software to compare the efficiency of the three studied production systems under the following assumptions:

(i) The optimization LP function was used to maximize the farm gross margin, which was calculated by subtracting the variable cost from gross output.

(ii) LP model constraints included available cash resources (ACR), which was assumed to be equal to the gross output, labor, grazing area, goat productivity and feeding requirements (Table 1).

(iii) Variable costs in both S2 and S3 included feeding requirements, veterinary services, labor and other miscellaneous costs. While, in S1 included only labor cost for one shepherd.

(iv) Gross output (GO) was calculated as: GO = kg live body weight of does sold in S1 and sold fattened kids in S2 and S3 each multiplied by 15 LE (farm gate price in 2002).

(v) There is no dynamic relationship between grazing and growth performance.

III – Results and discussion

1. Statistical model solution

The intensification form system to another depends on higher kidding rates, lower kid mortality and higher sale weights of fattened kid. The statistical analysis showed significant effects on the two studied economic indicators in the three studied systems (Table 2). Higher level of significance (P<0.01) was detected for IRR and RPA indicating that systems responded differently to the owner activities. The highest IRR percentages and RPA per LE was scored for system 3, while the lowest was scored for system 1. Also, the standard error of S1 and S2 was similar for IRR% while in RPA (LE) the standard error of S1 is higher then the other two studied systems. Moreover, the observed differences between the three studied systems are very close but, they are significant due to the high difference between the standard errors. These results could be accrued due to the data transformation of IRR % indicator and for different number between the three studied systems in RPA (LE) indicator. Also, these results could be accrued due to the biological differences of feeding regime between the three studied systems and the assumption of there is no dynamic relationship between grazing and growth performance, which meaning that growth performance is not affected by grazing area, time and (or) the type of grazing plants.

Table 2. Least squares means (LSM) and standard errors (±SE) for the impact of three goat production system on inter rate of return (IRR %) and return per animal (RPA) per LE

Source of variation	IRR (%)			RPA (LE)		
	No.	LSM	±SE	No.	LSM	±SE
Systems		0.07**			0.05**	
S1	52	0.13[a]	0.10	52	0.01[a]	0.20
S2	87	0.15[a]	0.11	87	0.02[b]	0.01
S3	95	0.19[b]	0.06	95	0.03[c]	0.01
Farm (System)†	0.007 (231) [df]			0.007 (231) [df]		

***, [a], [b]: mean significant at P< 0.01*
†Farm (System) used as an error term;
df: degrees of freedom.

2. Mathematical Linear Programming (LP) solution

The actual situation and optimal LP output solutions are shown (Fig. 1). The optimal LP solution suggested that, owners should increase the average herd size from 20, 29, 45 heads to 30, 40 and 70 heads in S1, S2 and S3, respectively. Also, grazing area should be increased from 18 feddans (1 feddan = 4200 m2) to 28 feddans in winter and from 24 feddans to 32 feddans in summer in S1. In S2, the grazing area should be increased from 8 feddans to 17 feddans in winter and from 12 feddans to 20 feddans in summer. In addition, labor should be increased by 100% in the three studied systems. Moreover, the raw gross margin in S3 was higher than the other two studied systems (S1 and S2) while, the relative gross margin to actual situation was improved by about 43%, 47% and 45% in S1, S2 and S3, respectively. Also, the relative return per head was improved by about 14%, 25% and 14% in S1, S2 and S3, respectively. These results indicated that S2 showed higher economic efficiency than other two systems (S1 and S3) in both relative gross margin and return per head. Moreover, the S2 system used the highest number of labor compared with other two systems as it included two activities i.e. grazing and fattening kids. On the other hand, the S2 system would help to reduce the feeding requirements through animal grazing. So, it could be recommended to owners in other different

goat production areas in North Sinai region to follow this system in order to improve their income by 11% per year.

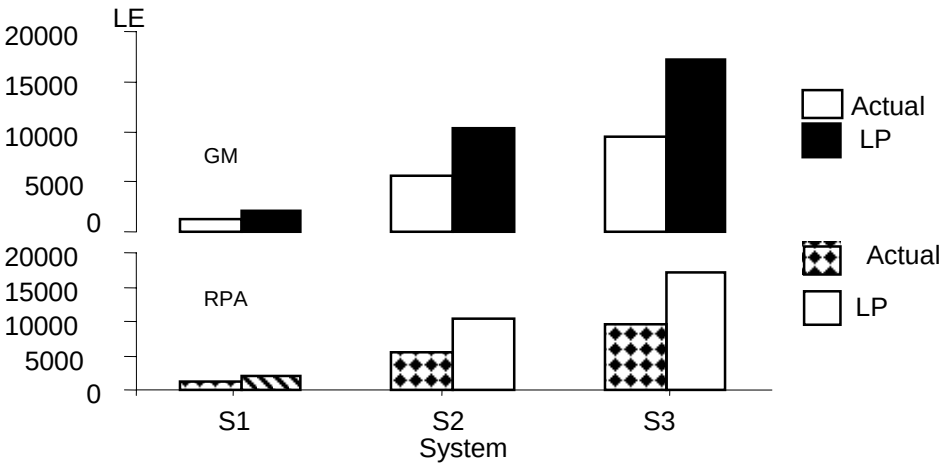

Fig. 1. Gross margin (GM) and return per animal (RPA) per Egyptain pound (LE) for actual and LP solution for the three studied systems.

IV – Conclusion

The three studied systems had positive significant (P< 0.01) effect on the two studies economic indicators. The degree of impact differed among the three studies systems where system 3 showed the highest impact on IRR% and RPA per LE. In goat production systems in North Sinai, animal activities contribute substantially, about 25%, to the total farm gross margin.

References

Alsheikh S.M., Ahmed A.M., Mansour H. and Galal E.S.E., 2002. Improving crop/livestock production system in a newly reclaimed area in Egypt. In: *Egypt. J. Anim. Prod.*, 39, p.147-160.

El-Shaer H.M., 1999. *Range-livestock interaction component*. Annual Report of Desertification of Arid Lands in the Middle East Project, Desert Research Center, 3, p. 26.

GAMS, 2000. *General Algebra Modeling System* software, version. 2.5, GAMS Development Corporation, 1217 Potomac St., N W Washington, DC 20007, USA.

Galal S., Rasoul F.A., Anous M.R. and Shaat I., 2002. On-station characterization of small ruminant breeds in Egypt. ICARDI report, p. 1-78.

MOALR, 2004. *Agricultural Statistics, Economic Affairs Sector.* Ministry of Agriculture and Land Reclamation, Egypt, p. 1-223.

SAS, 1998. *SAS/STAT User's Guide*, Release 6.03 Edition. SAS Institute Inc. Cary, North Carolina, USA.