POSTER PRESENTATIONS

A WHOLE FARM ANALYSIS OF GOAT PRODUCTION SYSTEMS IN NORTH SINAI, EGYPT

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SUMMARY

The present study was carried out in the North Sinai region, 320 km North East of Cairo. Data were collected as a part of the project sponsored by MERC, USAID. Three goat production systems were identified in North Sinai according to water source and type of feeding or grazing. The goat production systems classified were System-1; extensive rain fed (S1). System-2; semi intensive production where water source is the rain and animals received supplementary feeding besides grazing (S2). System-3; intensive irrigated production system (S3). The study was carried out on 234 farms during the agriculture year 2001–2002. The data were statistically analyzed to test the effect of the three mentioned systems on two economic indicators, Inter rate of return (IRR %) and return per animals (RPA) per LE. The statistical analysis showed significant ($p<0.01$) effects on these economic indicators in the three studied systems. The highest IRR % and RPA per LE was scored for system 3, while the lowest was scored for system 1. Linear programming LP model was used to optimize gross margin of each system. The optimal LP model suggested for S1 system an increase in maximum grazing area from 18 feddans to 28 feddans in winter and from 24 feddans to 32 feddans in summer and herd size from 20 head to 30 head. For S2 system, the suggested increase was 8 feddans to 17 feddans in winter and from 12 feddans to 20 feddans in summer for grazing area and from 29 heads to 40 heads for herd size. On the other hand, the largest income for the LP model 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 resources while labour was not. In goat production systems in North Sinai, goat activities contribute substantially, about 14–25%, to the total farm gross margin. Statistical and LP analyses showed different results, with highest return in system 3 in statistical analysis to highest return in system 2 in LP analysis.

Keywords: production systems, linear programming, goats, grazing

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 than they have elsewhere in 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 linear programming (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.

MATERIALS AND METHODS

Data and technical coefficients: The present study was carried out at the North Sinai region, 320km North East of Cairo. The target area extends about 150km in length with approximately 50km depth. 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 titled "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 ware classified according to water source and the type of feeding and grazing. System-1; extensive rain fed (S1). System-2; semi intensive production where water source is the rain and animals received supplementary feeding besides grazing (S2). System-3; intensive irrigated production system (S3). Technical coefficients of the three goat production systems are presented in Table 1.

Economic indicators: Two economic indicators were considers. 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.

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} system;
μ = overall mean;
S_i = the effect of system, i =1,…3; and
$F_{j(i)}$ = the effect of farm within 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.

Mathematical LP: LP model was done using GAMS (2000) software to compare the efficiency of the three studied production systems under the following assumptions:

1. The optimization LP function was used to maximize the farm gross margin, which was calculated by subtracting the variable cost from gross output.
2. LP model constraints included available cash resources (ACR), which was assumed to be equal to the gross output, labour, grazing area, doe productivity and feeding requirements (Table 1).
3. Variable costs in both S2 and S3 included feeding requirements, veterinary services, labour and other miscellaneous costs. While, in S1 included only labour cost for one shepherd.
4. 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).
5. There is no dynamic relationship between grazing and growth performance.

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. of weaning 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

S1: Extensive rain-fed production system.
S2: Semi intensive production system.
S3: Intensive irrigated production system.
NP: Not practical.
* Variable cost in S1 was assumed that one shepherd obtained 200 LE as monthly salary.

RESULTS AND DISCUSSION

Statistical model solution: The intensification form system to anther 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.

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

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

Farm (System) used as an error term.

Mathematical Linear Programming (LP) solution: The actual situation and optimal LP output solutions are shown in Table 3 and Figure 1. The optimal LP solution suggested that, owners should increase the average herd size from 20, 29, 45 head to 30, 40 and 70 head in S1, S2 and S3, respectively. Also, grazing area should be increased from 18 feddans 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, labour should be increase 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 labour 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.

Table 3. Actual situation (A) and linear programming (LP) solutions for the three studied goat production systems in North Sinai of Egypt

Item	System I			System II			System III	
	A	LP		A	LP		A	LP
Biological output								
Av. herd size (head)	20	30		29	40		45	70
Gazing area (feddan)								
Winter	18	28		8	17		–	–
Summer	24	32		12	20		–	–
Labor (person-day)								
Winter	1	2		2	4		1	2
Summer	1	2		2	4		1	2
Economic output								
ACR (LE)	3200	5000		9000	9000		21000	21000
Gross margin (LE)	1200	2100		5600	10320		9500	17230
Return per head(LE)	60	70		193	258		211	246

Values were round to the nearest integer.

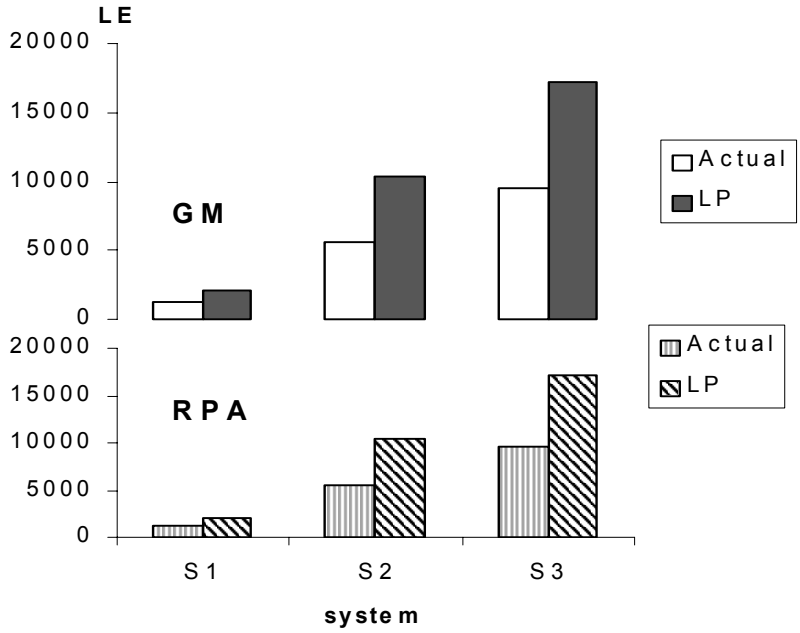

Figure 1. Gross margin (GM) and return per animal (RPA) per LE for actual and LP solution for the three studied systems.

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. LP model showed that both grazing area and available cash resources were the limiting resources while labour was not. In goat production systems in North Sinai, animal activities contribute substantially, about 14–25%, to the total farm gross margin.

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