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Metawi H.R.

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Economic sustainability of goat production under different production systems in Egypt

H.R.M. Metawi

Animal Production Research Institute, Agriculture Research Center, Cairo (Egypt)
hrmmetawi@hotmail.com

Abstract. A questionnaire was conducted with 92 goat owners in three areas, each one representing one of the most prevalent production systems in Egypt. Bio-economic data were collected and submitted to cost-benefit analysis. When family labor cost was included as an opportunity cost, the economic analysis revealed a break even for semi-intensive system while transhumant /extensive system was losing. Although the smallholder production system gave positive return, the high kid mortality rate of 25.7 %, greatly affected its profitability. Simulation techniques were used to simulate the introduction of technical packages, which included preventive health care, the introduction of Damascus breed genes, enhanced nutritive value of crop byproducts and supplementary feeding during critical periods. It can be concluded that a multidisciplinary approach is necessary, with varying degrees of importance, to improve the economic sustainability of goat production systems.

Keywords. System approach – Tanshumant/extensive system – Semi-intensive system – Smallholder system – Simulations.

La durabilité économique de la production caprine dans différents systèmes de production en Egypte

Résumé. *Un questionnaire a été utilisé auprès de 92 éleveurs de chèvres dans trois zones, chacune représentant l'un des systèmes de production les plus répandus en Egypte. Des données bioéconomiques ont été collectées et utilisées dans une analyse coût - bénéfice. Lorsque le coût du travail familial est inclus comme un coût d'opportunité, l'analyse économique révèle un seuil de rentabilité positif pour le système semi-intensif alors que le système transhumant / extensif est déficitaire. Bien que le système de production des petits exploitants donne un rendement positif, le taux élevé de mortalité des chevreaux (0-4 mois) de 25,7% affecte grandement la rentabilité. Des techniques de simulation ont été utilisées pour simuler l'introduction de packages techniques intégrés, qui incluent des soins préventifs de santé, l'introduction génétique de la race Damascus, l'amélioration de la valeur nutritive des résidus de récolte et l'alimentation complémentaire durant les périodes critiques. L'étude montre qu'une approche multidisciplinaire est nécessaire, à des degrés divers , pour améliorer la durabilité économique des systèmes de production caprins.*

Mots-clés. *Approche système – Système transhumant/extensif – Système semi intensif – Système de production des petits exploitants – Simulations.*

I – Introduction

Prevailing small ruminant production systems in Egypt can be classified into transhumant/extensive, semi-intensive and smallholder (Galal, 2007).

The transhumant / extensive system prevail in the northwestern coastal zone and Sinai. These are classified as arid zones with annual rainfall <150mm. Most of the inhabitants are Bedouins, depending raising small ruminant's flocks, beside cultivation of barley and some fruits as olives and figs. This production system is characterized by long-distance movements in search for feed, flocks graze natural pastures during winter and spring and move to crop areas after the harvest to graze crop residues. Flocks in this system are usually large. Over the last few decades, rangelands have largely deteriorated due to increasing pressure of man and animal

and the contribution of range was reported by Galal *et al.* (2005) to meet only 30% of small ruminant feed requirements.

Semi-intensive production system is more common in reclaimed areas where small ruminant production represents the main source of income. The crop rotation usually includes large proportion of the farm area as a winter fodder crop (mainly berseem, *Trifolium alexandrinum*). Land is intensively cultivated with an average of more than two crops a year which would allow for the cultivation also of summer fodder crops. These fodder crops plus crop and by-products constitute the small ruminant feed resources.

The smallholder production system is prevailing in the Nile Valley and the Delta. It is a mixed crop-livestock integration system, where farmers keep small flocks mainly for home consumption and to generate additional income.

To improve traditional goat production systems in Egypt existing constraints within each system must be surmounted. Therefore, this study was initiated to describe the goat production systems mostly prevalent in Egypt and assessing their economic sustainability. In addition, the roles of introducing technical packages in improving the herd profitability of the studied systems were investigated.

II – Material and methods

1. Data collection and analysis

The survey was conducted by way of personal interviewers with 92 goat owners covering three districts; each one represents one of the most prevalent production systems in Egypt. Two of the studied districts (Marsa Matrouh and Borg-Arab) fall, respectively, on west and east of the north coastal zone of Egypt, while the third district located in Sharkia governorate, east of the Nile Delta. The most represented goat breed and predominantly production system in the three districts are presented in Table1.

A special questionnaire was designed to collect information on general household characteristics, herd management and input and output parameters. Parallel to the household survey, seven herd per district were asked to continue with a performance test of their goat herds. Regular monthly visits were conducted to each of these herds over a period of two years.

Least squares analyses of variance were conducted using the general linear model procedure of SAS (1990) .Statistical model included production system, year, season of kidding, flock size and all possible interaction.

2. Economic analysis of goat production

Cost-benefit analysis (CBA) was performed using Microsoft Excel spreadsheet. The financial analysis accounted only for paid expenditures, as feeding and veterinary costs and some other miscellaneous items such as service charge cost, in the case of flock without bucks. While the economic analysis accounted for all paid and unpaid input costs including family labor cost, which was given an opportunity cost. Average input and output prices were estimated based on the actual market value paid by farmers to purchase these items/services. In both analyses, the fixed costs were assumed nil since houses are made of available and cheap materials and no special equipment are needed. The economic sustainability was examined using a CBA and comparing the benefit-cost ratios.

3. Simulation model

Four scenarios were proposed to enhance the production system efficiency, namely: (i)

preventive health care; (ii) introduction of Damascus breed genes; (iii) enhancing nutritive value of crop by-products; and (iv) supplementary feeding during the critical periods. Simulation techniques were used to apply the proposed scenarios on farm models in each system. The model was a modified version of the Texas A&M sheep simulation model (Blackburn and Cartwright, 1987a, b, c). Detailed description of the simulation model is presented in Almahdy and Metawi (2000). Goat herds were simulated for 10 years life-cycle production.

III – Results and discussion

1. Characterization of the goat production systems

A. Production resources

Excluding the grazing lands in Marsa Matrouh, which are communal lands, the average land area (rented, owned or set by) per producer, allocated to produce barley and some fruits were 56.9 feddan (Table1). The highest frequency of herd owners (66.7%) were those having more than 20 feddan (1feddan = 1.038 acres).

Table 1. The major features of the goat productions systems

Character	Districts		
	Marsa Matrouh	**Borg-Arab**	**Sharkia**
Production system	Transhumant/extensive	Semi-intensive	Smallholder
Farm size (feddan)†	56.9	12.7	2.7
% Farmers holdings:			
1 or less feddan	-	10.0	70.0
>1-5 feddan	8.3	23.3	23.2
>5-10 feddan	8.3	36.6	6.6
>10-20 feddan	16.7	16.6	-
>20 feddan	66.7	13.3	-
Family size (person)	7.8	5.7	6.4
Herd size (head)	140.7	123.0	13.3
Dominating breed	Barki	Barki	Baladi (native)
Flock composition:			
Goat herds (%)	3.4	6.6	26.6
Mixed flocks (%)	96.6	93.4	73.4
%of goats in mixed flock	14.5	18.6	34.2
Feeding system††	NV+CR+SF	IF+SF	IF+CR

†1 feddan = 1.038 acres.
††NV=natural vegetation, CR=crop residues, SF=supplementary feeding and IF=irrigated fodder.

Seventy percent of farm holdings in Sharkia are less than one feddan, which reflects the density of human population on the old cultivated lands in Egypt. This has resulted in the partitioning of the lands into small farm holding, which average 2.7 feddan in size. In the new reclaimed areas (Borg-Arab), 33.3% of farm holdings are less than five feddan with average farm size of 12.7 feddan. In Sharkia, sheep and goats are kept in small flock size (13.3 heads) while about 27% of the flocks comprised goats.

B. Current management practices

The existing feeding practices under the different production systems are presented in Table1.

Producers in Marsa Matrouh are basically transhumant pastoralists, who graze small ruminants on the rangelands. Outside of the rainy season, small ruminants graze low quality herbage and depend on supplementary feeding. The supplementation-feeding period depends mainly on the rainfall. Herd owners in Borg-Arab use large proportion or all their land to cultivate fodder crops for their small ruminants. Supplementation is not common in winter, only on rainy days and for does that will be kidding. During summer months, supplementation is given according to fodder quality.

In both previous systems, most of the breeders try to induce kidding at the most favorable period of the year. They selected their bucks from their own herds based on the buck dam performance and their own phenotype. The mating is not well managed and has resulted in inbreeding. On the other hand, uncontrolled mating within the smallholders flock was predominant. The majority of the households cannot afford keeping a buck on their farms. Estrous does were mated with bucks available in the village against a service charge.

In all systems, management of the goats was based on primary experiences, and modern technology was not applied. Supplementation is based on the reproductive state of the does and practiced only with lactating does. Kids are not generally weaned.

C. Production performance

Table 2 shows that Baladi goats under smallholder system are superior in twinning rate than Barki goats under others two production systems. The average litter size was found to be 2.06 *vs* 1.25. A close estimates to the present results were determined by Galal (2005), under research stations condition. Herd productivity, expressed as annual kilograms of kids produced per doe, was higher under semi-intensive system than that of corresponding figures obtained under transhumant/extensive and smallholder systems.

Higher rate of kid's mortality (25.7%) and lower kid body weights at 4 months (11.85 kg) are the major's factors limiting productivity for the smallholder herds.

Table 2. Least squares means and standard errors of the goat performance under the different production systems

Criterion	Production systems		
	Transhumant/extensive	Semi-intensive	Smallholder
Litter size at birth	1.25 ± 0.06[b]	1.27 ± 0.07 [b]	2.06 ± 0.05[a]
Kid mortality from 0 to 4 months	11.4 ±0.74 [a]	9.6 ±0.22[b]	25.7± 0.53[c]
Kid weights at 4 months	14.31±0.41 [a]	16.47± 0.44 [b]	11.85± 0.48[c]
Kg kids production/doe/year	19.0	22.7	21.8

Means in the same column with different superscripts differ significantly (P<0.05).

2. Economic analysis

All the systems had positive profits in the financial analysis, while only smallholder system was profitable in the economic analysis (Table 3). This was further confirmed by the benefit-cost ratio, which was high (more than 1). Farmers in this system integrated small ruminant with crop production thus cutting down on feed expenses. Furthermore, small ruminant provide a means to profitably use farm labor during periods when it is not needed for cultivation or harvesting crops (Savadogo, 2000).

Transhumant/extensive and semi-intensive production systems were economically unfeasible. The inclusion of labor cost as an opportunity cost in the economic analysis inflated the cost/doe with negative effects on feasibility. However, the valuation of herding family labor was reported to be problematic in most traditional small ruminants systems (Scoones, 1992).

Table 3. Cost, revenue and profit per doe and annual benefit-cost ratio (BCR) for the three-production systems

Production systems	Cost/doe (LE)	Revenue/doe (LE)	Profit/doe (LE)	Benefit-cost ratio
Financial analysis:				
Transhumant/extensive	364.96	379.35	14.39	1.02
Semi-intensive	372.12	431.15	59.03	1.13
Smallholder	301.85	434.28	132.43	1.13
Economic analysis:				
Transhumant/extensive	411.77	379.35	-32.42	0.90
Semi-intensive	425.78	431.15	5.37	1.13
Smallholder	314.64	434.28	119.64	1.42

1$= LE 5.7

3. Simulation results

Scenario 1 was most effective under the smallholder production system (Table 4), which reflects that kid mortality rate is the major production constraint in this system. Replacing the indigenous goats by Damascus crossbred (scenario 2) achieve improvement in all the production systems. Crossbreeding efficiency is more efficient under semi-intensive system. Kosgey *et al.* (2006) reported that crossbreeding efficiency is constrained by the prevailing low-input smallholder production systems. The main advantages of the Damascus crossbreds were reported by Aboul-Naga *et al.,* (2008). Reducing feed cost by enhancing crop by-products nutritive value (scenario 3) is more recommended under transhumant/extensive system. El-Abid and Ahmed (2010) concluded that efficient utilization of available feed resources will establish sustainable farming practices that will insure continued supply of flock production with reasonable cost. However, there are many different kinds of agriculture and agro-industrial by-products available in the region, which are seriously under exploited.

Table 4. Simulation results for the proposed scenarios in different production systems

Production systems	Profit/doe , LE†			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Transhumant/extensive	24.96	98.25	68.88	38.6
Semi-intensive	31.08	180.13	24.24	43.99
Smallholder	120.68	49.06	12.00	62.97

†Accounted for annual total costs and revenues above current situation. Scenarios: 1: Preventive health care; 2: Replacement of a native goat by Damascus crossbred; 3: Enhance nutritive value of crop byproducts; and 4: The supplementary feeding during critical periods.

Supplementary feeding during critical periods (scenario 4) increased profit/doe by LE 38.6, 43.99 and 62.97, respectively, which indicated that the economic benefit of applying this scenario is high enough to justify the additional feed costs.

IV – Conclusion

All the systems had positive profits in the financial analysis, while only smallholder system was profitable in the economic analysis. The highest producing production system was not the most

economic one. Integration of goat into cropping systems plays an important role for efficient utilization of farm input resources.

Nutrition is the most important constrain in the transhumant/extensive system. The main expenses are due to the feeding when supplements are used. Lack of appropriate goat breed is the major constrain limiting profitability of semi-intensive system. Animal health seems to be one of the major factors limiting productivity of smallholder system.

Generally, simulation results showed that the introduction of the proposed scenarios had different positive impacts on the profitability of all production systems studied. Therefore, a multidisciplinary approach is necessary, with varying degrees of importance, to improve the economic sustainability of goat production systems.

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