RESEARCH OPINIONS IN ANIMAL & VETERINARY SCIENCES

ISSN 2221-1896 (PRINT) www.roavs.com ISSN 2223-0343 (ONLINE)

Economic analysis of intensive sheep production system in Iran by bio-economic model

Kian Pahlevan Afshari[1], Mokhtar A. Abbasi[2], Mehdi Aminafshar[1], Mahmood Vatankhah[3] and Mohammad Chamani[1]

[1]Department of Animal Science, Islamic Azad University, Science and Research Branch, Tehran, Iran; [2]Animal Science Research Institute of Iran, Karaj, Iran; [3]Department of Animal Science, Agriculture and Natural Resources Research Center, Shahrekord, Iran

Abstract

For the economical analysis of the intensive sheep production system in Iran, a bio-economic model was used. Two flocks of Zel breed of capacities of 3400 and 900 heads, were studied. The variable costs accounted for about 98.81% of the total costs. Among the variable costs, feed costs had the highest proportion (87.14%). Income sources included meat, wool, and manure, where meat was the most important one and it formed 96.36% of the total revenue. All the animal categories had negative profits except yearling lambs. The total profit per ewe per year was calculated as 1969254 Rls. The results showed that intensive sheep production system is a profitable system compared with village and nomadic systems. The study provided some important information on the traits that should be included as breeding objectives.

Key words: Sheep; Economic analysis; Bio-economic model; Intensive production system

Introduction

The relationship between man and ruminant has generally been viewed as synergistic. Today, however the pressures of a rapidly expanding world population with increasing expectations for an adequate diet have caused many to question the future of ruminant animal agriculture (Fitzhugh, 1978). Iran has 53800000 heads of sheep which are reared under two major production systems, the rural and migratory systems (FAO, 2008). Today in the world, various methods and systems of sheep production are applied based on economic factors, natural resources and even religious and racial factors (Petrović, 2005). Therefore, there is no one general model for all the other cases in the world (Osamu, 2005). Profit is the common objective for ruminant production systems. With the increasing demand for sheep meat in the world, there is a need to study various aspects of the production chain, including costs and revenues of the system (Lôbo et al., 2011). Economic analysis of sheep production systems were studied in the past years. For example these objectives were reported by Vatankhah (2005), Tolone et al. (2011) and Şahin (2002). Normative methods make use of profit functions or bio-economic models. A profit function is a single equation designed to represent the relationship between the performance of animals in economically important traits and farm-level profit, or some other measure of economic outcome (Bourdon, 1998). Single-equation methods for economic analysis may not be precise and flexible enough for describing different production systems and economic conditions. An alternative to the single-equation method is the use of a bio-economic simulation. Bio-economic models consist of a collection of equations that characterize biological relationships, simulate management and economic situations and determine profitability or some other measures of economic efficiency of the evaluated production system (kropová et al., 2008). In Iran, economic analysis have been studied for various breeds of sheep kept in rural and migratory systems but there is no a study based on intensive sheep production system. The objective of this study is a cost-benefit analysis for industrial sheep production system by the bio-economic

Corresponding author: Kian Pahlevan Afshari, Department of Animal Science, Islamic Azad University, Science and Research Branch, Tehran, Iran. Tel: +982144865023 - Fax: +982144865464

approach. This aim will support the development of breeding objectives, which is generally regarded as the first step in the development of structured breeding programs (Ponzoni, 1986).

Materials and Methods

Collection of Information and Definitions

In order to collect the information of management and the economic parameters for the bio-economical equations, two flocks of Zel breed with the capacities of 3400 and 900 heads were studied directly from the beginning of September 2010 to September 2011. The production system of the flocks was completely intensive and animals were kept and fed inside of pen throughout the year. Pregnancy was three times within the two years (each eight months once) using estrus synchronization. Diets were formulated based on the energetic needs of each production stage (NRC 2007). In this study the average prices of 2011 were used and all costs and prices were expressed in Iran Rls. (US$1.00≈ 12800). Performance data, management and economical parameters used in model are summarized in Table 1.

Animal flows and events

Fig. 1 shows animal events and animal flows of the intensive sheep production system for Zel breed. Five animal categories were distinguished according to age: (1) pre-weaning lambs (0-3 months old); (2) post-weaning lambs (3-6 months old); (3) yearling lambs (6-12 months old); (4) breeding rams (> 12 months old) and (5) breeding ewes (> 18 months old). Age of replacement for females and males was 12 months old and that of selling of lambs was 9 months. The fattening period was three months and is done before the sale of lambs.

Expenses and revenues resources

Inputs and outputs in the intensive production system of Zel sheep included:

Table 1: Average of productive and management parameters in the intensive sheep production system to be used in the bio-economic model

Variable	Mean
Flock structure	
Number of ewe in flock	2150
Number of ram in flock	43
Conception rate (%)	98
Parturition rate (%)	99
Twining rate (%)	23
Number of lambing per year	1.5
Number of lamb per birth	1.23
Ewe survival (%)	98
Ram survival (%)	98
Pre- weaning survival (%)	97
Survival before 6 month (%)	96
Replacement female survival (%)	99.5
Replacement male survival (%)	99.5
Ewe's Culling rate due to disease (%)	4
Mortality rate of replacements (%)	0.5
Mortality rate of ewes (%)	2
Mortality rate of rams (%)	2
Mortality rate of lambs from birth time till weaning (%)	3
Mortality rate of lambs from 3 months till 6 months (%)	1
Mortality rate of lambs from 6 months till 12 months (%)	1
Birth weight (kg)	3.5 ± 0.19
Weaning weight (kg)	20 ± 2.01
Female lambs weight at 6 months (kg)	30 ± 3.52
male lambs weight at 6 months(kg)	40 ± 1.5
Weight of female lamb's at yearling (kg)	35 ± 1.3
Weight of male lamb's at yearling (kg)	45 ± 2.2
Weight of ewe's (kg)	45± 1.2
Weight of ram's (kg)	55 ± 3.3
Annual wool weight of ewes (kg)	1.6 ± 0.4
Annual wool weight of rams (kg)	2.5 ± 0.6
Annual wool weight of lambs (kg)	0.9 ± 0.1
Daily gain from birth till weaning (kg)	0.180
Daily gain from 3 months till 6 months of male lamb (kg)	0.220
Daily gain from 3 months till 6 months of female lamb (kg)	0.120
Daily gain from 6 months till 12 months of male lamb (kg)	0.05
Daily gain from 6 months till 12 months of female lamb (kg)	0.027
Weight of male lamb's at 18 months (kg)	55
Management variable	
Weaning age of lambs (months)	3
Number of shearing times per year	1
Number of years keeping ewes in flock	6
Number of years keeping rams in flock	5
Feed intake variables	
Days using manual feeding	365
Roughage metabolic energy (Mcal/DM)	1.89
Concentrate metabolic energy (Mcal/DM	1.9
Cost of ME of breeding ewe (Rls./MJ)	307.93
Cost of ME of breeding ram (Rls./MJ)	319.21
Cost of ME of lambs till 3 months (Rls./MJ)	430.45
Cost of ME of yearling (Rls./MJ)	327.27
Cost of ME of lambs of 3-6 months (Rls./MJ)	335.33
Concentrate price (Rls /kg)	3300
Roughage price (Rls /kg)	1610
Management costs	
Drug , veterinary service ,parasite control and vaccination (Rls /head/year)	10000
Labour (Rls /100 head/month)	1018000
Shearing (Rls /head/year)	20000
Fuel , water and electricity (Rls /head/year)	80610
Marketing costs	
Price of live weight of lamb (Rls /kg)	65000
Price of live weight of culled ewe (Rls /kg)	50000
Price of live weight of culled ram(Rls /kg)	50000
Wool price (Rls /kg)	15000
Manure price (Rls /kg)	300

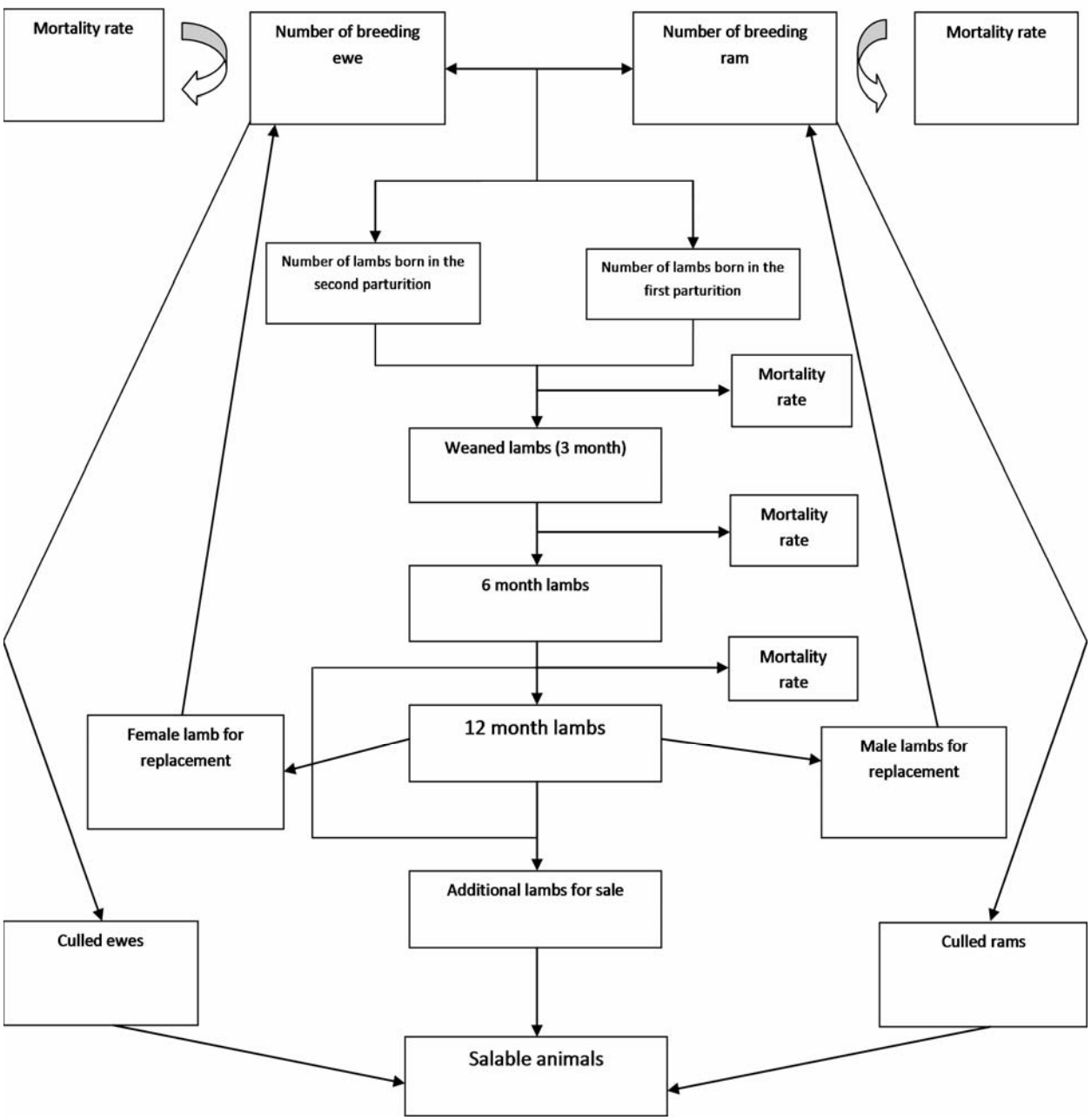

Fig. 1: Animal flow in the intensive sheep production system

- Feeding costs including concentrate feed and roughage.
- Non-feeding costs or productive expenses including labor costs (payment of shepherd, sheep shearing and veterinary servicing), costs of hygienic control (including expenses of antisepticising, vaccination, drugs and treatment), electricity, water, fuel and costs related to installations repair and vehicles.
- In intensive production systems, the breeder builds places to keep the animals, therefore in this research the costs of building has been considered as a fixed cost.
- Outputs are effective factors in income. In Zel sheep flocks income included the sale of lambs, sale of male and female culled animals, sale of wool and manure.

Profit equations

The bio-economic model developed by Kosgey et al. (2003) was used to calculate Profit as following:

a) Calculation of the income of the different animal groups was described by the equation (1):

$$R_e = \sum_{i=1}^{5}[N_i \times f_i \times (1-m_i) \times Lw_i \times Pm_i] + \sum_{i=1}^{5}[N_i \times f_i \times C_i \times P_{w_i}] + \sum_{i=1}^{5}[N_i \times f_i \times O_i \times P_o]$$

Where R_e is the revenue per ewe per year, i is the animals groups that described above, N_i refers to the number of animals group relative to number of ewes present in this and all of equations, f_i is the fraction of animals in the i groups which have a role in the revenue, m the mortality rate of animals(%), LW is the live weight at slaughter of an animal (kg), Pm_i is the price $kg^{-1}$of live weight of animal in the i group, C_i is the wool production of an animal (kg per year), Pw is the price kg^{-1} of wool, O_i is the manure production of an animal (kg per year), p_0 is the price kg^{-1} of manure.

b) The feeding costs (Cf) were calculated from equation (2):

$$C_f = \sum_{i=1}^{5}[N_i \times (Rf_i \times L_i \times \Pr_i \times Z_i)] + \sum_{i=1}^{5}[N_i \times Ps_i]$$

Where Rf_i is the sum of the energy needed for group i at the time of hand feeding (MJ), L_i is the number of days of hand feeding in group i, Pr_i is the price of each energy unit in the ration of the i group, Z_i is the ratio of requirement of energy for the i group from hand feeding which, in this study, was 1, Ps_i is the cost of post harvest grazing and other grazing costs which in this study was zero.

c) The management costs (C_h) were calculated from equation (3):

$$C_h = \sum_{i=1}^{5}[N_i \times P_{lb} \times L_{mi}/100] + \sum_{i=1}^{5}[N_i \times C_{wc} \times Lmi] + \sum_{i=1}^{5}[N_i \times Wb \times L_{mi}] + \sum_{i=1}^{5}[N_i \times Sh]$$

Where P_{lb} is the monthly cost of shepherd for 100 animals, L_{mi} is the number of months of keeping the animals in group i, C_{wc} is the monthly health and hygienic costs of each animal, Wb is the monthly costs of water and electricity for each animal, Sh is the costs of sheep shearing per animal.

d) The fixed costs (C_{FCF}) were estimated from equation (4):

$$C_{FCF} = \sum_{i=1}^{n}\left(P/S\right)$$

Where, P is the sum of all of the amounts invested in each of the related units in the fixed costs, S is the durability of each one of the related units in the fixed costs and i is the related units in the fixed costs.

e) The total annual profitability of the sheep flock (Pflock) was described by the equation (5):

$$P_{flock} = [N_f (R_e - C_e) - C_{FCF}]$$

Where N_f is the number of ewes, R_e is the average revenue of each ewe per year, C_e is the variable costs those includes feeding and management costs and C_{FCF} is the fixed costs per flock per year.

Results and Discussion

Table 2 presents the expenses, incomes and profit for the intensive sheep production system in the current case study. The values presented are weighted by the proportion of each animal category with respect to number of ewes present, and the totals are expressed per ewe per year. For example, in Table 2 feeding expenses for 0.025 breeding rams was 33263.5 Rls and management costs for 1.62 yearlings were 140928 Rls. Total management and feeding costs per ewe per year were 412612 Rls and 3078764 Rls, respectively. Feeding costs represented 87.14% of the total costs and

Table 2: Costs, revenues, and profit of each category (Rls per ewe per year) for intensive sheep production system in the case study

	Animal category						
	Pre-weaning lambs(3month)	Post-weaning lambs(6month)	Yearling lambs	Breeding rams	Breeding ewes	Total[a]	Percentage of total
Proportion of animal to ewes	1.65	1.64	1.62	0.025	1		
Input							
Feed	475038.5	771220.52	683380.8	33263.31	1115861	3078764.13	87.14
Feed costs of each group to total feed costs ratio (%)	15.43	25.05	22.19	1.08	36.24	----------	100
Management	58569	43448	140928	3952	165715	412612	11.67
Management costs of each group to total management costs ratio (%)	14.19	10.53	34.15	0.95	40.16	----------	100
Fixed costs						41666.5	1.17
Total	533607.5	814668.52	824308.8	37215.31	1281576	3533042.5	100
Output							
Meat	0	0	4768117	17585.78	516666	5302369	96.36
Manure	24231	41014	43236	1389	42946	152816	2.77
Wool	0	0	22161.5	1172.5	23776.5	47110.5	0.86
Total	24231	41014	4833514.5	20147.28	583388.5	5502295.5	100
Profit	-509376.6	-773655	4009206	-17068	-698186.1	1969254[b]	

[a]weighted by animal proportions; [b] profit by one breeding ewe

management about 11.67%. The fixed cost for per ewe per year in industrial system was 41666.5 Rls about 1.17% of total costs.

Revenue sources in this study included the sale of meat, wool and manure. Sale of meat, manure and wool accounted for about 96.36%, 2.77% and 0.85% of the total revenues. The total profit per ewe per year was 1969254 Rls, which in researches of Bagheri (2010) and Vatankhah (2005) showed that profit of sheep production in village and nomadic systems in Iran were lower than our findings. All the animal categories had negative profits except yearling lambs. The lambs had only manure as a source of revenue and breeding rams and breeding ewes had meat**,** manure and wool as sources of revenue but the total sum of which was lower than the cost of inputs. In the intensive production system, the feeding costs were 87% of the total amount. The breeding ewes had the greatest amount of feeding costs with the average of 36.24% and the breeding rams group had the lower amount of feeding costs with the average of 1.08%. Ponzoni (1986) commented that the cost of feed, although a major cost component for sheep and goat farms, is difficult to measure and so is sometimes incorrectly excluded from the definition of selection goals. The difficulty in calculating feed costs occurs mainly with animals reared on pasture. In the present study as all animals were fed by hand throughout the year, therefore feeding costs were calculated correctly. In the management expenses the highest amount were for the breeding ewes and yearling groups with the average of 40.16% and 34.15%, respectively, and the lowest was for breeding rams of 0.95% of the total management costs.

The fixed costs in the intensive system was 1.5% of the expenses and this is due to the increase of feeding and management costs and also the higher number of animals compared with that may present in the rural (extensive) system. Vatankhah (2005) reported that in the rural system for raising Lori Bakhtiari sheep, 97.65% of the total expenses was dedicated to variable costs which is in accordance to the present research.

Erkan et al. (1993) showed that, for Toros Mountainous village's sheep, the major part of the variable expenses (61.9%) was feed expenses. Yıldırım (1993) found this ratio as 47.3% for sheep farms in Çatak Town of Van Province. Increasing of feeding costs in intensive sheep production system is due to hand feeding throughout the year. In the industrial system, the revenue resource was meat, manure and wool. The income from meat was 5302369 Rls which is 96.4% of the total income. The current results were slightly hihger than that reported by Vatankhah (2005) for Lori Bakhtiari sheep. He reported that the meat income was 95.04%. Şahin (2002) reported the lamb value amounted to 67.8% of the gross production value in Van Province in Turkey. Kosgey et al. (2003) reported that the total amount of meat sell was 89% of income in tropical breeds. Deference between theses researches and the current study was the existing milk production as an extra resource of revenue in rural system.

The average income from manure was about 2.8% the total amount. This value is relatively in accordance to Vatankhah (2005) results (1.6%). The sale of wool in the current case study was 0.9% of the total amount. However, Khodaei (2004) reported that the selling of wool in Gilani breed was 5% of the total income.

Conclusions

Intensive sheep production system is a profitable system and the study provided some important information on the traits that should be included as breeding objective in an intensive sheep production system, where annual investments are very high and hand feeding is the main source of food for the breeding stock.

References

Bourdon, R.M. 1998. Shortcomings of current genetic evaluation systems. *Journal of Animal Science*, 76: 2308-2323.

Bagheri, M. 2010. Determination of economic weights of important traits of Lori-Bakhtiari sheep in Nomadic system. Final Report of Research Plan, In: Agriculture and natural recourses research centre of Chaharmahal and Bakhtiari province, Iran.

Erkan, O., Yılmaz, İ. and Şengül, H. 1993. Toros dağ köylerindeki küçük ölçekli tarım işletmelerinin üretim sistemlerinin analizi. *Çukurova Üniversitesi Ziraat Fakültesi Dergisi*, 8:105-120.

FAO Stat. 2008. Available at: *www.FaoStat.org*

Fitzhugh, H.A. 1978. Bioeconomic analysis of ruminant production Systems. *Journal of Animal Science*, 46:797-806.

Khodaei, M. 2004. Defining a proper breeding scheme for Gilani sheep. M. Sc thesis, University of Gilan, Iran.

Kosgey, I.S., Van Arendonk, J.A.M. and Baker, R.L. 2003. Economic values for traits of meat sheep in medium to high production potential areas of the tropics. *Small Ruminant Research*, 50:187-202.

Krupová, Z., Oravcová, M., Krupa, E. and Peškovičová, D. 2008. Methods for calculating economic weights of important traits in sheep. *Slovak Journal of Animal Science, 41: 24 - 29*

Lôbo, R.N.B., Pereira, I.D.C., Facó, O. and McManus, C. 2011. Economic values for production traits of Morada Nova meat sheep in a pasture based

production system in semi-arid Brazil. *Small Ruminant Research,* 96:93-100.

NRC, 2007. Nutrient requirements of small ruminants. National Academy of Research, Washington DC.

Osamu, S., Kazuo, I. and Yoshitaka, N. 2005. Breeds and breeding systems of dairy sheep in the Mediterranean countries. *Experimental Herbivora, 29:39-48.*

Petrović, P.M. 2005. Sustainable sheep breeding. *Institute for Animal Husbandry, Belgrade* Pp: *256.*

Ponzoni, R.W. 1986. A profit equation for the definition of the breeding objective of Australian merino sheep. *Journal of Animal Breeding and Genetics*. 103:342–357.

Şahin. A., 2002. Economic analysis of sheep farms in center district of Van province. *Journal of Agricultural Science,* 12: 47-52.

Tolone, M., Riggio, V., Maizon, D.O. and Portolano, B. 2011. Economic values for production and functional traits in Valle del Belice dairy sheep using profit functions. *Small Ruminant Research,* 97:41-47.

Vatankhah, M. 2005. Defining a proper breeding scheme for Lori-Bakhtiari sheep in village system. Ph. D dissertation, Tehran University, Tehran.

Yıldırım, İ. 1993. Van İli Çatak İlçesi Koyunculuk İşletmelerinin Üretim Ekonomisi Doktora Tezi, Yayınlanmamış. EÜ Fen Bilimleri Enstitüsü, Bornova, İzmir, Pp: 314.