

TECHNICAL AND FINANCIAL ANALYSIS OF BARKI SHEEP UNDER SEMI-INTENSIVE PRODUCTION SYSTEM

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SUMMARY

The aim of the current study was to compare the profitability of ten simulated Barki flocks in relation to their biological performance under semi-intensive production system in Egypt. Data on biological traits of 6257 records obtained from 2039 breeding ewes belonging to the Desert Research Center were analyzed. Biological criteria considered were number of ewes lambed per ewe joined (EL/EJ), number of lambs born per ewe joined (LB/EJ), number of lambs weaned per ewe joined (LW/EJ), kilograms weaned per ewe joined (KGW/EJ). Technical coefficients derived from the statistical analysis were used to create ten simulated flocks of ten different levels of KGW/EJ. Financial criteria were annual profit/ewe, cost per one kg of weaned lambs produced, marginal rate of return and benefit/cost ratio. The overall least squares means for EL/EJ, LB/EJ, LW/EJ and KGW/EJ of the ten simulated flocks were 0.77, 0.80, 0.62 and 12.15 kg, respectively. Annual profit/ewe was LE+167.6, zero and LE-73.7; cost per one kilogram of weaned lambs produced LE16.4, LE23.6 and LE47.1 and benefit/cost ratio 1.58, 1 and 0.73 for the top, middle and bottom simulated flock, respectively. While the marginal rate of return was LE13.13 and LE14.20 for the top and middle simulated flock compared to bottom one. The break-even point of KGW/EJ of Barki sheep was 11.66 kg under semi-intensive production system.

Keywords: *Barki sheep, financial analysis, simulation, break-even point*

INTRODUCTION

Total kilograms of lamb weaned each year from a flock of sheep is the best single measure of the meat productive ability of that flock, since it combines both ewe and ram fertility, as well as mortality and growth rate of lambs into one index (Younis *et al.*, 1990). This trait is dependent on both the number of lambs weaned and the weight of the individual lamb weaned. The number of lambs weaned is a function of the number of ewes lambed per ewe joined (EL/EJ), the number of lambs born per ewes joined (LB/EJ), the number of lambs weaned of live lambs born per ewe joined (LW/EJ) and kilograms weaned per ewe joined (KGW/EJ). The mentioned traits are the most important traits to be considered in any breed of sheep raised for mutton production.

Thus, any change in one or a combination of those components, is going to change the total number of kilograms of lambs weaned per ewe joined. Biological

performance level of the flock may affect its overall economic performance. Poor reproductive performance reduces income and profitability through its effects on several areas of flock performance: low EL/EJ and LB/EJ lead to fewer lambs born each year, subsequently, fewer lambs for sale or for use as flock replacements. This may increase the number of replacements needed to maintain flock size. Improving reproductive efficiency is one way to reduce costs of one kilogram of weaned lamb produced and increase the efficiency of production and, therefore, profit.

Biological and financial analyses are needed in order to measure the profitability of sheep farms. It is important to identify and measure the critical control points (CCP) of operating a profitable sheep enterprise, so managers can focus their efforts and skills on those points most likely to affect the bottom line (break-even point) of the sheep profit center.

Few studies are available to determine the bottom line of number of kilograms of weaned lambs per ewe joined in flocks of Barki sheep under semi-intensive production system in Egypt. The primary objective of the current study was to measure the impact of the biological critical control points (CCP) on sheep production enterprise profitability. The second objective was to estimate the relationship of various measurable financial and production criteria, and the rate of change in KGW/EJ per unit change of the studied biological criteria.

MATERIALS AND METHODS

Basic Data

Basic data utilized in this study were obtained from the accumulated records collected over 33 successive breeding years of Barki sheep flock raised under semi-intensive production system at Maryout Research Station belonging to the Desert Research Center. This station is located in the North West of Nile Delta, 180 km from Cairo.

Flock performance data in each breeding year included a unique identifying number for each ewe and all of her lambs, birth date of the lambs, sex of the lambs, weaning date and weight for each lamb. Lambs that died were recorded along with the date of death. Data for the present study were 6257 records of Barki ewes representing 2039 breeding ewes.

Flock Management Practices

Animals were kept in open barns. Feed was composed of concentrate feed mix plus berseem (*Trifolium alexandrinum*) as a green fodder during the period from October to May, while the rest of the year berseem was replaced by berseem hay. In addition to these feed, rice or wheat straw was available all the year round. Extra supplementary concentrate feed mix of about 0.25 kg/head/day was offered two weeks prior to mating season for flushing the ewes and during late pregnancy and early lactation. The mixture was fed once a day and water was available twice daily.

Breeding rams and ewes were selected according to breed characteristics and productive and reproductive performance. Breeding ewes were distributed in mating groups in the breeding pens (20 – 25 head/pen). At lambing, new born lambs were identified and their sex, type of birth and pedigree recorded. Weights were recorded within 24 hours of birth and bi-weekly till weaning age. Ewe lambs and ram lambs

joined mating season for the first time at age of 1.5 years. Detailed description of the flock management practices are presented in Mohammady (2005).

Study Design

The current study included two phases, the first phase used the collected cumulative records (basic data) of the studied flock to extract the least squares estimates of KGW/EJ of the studied 33 different breeding years and variability of its value of different breeding years. The range of KGW/EJ estimates of the different breeding years was subdivided into 10 groups. Technical coefficients (EL/EJ, LB/EJ, LW/EJ and KGW/EJ) estimated from the least squares analyses of each of the ten groups were used to establish ten simulated flocks of different estimates of KGW/EJ. The second phase was an empirical economic simulation study to investigate the impact of the biological performance of the ten simulated flocks on the farm profitability.

Data Processing

Statistical analysis

Least squares analysis described by SAS (1998) was performed using a fixed effects linear model for all studied traits and to develop technical coefficients of the ten simulated flocks. Total variance was partitioned into parts attributed to non-genetic source of variance assumed to influence each trait. Linear regression of each of EL/EJ, LB/EJ and LW/EJ on number of kilograms weaned per ewe joined was estimated. The fixed linear model used to analyze the biological traits was as follows:

$$Y_{ijk} = \mu + a_i + b_j + c_k + (ab)_{ij} + e_{ijk}$$

Where:

Y_{ijk} = is the observation,

μ = is the overall mean,

a_i = is the effect due to i^{th} age of dam, $I = 2$ to 10 years,

b_j = is the effect due to j^{th} breeding season, $j = 1$ and 2 for summer and autumn breeding season, respectively,

c_k = is the effect due to k^{th} breeding year, $k = 1$ to 33,

$(ab)_{ij}$ = is the interaction of i^{th} age of dam and j^{th} breeding season,

e_{ijk} = is the error. This element represents all the unidentified factors that may affect the trait under investigation and are not included in the model.

Biological criteria considered were EL/EJ, LB/EJ, LW/EJ and KGW/EJ. Total weight of lambs weaned was adjusted for 120 days by extrapolation from birth to the nearest age to weaning.

Farm budget analysis

Financial data included the total costs of all inputs; feed (concentrate feed mix, berseem, berseem hay and straw), and non-feed inputs (veterinary costs, wages of permanent and hired labor for shearing season and ear tags), in addition to fixed costs (farm maintenance, land rent and miscellaneous). While, total revenues represent the sale of weaned lambs, culled rams and ewes, wool and manure. Annual profit per ewe, benefit/cost ratio and cost per one kg of weaned lambs produced were used as financial criteria for comparing among the ten simulated flocks.

Another criterion which takes the cost factor into account is the marginal rate of return (MRR). MRR measures the increase in profit which is generated by each additional unit of total costs due to better management, compared to the present one (CIMMYT, 1988).

Break-even analysis uses the basic element of cost-value-profit relationship. The break-even point is the point which total revenues equal total costs. Break-even is the point at which an organization begins to earn profit. When a new product line is being planned, the likelihood of success can be quickly measured by finding the project's break-even point (Ronald, 1981). The general equation for finding the break-even point is:

$$S = VC + FC$$

Where; S = sales in LE, VC = variable cost and FC = fixed cost.

Simulated Flocks

A reasonably accurate estimate can be made using some assumptions based on previous management practices of Barki flocks. Financial calculations were made on how costs and revenues change when biological performance change. In order to compare the ten simulated flocks, and to estimate the economic consequences of changed biological performance of the flock, the following general assumptions were made:

- Flock size is 500 breeding ewes of local Barki sheep for each flock.
- Flock is raised under semi-intensive production system.
- Management practices of the ten simulated flocks were supposed to be similar to the standard practices used in the original flock.
- Feed requirements of the simulated flocks were calculated according to these requirements vary according to physiological status, body weight and availability of feedstuff. Price list in LE (1 US \$= 5.47 LE when preparing this manuscript) of feeds were; concentrate feed mix = 1200/ton, berseem = 150/ton, berseem hay = 700/ton and straw = 250/ton
- Annual veterinary care = 20 LE / per ewe.
- Actual farm-gate prices in Egyptian Pounds (LE) prevailing in 2007 were used. Price list in LE were; weaned lambs = 20/kg, culled rams = 18/kg, culled ewes = 15/kg, geasy wool = 1200/ton and manure = 15/m³

RESULTS AND DISCUSSION

A. Biological Characteristics

Results of least squares procedure of the ten simulated flocks are presented in Table (1). The overall least squares means for EL/EJ, LB/EJ, LW/EJ and KGW/EJ were 0.77, 0.80, 0.62 and 12.15 kg, respectively. The least squares estimate for EL/EJ obtained is close to that reported by Mabrouk (1970) of 79.2% and Mohammady (2005) of 79 % for the same breed, but lower than those given by Salem (1990) of 87% and Mohammady (1999) of 82.4%. As expected, the obtained estimate of EL/EJ of the top simulated flock (1) was higher than the bottom one (10), (0.91 vs. 0.62).

Table 1. Least squares means and standard errors (SE) of biological performance criteria of the ten simulated flocks

Simulated flocks	No.	EL/EJ	LB/EJ	LW/EJ	KGW/EJ
		Mean±SE	Mean±SE	Mean±SE	Mean±SE
Overall mean	6257	0.77±0.005	0.80±0.006	0.62±0.007	12.15±0.139
1 (Top)	417	0.91±0.014	0.94±0.017	0.83±0.022	17.58±0.509
2	691	0.86±0.013	0.89±0.016	0.74±0.018	16.69±0.433
3	605	0.83±0.015	0.86±0.017	0.72±0.021	15.43±0.466
4	818	0.81±0.013	0.87±0.016	0.71±0.018	13.49±0.362
5	502	0.76±0.019	0.77±0.019	0.64±0.022	12.60±0.475
6 (Middle)	671	0.70±0.017	0.72±0.018	0.58±0.020	11.66±0.418
7	339	0.61±0.026	0.63±0.029	0.45±0.029	10.50±0.706
8	959	0.60±0.013	0.62±0.015	0.45±0.017	9.58±0.283
9	639	0.62±0.015	0.63±0.016	0.44±0.020	8.53±0.345
10 (Bottom)	616	0.62±0.019	0.64±0.021	0.32±0.019	5.72±0.374

EL/EJ, Number of ewes lambing per ewe joined; LB/EJ, Number of lambs born per ewe joined; LW/EJ, Number of lambs weaned per ewe joined; KGW/EJ, Kilograms weaned per ewe joined.

Annual crop of lambs born per ewe joined (LB/EJ) is of interest to ensure replacement, provide surplus stock either for sale or build up numbers and to ensure as high selection differential as possible (Turner *et al.*, 1968). The current overall mean of LB/EJ is 80.0 %. This estimate is higher than those reported for the same breed by Bedier (1987) of 63.0 %, Younis *et al.* (1984) of 79.0 % and 68.0 % under experimental and commercial farms, respectively. Also, the current least squares procedures showed higher estimate of LB/EJ of the top simulated flock (1) than the bottom one (10) (0.94 vs. 0.64).

Number of lambs weaned per ewe joined (LW/EJ) combines fertility of ewe and ram, prolificacy and survival of lambs. The overall least squares mean of the simulated flocks is 0.62. However, the current estimate is higher than those reported by Bedier (1987) of 59% and Ahmed *et al.* (1992) of 54% for the same breed.

The overall mean of KGW/EJ obtained is close to that reported by Bedier (1987) of 11.08 kg. However, lower estimates were reported by Younis *et al.* (1990) and Ahmed *et al.* (1992). This parameter is a function of lambing rate, twinning rate and lambs mortality. It indicates as well, the mothering ability of ewe and growth rate of lambs in the flock. Data analysis showed that average weaning weight also, as other traits, was varying among the 10 simulated and tended to be the highest in the top simulated flock (1) and the lowest in the bottom simulated flock (10). In addition, the economic performance of sheep farms is finally evaluated on the basis of the total value of lambs crop produced. The obtained result revealed that the top simulated flock (1) achieved the highest KGW/EJ (17.58 kg.), while the bottom simulated flock (10) was the lowest one (5.72 kg.)

Biological performance of the studied ten simulated flocks is presented in figure (1). The simulated flock (1) showed the highest biological performance in all studied traits, while the bottom simulated flock (10) showed the lowest one. The figure also characterized the ten simulated flocks and illustrated the variations in level of all technical coefficients (EL/EJ, LB/EJ and LW/EJ) between the top simulated flock (1) and the bottom one (10). It could be noticed that, as the studied technical coefficients increase, the flock performance improve. In the same time, the figure reflects and translates the outputs of poor, average and good management practices on the biological performance of the simulated flock.

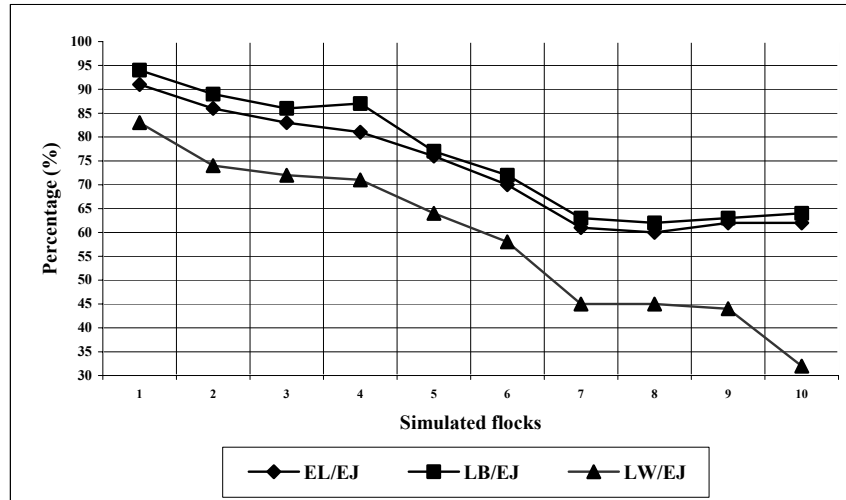


Figure 1. Biological performance of the simulated flocks

The sensitivity analysis allows to estimate the risks and the rate of change in KGW/EJ when biological parameters changes. Results of the linear regression analysis showed that, obtained regression coefficients (b) for EL/EJ, LB/EJ and LW/EJ on KGW/EJ were 0.30 kg, 0.27 kg and 0.22 kg, respectively. The obtained results showed that the percentage of ewe lambed per ewe joined (EL/EJ) was the parameter accounting for the main variation in KGW/EJ of the simulated flocks. When the EL/EJ changes by one percentage point, the KGW/EJ will be changed by 0.30 kg. It could be concluded that, KGW/EJ is more sensitive to changes in EL/EJ than change in LB/EJ or LW/EJ. These results allow producers to understand the underlying production relationships that are critical to operate a profitable sheep farm.

B. Economic Indicators

The impacts of biological performance of the simulated flocks on the economical efficiency are presented in Table (2). The top simulated flock (1) achieved the highest annual revenues per ewe joined, while the bottom one (10) was the lowest (LE456.6 vs. LE195.4), in spite of the difference in annual total cost per ewe joined

was only LE 19.9 (LE 289 Vs. LE 269.1). Economic analysis clearly indicates that improving the biological performance (from middle flock to top flock), results in LE 167.6 profit per ewe. In the same context, poor biological performance of bottom flock, the annual loss per ewe was LE -73.7. Annual cost per one kg of weaned lambs produced decreased as flock performance improves. Under poor management it was LE 47.1, while it costs LE 16.4 under good management (top flock).

Benefit/cost ratio indicates the relationship between the annual revenues and annual total costs. At the level of middle flock (6) of 11.66 KGW/EJ, the annual revenues were equal the annual total costs (zero profit) which represents the break-even point. B/C ratio revealed that, in top simulated flock (1) each unit of money spent earned LE 1.58. In contrary, bottom flock (10) which characterized by poor performance, each LE spent, earned only LE 0.73. Profit generated by each additional unit of total costs (marginal rate of return) was LE14.2 and LE13.13 for middle and top flocks compared to bottom flock, respectively. This result revealed that, the increase of marginal rate of return is matching with biological performance of the simulated flocks and that the increase is not linear where the extra returns decline with each additional unit of costs .

Table 2. Economic indicators of the simulated flocks (LE)

Economical indicator	Bottom flock (10)	Middle flock (6)	Top flock (1)
Annual revenues/ewe	195.4	274.7	456.6
Annual total cost/ewe	269.1	274.7	289
Profit/ewe	-73.7	Zero	+167.6
Cost/one kg of weaned lambs	47.1	23.6	16.4
Benefit/cost ratio	0.73	1.0	1.58
Marginal rate of return	----	14.2	13.13

Break-even point

The two curves in figure (2) represent the annual total costs and annual revenues of the ten simulated flocks. As the biological performance (EL/EJ, LB/EJ, LW/EJ and KGW/EJ) of the simulated flocks improved, the annual revenues increased. The annual total costs curve increase, too, which account for some of the increased costs associated with improved reproduction such as feed costs for extra pregnant ewes and lambs born. The figure also indicates that, simulated flock number (1) earned the highest revenues and in the same time spent the highest total costs among the studied simulated flocks, while flock number (10) earned the lowest and spent the lowest too. The two curves intersected at the point (break-even point) located at flock number (6) of KGW/EJ was equal 11.66 kg, where annual revenues equal annual total costs. It could be concluded that, the bottom line for KGW/EJ of Barki sheep under semi-intensive production system is 11.66 kg. Under these conditions, the sheep producers will gain profit above this point but lose money under below it.

CONCLUSION

Results in the current study suggest that maintaining a high levels of biological performance is required to improve flock profitability. Therefore, producers should focus their management on critical control points (EL/EJ, LB/EL, LW/EJ and

KGW/EJ) that will minimize the incidence of potentially harmful reproductive disorders. Producers must also, provide effective treatment for those problems expected under best management conditions.

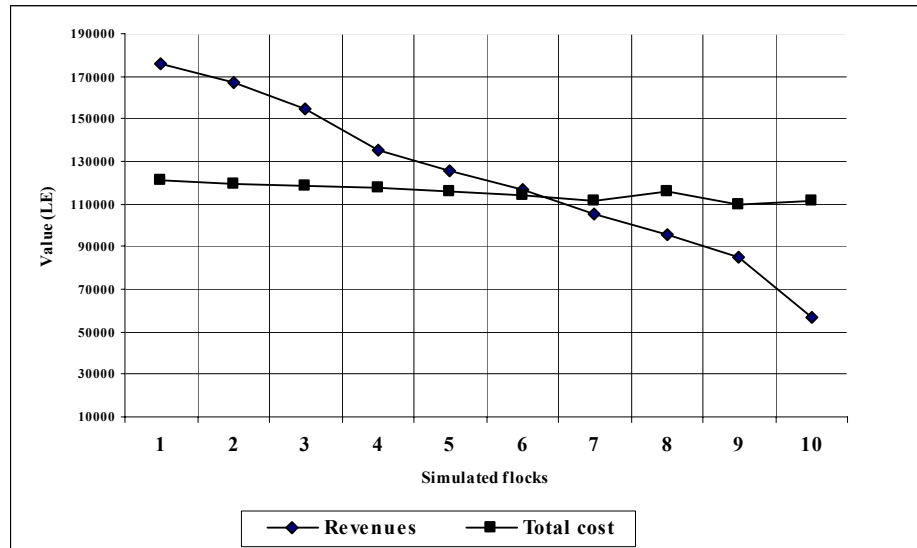


Figure 2. Break-even point of KGW/EJ of the simulated flocks

REFERENCES

- Ahmed, A.M., E.S.E. Galal and A.A. Younis, 1992. Estimates of productive and reproductive performances of commercial flock of Barki sheep. *Egyptian J. Anim. Prod.*, 29:109-122.
- Barnard, C.S. and J.S. Nix, 1993. *Farm Planning and Control*, 2nd Edition. Cambridge University Press, Cambridge.
- Bedier, N.Z., 1987. A study on optimum ewe size under desert conditions. Ph.D. Thesis. Faculty of Agriculture, Ain-Shams University, Cairo. Pp 120.
- CIMMYT (International Maize and Wheat Improvement Centre). 1988. From agronomic data to farmer recommendations: Economic training manual. Completely revised edition. CIMMYT, Mexico.
- Mabrouk, M.M., 1970. Studies on the reproductive performance of sheep under coastal desert conditions. M.Sc. Thesis, Al-Azhar University, Cairo, Egypt.
- Mohammady, M.I., 1999. Biological efficiency of sheep and goat production. M.Sc. Thesis, Faculty of Agriculture, Cairo University. Pp126.
- Mohammady, M.I., 2005. Flock dynamics of desert Barki sheep in relation to age structure. Ph.D. Thesis, Faculty of Agriculture, Cairo University. Pp 203
- Ronald, D.K., 1981. *Farm Management*. McGraw-Hill Book Company, New York.

- Salem, H.A., 1990. A study on the frequency of lambing in relation to productivity in Barki sheep. M.Sc. Thesis, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt.
- SAS, 1998. User's guide, 6.03 Edition, Statistical Analysis System Institute Inc. Cary NC 27511-8000, USA.
- Turner, H.N., G.H. Brown, and G.H. Ford, 1968. The influence of age structure on total productivity in breeding flock of Merino sheep. 1. Flocks with a fixed number of breeding ewes, producing their own replacement. *Aust. J. Agric. Res.*, 19: 443-745.
- Younis, A.A., M.M. Abdel-Aziz, E.A. Afifi, and M. Khaiery, 1984. Biological efficiency of meat production in Barki sheep. *World Rev. of Anim. Prod.* XX, (4): 1-37.
- Younis, A.A., E.S.E., Galal, N.Z., Bedier, Y.S. Ghanem, and K., Ghonem, 1990. Reproductive performance and lamb production of purebred and crossbred sheep. *World Rev. of Anim. Prod.*, 2: 87-92.

التحليل الفني والمالي للأغنام البرقي تحت نظام الإنتاج شبة المكثف

على مصطفى أحمد

مركز بحوث الصحراء- شعبة الإنتاج الحيواني - المطرية - القاهرة

تهدف هذه الدراسة إلى تحليل العلاقة بين الأداء البيولوجي لقطعان الأغنام البرقي وأرباحه القطيع تحت نظام الإنتاج شبة المكثف. وقد استخدمت في هذه الدراسة بيانات 6257 سجل تمثل 2039 نعجة لقطيع أغنام البرقي المرباه بمحطة بحوث مربوط. الصفات البيولوجية التي درست منسوبة إلى عدد النعاج الملقحة هي عدد النعاج الوالدة، عدد الحملان المولودة، عدد الحملان المفطومة وعدد كيلوجرامات المفطومة. تم استخدام تقنية المحاكاة بالاعتماد على المعدلات الفنية المستخرجة من التحليل الإحصائي لبيانات القطيع في تكوين ومحاكاة 10 قطعان من الأغنام طبقا للمستويات المختلفة في عدد كيلوجرامات المفطومة منسوبة إلى عدد النعاج الملقحة. المعايير المالية المدروسة هي الربح السنوي للنعجة، تكلفة إنتاج كيلوجرام من الحملان المفطومة، نسبة المنافع إلى التكاليف، معدل العائد الحدي ونقطة التعادل لعدد كيلوجرامات المفطومة. بلغت تقديرات المتوسطات العامة للصفات البيولوجية المدروسة هي 0.77، 0.80، 0.62 و 12.15 كيلوجرام، على التوالي. كانت نتائج الربح السنوي للنعجة الملقحة، تكاليف إنتاج كيلوجرام من الحملان المفطومة ونسبة المنافع إلى التكاليف هي +167.6 جنيه، صفر، -73.3 جنيه، 16.4 جنيه، 23.6 جنيه، 47.1 جنيه، 1.58، 1، 0.73 لقطعان المحاكاة ذات الأداء البيولوجي المرتفع والمتوسط والمنخفض، على التوالي. وبلغ معدل العائد الحدي 13.13 جنيه، 14.2 جنيه للقطعان ذات الأداء البيولوجي المرتفع والمتوسط بالمقارنة بالقطيع المنخفض الأداء. كانت نقطة التعادل للأغنام البرقي تحت نظام الإنتاج شبة المكثف عند 11.66 كيلوجرام من الحملان المفطومة.