B-4510
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RESEARCH ARTICLE Indian Journal of Animal Research

Production, Reproduction Performance and Cost Economics of Nellore Brown Lambs Reared under Different Systems of Rearing

B. Rangamma, A. Sarat Chandra, N. Rajanna, M. Gnana Prakash,
M. Venkateswarlu, Ch. Hari Krishna

10.18805/IJAR.B-4510

ABSTRACT

Background: To know the production and reproductive performance of Nellore brown lambs under three systems *i.e.* intensive, semi-intensive and extensive system of rearing and which system of rearing was beneficial for the farmer community in terms of cost economics.

Methods: 36 Nellore brown lambs of 3 months age from Livestock Research Station, Mamnoor, Warangal district were randomly allotted to three rearing systems *i.e.* Intensive (G1), Semi-intensive (G2) and Extensive (G3) system of each 12 animals. The body weight and ADG of lambs in the three systems were recorded fortnightly and calculated the cost economics. The reproductive parameters of ewe lambs were recorded.

Result: From 3-9 months age, the mean gain in body weight (kg) in the G1 group was significantly (P< 0.01) higher followed by G2 (10.95 ± 0.18) and G3 (9.33 ± 0.09) groups. The mean ADG (gm) was significantly (P<0.01) higher in G1 group (75.14 ± 1.56) than G2 (60.83 ± 1.02) and G3 (51.81 ± 0.47) groups. Significant (P<0.05) difference was observed in the mean age at puberty of ewe lambs in the three groups. The mean age at first service was lowest in G1 (329.50 ± 6.99) followed by G2 (360.17 ± 6.56) and G3 (385.17 ± 5.60) groups. The net income (Rs.) obtained from each lamb was 1870.8, 1406.7 and 1217.3, respectively in G1, G2 and G3 groups. The cost per kilogram live weight gain was higher in the G1 group followed by G2 and G3 group.

Key words: ADG, Body weight, Economics, Lambs, Systems of rearing.

INTRODUCTION

Sheep are raised in India on natural vegetation and public grazing lands. Sheep need less labor and provide an alternative source of income for smallholder farmers (Arora *et al*., 2016). The contribution of small ruminants is very valuable in rural areas (Ramesh *et al*., 2012). Of the various environmental factors which limit the productivity of sheep and goats, nutrition is by far the most important factor (Devendra, 1980).

Extensive system is the most dominant system of production where the small ruminants are reared on community rangeland during the monsoon and later on stubble grazing on cropped land or forest land. In semi-intensive system, animals are allowed to graze on the common property resources or cultivable/fallow land for 8-12 hours per day and then supplemented with concentrates. The level of supplementation is inversely proportional to the biomass available from the grazing lands and it is generally higher during summer in plains and in winter at high altitudes. The intensive system includes complete stall feeding on cultivated fodders, crop residues and concentrates or compounded feeds or grazing on developed pastures combined with stall feeding. It requires high labour and capital investment and constitutes less than 5% of the small ruminant production systems. But weather and geographical environments are the most important factors affecting the implementation of a particular rearing system, while production expense is the most important factor influencing the system's performance (Ocak *et al*., 2016). Based on the above facts, to know the performance of Nellore brown lambs breed under different systems of rearing the present was planned.

Department of Livestock Production Management, College of Veterinary Science, Sri Venkateswara Veterinary University, Tirupati-517502, Andhra Pradesh, India.

Corresponding Author: B. Rangamma, Department of Livestock Production Management, College of Veterinary Science, Tirupati-517 502, Andhra Pradesh, India. Email: dr.batthina@gmail.com

How to cite this article: B. Rangamma, A. Sarat Chandra, N. Rajanna, M. Gnana Prakash, M. Venkateswarulu and Hari Krishna, Ch. (): Production, Reproduction Performance and Cost Economics of Nellore Brown Lambs Reared under Different Systems of Rearing. Indian Journal of Animal Research. DOI: 10.18805/IJAR.B-4510.

Submitted: 04-05-2021 **Accepted:** 04-08-2021 **Online:** 21-08-2021

MATERIALS AND METHODS

Site of the study

The present study was conducted at Livestock Research Station, Mamnoor, Warangal district, Telangana state situated at an altitude of 290 meters above mean sea level on 79.59p longitudes and 17.9p latitude. The minimum and

maximum temperature range from 16.2 and 42.9°C. The average annual rainfall of the area is 994 mm. Some rainfall during the summer and post-monsoon months and it is mainly in the form of thunder storms.

Animals

Thirty-six (36, 3×12) weaned lambs of 3 months of age were selected from the sheep unit, Livestock Research Station, Mamnoor. The lambs were divided into three groups of twelve lambs in each group (3×12) with uniform body weights as possible by using Completely Randomized Design. These 12 lambs (six males and six females in each group) were allocated to each of the rearing system *viz.*, Intensive group (G1), Semi-intensive group (G2) and Extensive group (G3) to study the production performance. The lambs were housed in well- ventilated shed made up of asbestos sheet roofing with morum flooring and maintained under hygienic conditions. The sheds were cleaned every day morning and lime was applied on the floor once every fifteen days. The lambs were provided with bore well water *ad libitum* for drinking purposes. The waterers were cleaned every day and filled with fresh water in the morning and evening. The lambs were dewormed at the starting of the study. Prophylactic measures against Sheep pox, Enterotoxaemia, Pests des petits ruminants, Bluetongue, Hemorrhagic Septicemia, endo and ectoparasitic infections were carried out as per the institution calendar to ensure animal health condition throughout the study period.

Body weight recording

The bodyweight of the lambs was recorded at 7.30-8.30 am in the morning before offering feed by using platform balance. The weight of the lambs were recorded at fortnight interval from starting to end of the study.

Average daily gain (ADG)

The average daily gain (ADG) and feed conversion ratio (FCR) were calculated by using the following formulae.

$$\text{Average daily gain (ADG)} = \frac{\text{Final weight (kg) - Inital weight (kg)}}{\text{No. of days of trial}}$$

Cost economics calculation

The total cost of experimental diets per quintal were calculated on the basis of prevailing market rates for lambs and feed ingredients. The cost of production per ton of green fodder was taken and for labour cost per minimum wage act of Government of India was taken into account for the calculation of labor cost required for grazing operations.

Experimental procedure

The study was conducted for a period of more than 1 years from March 2019 to June 2020. All 36 selected lambs for the study was allotted to three rearing systems *i.e* Intensive (G1), Semi-intensive (G2) and Extensive (G3) system by using Complete Randomized Design (3x20). In G1 group, the lambs were kept in the shed throughout the day provided with farm-grown chaffed green fodders (APBN, CO-3 and 4, Super Napier, SSG and Hedge lucerne whichever available in the farm) in the morning and evening time, concentrate feed @ 1% of their body weight offered only in the evening time and not sent for grazing. The leftover fodder and feed was removed from the manger early morning every day and weighed for calculating amount of feed consumed by the animals. In G2 group, the lambs were sent for grazing for about 6 hours per day and offered an average of 125 grams of concentrate feed in the shed in the evening time. For the G3 group, the lambs were not offered any concentrate or supplemented feed in the shed and sent for grazing for 9 - 10 hours per day. The concentrate feed offered to the lambs in G1 and G2 group contain CP - 18 per cent, TDN - 72 Per cent.

The statistical significance of all bodyweight and BCS were analyzed as per the methods described by Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

Production Performance of lambs

Fortnightly body weight gain

The overall mean body weight (kg) gain of lambs in G1group was significantly (P<0.01) higher than lambs reared in G2 and G3 groups (Table 1). In intensive rearing system, the lambs were seldom exposed to harsh climatic conditions such as rain, cold and hot sun and this coupled with good plane of nutrition due to provision of chaffed succulent green forage and concentrate combination resulted in higher body weights as more nutrients were available for formation of muscle mass. In semi-intensive system, the growth rate were higher than extensive system due to supplementation with concentrate mixture apart from grazing.

The results of the present study were similar to the findings of Karthik *et al*. (2021) and Galmessa *et al*. (2002) who observed that the final body weight gain of lambs in concentrate supplemented group had significant (P<0.05) difference with only grazing animals group in Aged Horro sheep in Ethiopia. Pankaj (2010) in a study of 90 days on Marwari lambs found that the lambs supplemented with concentrate mixture of 1 per cent body weight had significantly higher body weight than non-supplemented group. Chaturvedi *et al*. (2010), Malisetty and Yerradoddi (2013), Jalajakshi *et al.* (2016) and Khanal *et al*. (2017) have also reported significantly (P<0.01) higher body weight gains with concentrate supplemented ram lambs than solely grazed lambs in extensive production system.

The results of the present study were in contradiction to the findings of Venkataramanan *et al*. (2015) who reported that the supplementation of 250 gram concentrate in addition to grazing did not have significant (P<0.05) effect on body weight gain and Karim *et al*. (2007) have observed that total body weight gain (kg) was higher in semi-intensive system followed by intensive feeding and extensive range management in Kheri lambs.

Table 1: Fortnightly body weights (kg) of Nellore brown lambs from 3-9 months in different systems of rearing.

Group	Initial body weight	Fortnights 1st *	2nd **	3rd **	4th **	5th **	6th **
G1	11.92 ± 0.15	13.73 ± 0.17 ^{a}	15.41 ± 0.18 ^{a}	16.93 ± 0.19 ^{a}	18.29 ± 0.20 ^{a}	19.53 ± 0.22 ^{a}	20.70 ± 0.23 ^{a}
G2	11.93 ± 0.15	13.47 ± 0.17 ^{ab}	14.87 ± 0.17 ^{ab}	16.11 ± 0.17 ^{b}	17.22 ± 0.17 ^{b}	18.24 ± 0.19 ^{b}	19.19 ± 0.19 ^{b}
G3	11.84 ± 0.13	13.10 ± 0.14 ^{b}	14.30 ± 0.15 ^{b}	15.36 ± 0.16 ^{c}	16.34 ± 0.16 ^{c}	17.25 ± 0.16 ^{c}	18.03 ± 0.15 ^{c}
SEM	0.082	0.10	0.12	0.146	0.168	0.190	0.124
P value	0.886	0.028	0.00	0.00	0.00	0.00	0.00

Fortnights 7th **	8th **	9th **	10th **	11th **	12th **	Overall mean gain in body weight **
21.69 ± 0.25 ^{a}	22.62 ± 0.26 ^{a}	23.49 ± 0.29 ^{a}	24.24 ± 0.31 ^{a}	24.89 ± 0.32 ^{a}	25.45 ± 0.35 ^{a}	13.53 ± 0.28 ^{a}
20.02 ± 0.19 ^{b}	20.78 ± 0.19 ^{b}	21.45 ± 0.20 ^{b}	22.00 ± 0.21 ^{b}	22.48 ± 0.22 ^{b}	22.88 ± 0.23 ^{b}	10.95 ± 0.18 ^{b}
18.70 ± 0.15 ^{c}	19.28 ± 0.16 ^{c}	19.80 ± 0.17 ^{c}	20.39 ± 0.14 ^{c}	20.82 ± 0.15 ^{c}	21.17 ± 0.15 ^{c}	9.33 ± 0.09 ^{c}
0.235	0.259	0.285	0.296	0.313	0.330	0.312
0.00	0.00	0.00	0.00	0.00	0.00	0.00

Means within a column having different superscripts differ significantly ** ($P<0.01$), *($P<0.05$).

G1 : Intensive system, G2 : Semi-Intensive system, G3 : Extensive system.

SEM : Standard error mean, P : Probability value.

There was no significant ($P<0.05$) difference in the body weight gain of lamb between G1 and G2 groups in the first two fortnights and there was no significant difference in body weight gain in lambs between G2 and G3 group in the first fortnights because of sufficient quantity of lush grasses and forage being available in grazing areas in these months due to sufficient rains in the month of August. From the third fortnight the growth rate of lambs in G1group were significantly ($P<0.01$) higher as compared to lambs in G2 and G3 groups.

The body weights of lambs in all the three systems of rearing linearly increased from 3 to 9 months age but the weight gain of lambs decreased as the age of the animal advances. Similar results were reported by Raman *et al*. (2003), Mishra *et al*. (2004), Patro *et al*. (2006), Devendran *et al*. (2009), Sivakumar *et al*. (2009), Balasubramanyam *et al*. (2010), Mondal and Kakati (2010), Tailor and Yadav (2011), Panda *et al*. (2012), Dass *et al*. (2012) and Chitra (2017) in different breeds of sheep wherein the growth rate was lowering as the age of the animal increasing.

Average daily gain (ADG)

The mean ADG of lambs in G3 group was lower throughout the study period as compared to lambs in G2 and G1 groups (Table 2), which might be due to inadequately available nutrients in the grasses and forages through grazing which was not sufficient for optimum growth and more energy was spent on locomotion in travelling long distances in search of food and water and exposure to harsh environmental conditions. The results of the present study were in close agreement with the reports of Porwal *et al*. (2006), Bharambe and Burte (2012), Kumar *et al*. (2018) and Kochewad *et al*. (2018) and contrary to the results reported by Venkataramanan *et al*. (2015). Karim *et al*. (2007) and Arslan *et al*. (2018) reported higher ADG in grazing lambs with *ad libitum* concentrate supplementation followed by intensive feeding and extensive range management. Chaturvedi *et al*. (2010), Pankaj (2010), Malisetty and Yerradoddi (2013), Jalajakshi *et al.* (2016), Kumar *et al*. (2017c) and Jalajakshi *et al*. (2018) reported supplementation with concentrate feed along with grazing had higher ADG than only grazing in lambs.

There was no significant ($P<0.01$) difference in mean ADG of lambs reared in semi-intensive system (G2) and extensive systems (G3) during 10th, 11th and 12th fortnights, which could be due to high parasitic load in the lambs, drinking water from drying water bodies which are potential sources of parasitic ova.

The higher ADG of lambs in the three rearing systems were observed between 3-5 months age as compared to 6-9 months age of the lambs which might be due to better utilization of nutrients between 3-5 months age. These results were similar to the findings of Patro *et al*. (2006), Sivakumar *et al*. (2009), Balasubramanyam *et al*. (2010), Dass *et al*. (2016) and Kumar *et al*. (2017a).

Cost economics of lambs in different systems of rearing

The cost of animals, labour, water and electricity was same

Table 2: Fortnightly ADG (gm) of Nellore brown lambs from 3-9 months in different systems of rearing.

Group	Fortnights					
	1st **	2nd **	3rd **	4th **	5th **	6th **
G1	120.56 ± 2.09[a]	111.67 ± 1.45 [a]	101.67 ± 1.86 [a]	90.56 ± 1.73 [a]	82.78 ± 1.73 [a]	72.92 ± 3.55 [a]
G2	102.22 ± 2.22 [b]	93.33 ± 1.42 [b]	82.78 ± 1.29 [b]	73.89 ± 1.92 [b]	68.33 ± 1.67 [b]	59.38 ± 1.44 [b]
G3	83.89 ± 1.53 [c]	80.00 ± 1.42 [c]	70.56 ± 1.29 [c]	65.56 ± 1.98 [c]	60.56 ± 1.53 [c]	48.44 ± 1.12 [c]
SEM	2.76	2.34	2.32	2.05	1.81	2.13
P	0.00	0.00	0.00	0.00	0.00	0.00
		Fortnights				Overall mean
7th **	8th **	9th **	10th **	11th **	12th **	ADG **
66.11 ± 2.24 [a]	61.67 ± 3.08 [a]	58.33 ± 3.30 [a]	50.00 ± 1.53 [a]	43.33 ± 2.53 [a]	37.22 ± 2.39 [a]	75.14 ± 1.56 [a]
55.00 ± 1.86 [b]	50.56 ± 1.92 [b]	45.00 ± 2.03 [b]	36.67 ± 1.74 [b]	31.67 ± 1.20 [b]	27.22 ± 1.53 [b]	60.83 ± 1.02 [b]
45.00 ± 2.03 [c]	38.33 ± 1.45 [c]	35.00 ± 1.67 [c]	32.44 ± 4.45 [b]	28.33 ± 1.45 [b]	23.33 ± 1.54 [b]	51.81 ± 047 [c]
1.86	2.05	2.11	1.89	1.49	1.44	1.74
0.00	0.00	0.00	0.007	0.00	0.00	0.00

Means within a column having different superscripts differ significantly ** (P<0.01), *(P<0.05).

G1 : Intensive system, G2 : Semi-Intensive system, G3 : Extensive system.

SEM : Standard error mean, P :Probability value.

Table 3: Cost economics of lambs in different systems of rearing.

Particulars	G1	G2	G3
Expenditure			
Cost of animals	39600	39600	39600
Cost of green fodder	4312	-	-
Cost of concentrate feed	9700	6300	-
Cost of labour	16200	16200	16200
Cost of veterinary aid	2050	2520	2520
Cost of water and electricity	1000	1000	1000
Miscellaneous	500	500	500
Total expenditure	73350	66120	59820
Total recurring expenditure/ lamb	2812.5	2210.0	1685
Income			
Sale/ Value of lambs	91800	81000	73428
Sale of manure	4000	2000	1000
Gross income	95800	83000	76960
Net income	22450	16880	14608
Net income/lamb	1870.8	1406.7	1217.33
Cost / each live weight gain	207.87	201.82	180.60
Benefit cost ratio	1.30: 1	1.26 :1	1.29 : 1

G1: Intensive system, G2: Semi-Intensive system, G3: Extensive system.

in the three groups. The cost of animals was highest in the three groups followed by cost of labour (Table 3). The cost of concentrate feed was higher in the G1 group than G2 group because in G1 group, the lambs were provided with concentrate @ 1 per cent body weight. The cost of veterinary aid was same in the G2 and G3 groups and higher than G1 group because in G2 and G3 groups deworming was done two times more than G1 group. The cost of recurring expenditure was higher in G1 group followed by G2 and G3 group. These results were in agreement with Porwal *et al.* (2006), Devendran *et al.* (2012) and Shivakumara and Kiran (2019).

Major part of income is through sale of lambs in all three systems of rearing. The income from sale of manure was higher in G1 group than G2 and G3 group because lambs are in the sheds throughout day. The gross and net income was higher in G1 group followed by G2 and G3 group. Similar results were reported by Porwal *et al.* (2006), Pankaj *et al.* (2010) and Mahanthesh *et al.* (2019). The cost of per kg live weight was highest in G1 group than G2 and G3 group because of concentrate and fodder cost.

CONCLUSION

The body weight gain and average daily gain during the experiment period was higher in intensive system than a semi-intensive and extensive system of rearing but the cost of meat production was higher in the intensive system of rearing. The age at puberty and first service was lower in the intensive system because the ewe lambs gained higher body weight at earlier than other two systems of rearing.

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