Research Article

GENETIC STUDIES ON REPRODUCTIVE PERFORMANCE OF INDIGENOUS GOATS IN NORTHERN ODISHA

S.Ray[1], S.K.Dash[1*], S.K.Dhal[1], G.D.Nayak[1], A.K.Parida[2]

ABSTRACT: Data on the reproductive parameters of 622 does, sired by 28 bucks, born during the period of 3 years from 2012 to 2015 in 28 villages of three districts *viz.* Deogarh, Keonjhar and Balasore of Odisha, India were included in the present study. It was observed in the present study that these goats in north Odisha attain sexual maturity at 249.15±1.01 days weighing 9.47±0.53 kg and drop the first kid at an average age of 410.72±1.17 days weighing 13.52±0.62 kg. Season of birth had no significant effect on any of the reproduction traits. The heritability estimates of age at sexual maturity, weight at sexual maturity, age at first kidding, weight at sexual maturity and kidding interval were found to be 0.18±0.08, 0.34±0.11, 0.26±0.19, 0.31±0.07, 0.36±0.12, respectively. Except kidding interval all other reproductive traits of economic importance showed moderate to high and positive genetic and phenotypic correlations ranging from 0.17±0.16 to 0.84±0.12.

Key words: Genetic correlation, Heritability, Phenotypic correlation, Reproductive performance.

INTRODUCTION

Odisha harbours 6.513 million head of goats having large genetic diversity of goat population (19th livestock census 2012). Goats in Odisha are meat type and are famous for their excellent meat and skin quality with high frequency of multiple births and less kidding interval (Dash *et al*. 2011). Knowledge on reproductive potential is the most important thing for developing strategy towards genetic improvement in meat type animals like goat.

Evaluation of different populations in the area would help to know the extent of genetic diversity present between and within group of goats. Study of the reproduction traits of these populations in detail with regard to their inheritance and relationship with other economical traits would be very beneficial for devising improvement programs. The findings on the inheritance and association among the important reproduction and growth traits need to be incorporated in selection indices specific

[1]*Department of Animal Breeding and Genetics,* [2]*Department of Agriculture Statistics, Orissa University of Agriculture & Technology, Bhubaneswar-751003, Odisha, India.*
*Corresponding author. e-mail: susantdash46@gmail.com

to the breed or type for improvement of the desired traits. Various genetic factors are known to influence economic reproductive parameters, which need to be accounted for and there by designing more efficient selection programme in the future.

Age at sexual maturity, weight at sexual maturity and age at first kidding are important economic factors, which influence the growth, production and reproduction pattern of any type of goat. Consideration of many economic traits to improve at a particular time is the target by all the stakeholders. Hence, genetic and phenotypic association among such traits of importance needs to be kept in mind before designing the breeding plan.

Very limited published information on heritability estimates of some reproductive traits and degree of association among those in indigenous goats of Odisha (Bariha *et al*. 2008; Rao *et al*. 2009; Dash *et al*. 2010) and Black Bengal goats (Chowdhury *et al*. 2002) have been accomplished.

Keeping in view the above facts, the present study was taken up in northern Odisha, harbouring heavy concentration of goats to assess the heritability of reproduction parameters and genetic association among those traits in indigenous goat population.

MATERIALS AND METHODS

The present study was conducted in Deogarh, Keonjhar and Balasore districts of Odisha situated between 21.34^0 N to 21.63^0 N latitude and 84.73^0 E to 86.66^0 E longitude. The climate ranges from hot and humid to hot and moist-sub humid. The average maximum and minimum temperatures are 39.0^0 C and 11.5^0 C observed in the month of May and January, respectively. The average relative humidity ranges between 37.2 and 86.2 per cent over the months during the year. The average annual rainfall is around 1500 mm.

Indigenous goats in the present study are reared only for meat purpose. Data on the reproductive parameters of 622 does, sired by 28 bucks, born during the period of 3 years (2012 to 2015) in 28 villages of three districts *viz.* Deogarh, Keonjhar and Balasore of Odisha were included in the present study. Kids were naturally weaned at 90 days of age. Goats were maintained exclusively under extensive system of management; mostly were allowed to graze from 8AM to 5 PM during winter and rainy season and from 7 AM to 11 AM and then from 3 PM to 6 PM during summer season . Dams were never milked and kids were allowed to suckle fully throughout the lactation length of around 90 days.

Data on age at sexual maturity, weight at sexual maturity, age at first kidding, weight at first kidding and average kidding interval were collected directly from farmers' flocks and further grouped according to district, season of birth and flock size. The entire year was divided to three seasons as summer (March to June), rainy (July to October) and winter (November to February). Flock size was taken as small flock (<10 heads), medium flock (>10 to<20) and large flock (>20 heads).

The heritability of economically important reproductive parameters was estimated by half sib correlation method, which is based on phenotypic resemblance between relatives as compared to unrelated individuals. The recorded data were analysed for the estimation of variation between and within sire groups and various components of variance were worked out (Kempthorne 1957). As there were unequal numbers of off springs in individual sire groups, the average number of progeny per sire (K) was worked out by formula:

$$K = \frac{1}{S-1} \times \frac{(N - \sum n^2_i)}{N}$$

Where,

S = Number of sires

N = Total number of progenies used in the study

$\sum$ = Sum of

n_i = Number of observations on the ith sire.

The heritability was estimated by multiplying intraclass correlation (t) with the factor 4.

$$t = \frac{ó^2s}{ó^2w + ó^2s} \quad \text{and} \quad h^2 = 4t$$

where,

t   = intraclass correlation

h^2 = heritability

$ó^2s$ = genetic variation

$ó^2_w$ = environmental variation

The data were subjected to least square analysis using Model Least-Square and Maximum Likelihood Program (Harvey 1990) for estimation of means along with standard errors, analysis of variance, heritability and degree of association among reproductive parameters.

RESULTS AND DISCUSSION

Reproductive performance as age and weight at sexual maturity and first kidding along with kidding interval, influenced by area, season and flock size is presented in Table 1. Goats in Deogarh district (North-western part of Odisha) were found to have significantly higher estimates than Keonjhar and Balasore (North-eastern part of Odisha) goats with respect to all reproductive parameters. However, no significant difference was observed between later two districts, proving indigenous goats of north eastern area better than those of north western area. It was observed in the present study that almost all the goats attained sexual maturity at around 8 months weighing 9.47±0.53 kg and dropped the first kid at 410.72±1.17 days of age weighing 13.52±0.62 kg. Further, these animals in north Odisha recorded high fertility rate as evident from estimated kidding interval value of 216.59±1.06 days. The estimates in all studied parameters in present study were in agreement with the findings of Bariha *et al*. (2008) and Dash *et al.* (2011).

Age at sexual maturity : Overall age at sexual maturity was 249.15±1.01 days with lower values in Keonjhar (234.92±1.42 days) and higher (269.39±1.28 days) in Deogarh district. The present finding corroborates with the report of Halim *et al*. (2011) as 234.16±6.54 days, Paul *et al*. (2014) as 8.63 to 9.24 months in Black Bengal goats and Bariha *et al*. (2008) as 229.47±0.96 days in indigenous goats of Keonjhar district of Odisha. However, comparatively higher estimates have been reported by Kharkar *et al*. (2014) for Berari goats found in Maharashtra as 292.10±1.66 days and Fahim *et al*. (2013) for Rohilkhand goats as 282.23±6.51 days and Rao *et al*. (2009) for Ganjam goats as 440.92 ± 3.13 days. Lower estimate was reported by Faruque *et al*. (2010) as 138.83±15.38 and 197.82±12.58 days for Black Bengle goats reared under intensive and semi-intensive rearing system, respectively.

Weight at sexual maturity: Average weight at sexual maturity in the present study was 9.47±0.53 kg ranging from 8.60±0.56 kg in Balasore to 10.71±0.63 kg in Deogarh district. The present finding is in agreement with the report of Faruque *et al*. (2010) and Paul *et al.* (2014) with values ranging from 9.12±0.47 to 9.70±0.67 kg in Black Bengal goats, However, higher estimates have been reported by Rao *et al*. (2009) in Ganjam goats of Odisha and

Table 1. Least squares means along with standard error for reproduction traits.

Particulars	Age at sexual maturity (Day)	Weight at sexual maturity (Kg)	Age at first kidding (Day)	Weight at first kidding (Kg)	Kidding interval (Day)
Overall	249.15±1.01 (622)	9.47±0.53 (622)	410.72±1.17 (610)	13.52±0.62 (610)	216.59±1.06 (610)
Deogarh	269.39[a]±1.28 (231)	10.71[a]±0.63 (231)	434.96[a]±1.36 (226)	14.96[a]±0.74 (226)	226.03 [a]±1.14 (226)
Keonjhar	234.92[b]±1.42 (206)	8.85[b]±0.61 (206)	394.35[b] ±1.58 (203)	12.79[b] ±0.73 (203)	209.95[b] ±1.12 (203)
Balasore	239.72[b] ±1.41 (185)	8.60[b] ±0.56 (185)	398.82[b] ±1.64 (181)	12.53[b] ±0.64 (181)	212.24[b] ±1.11 (181)
Summer	251.18±1.89 (163)	9.50±0.75 (163)	413.03±1.74 (160)	13.58±0.84 (160)	219.17±1.56 (160)
Rainy	250.78±1.23 (217)	9.49±0.80 (217)	411.39±1.69 (213)	13.51±0.91 (213)	217.43±1.12 (213)
Winter	246.32±1.96 (242)	9.43±0.81 (242)	408.56±1.69 (237)	13.49±0.98 (237)	215.58±1.01 (237)
Small flock	251.12±1.76 (342)	9.48±0.82 (342)	417.41[a]±2.41 (335)	13.58[a]±0.97 (335)	223.46[a]±1.69 (335)
Medium flock	247.19±1.78 (199)	9.47±0.76 (199)	403.82[b]±1.99 (196)	13.45[b]±0.87 (196)	209.38[b]±1.07 (196)
Large flock	245.64±1.87 (81)	9.43±0.74 (81)	399.45[b]±1.52 (79)	13.44[b]±0.83 (79)	205.34[b]±1.37 (79)

*Figures in parenthesis indicate number of observations.
 Different superscripts along the column indicate significantly different values (P<0.05).

Yadav and Khada (2009) in non-descript goats of Rajasthan.

Age at first kidding: Overall age at first kidding was found to be 410.72±1.17 days in the present study with lower values in Keonjhar (394.35±1.58 days) and higher in Deogarh district(434.96±1.36 days). The present finding corroborates the report of Bariha *et al*. (2008). However, higher estimates have been reported by Kharkar *et al.* (2014) in Berari goats, Patel and Pandey (2013) in Mehsana goats and Kumar *et al.* (2012) in Sirohi goats. Lower values compared to the present finding have been reported by Halim *et al.* (2011) and

Table 2. Heritability, genetic and phenotypic correlations among reproductive traits.

Trait	Age at sexual maturity	Weight at sexual maturity	Age at first kidding	Weight at first kidding	Kidding interval
Age at sexual maturity	**0.18±0.08**	0.78±0.14	0.66±0.11	0.17±0.16	0.08±0.11
Weight at sexual maturity	0.74±0.22	**0.34±0.11**	0.57±0.18	0.28±0.15	0.17±0.16
Age at first kidding	0.84±0.12	0.27±0.09	**0.26±0.19**	0.43±0.10	0.14±0.18
Weight at first kidding	0.63±0.21	0.57±0.13	0.77±0.16	**0.31±0.07**	0.09±0.14
Kidding interval	0.24±0.09	0.27±0.12	0.17±0.05	0.15±0.07	**0.36±0.12**

*Values of diagonal are heritability estimates, above diagonal are genetic correlations and below diagonal are phenotypic correlations.

Faruque *et al.* (2010) in Black Bengal goats. The variation of age at first kidding is partly environmental and partly genetic in origin. Thus, early age at first kidding reduces the cost of rearing, replacements and increases economic returns and also facilitates rapid genetic improvement (Devendra and Burns 1983).

Weight at first kidding : The average weight at first kidding was found to be 13.52±0.62 kg in the present study. The present finding is in close agreement with the report of Haque *et al.* (2013), Bariha *et al.* (2008). Higher estimates have been reported by Patel and Pandey (2013) and Kumar *et al.* (2012) in Mehsana and Sirohi goats, respectively.

Kidding interval: The present study revealed that the kidding interval was 216.59±1.06 days. The present finding corroborates with the earlier report of Das

et al. (2008) in Black Bengal goats. But, higher estimates have also been reported by Singh *et al.* (2009) in Mehsana goat.

Season of birth had no significant effect on any of the reproduction traits in the present study. Similar finding was observed by Paul *et al.* (2014) for weight and age at sexual maturity in Black Bengle goats. However, the flock size showed no significant effect on age and weight at sexual maturity, whereas, age and weight at first kidding along with kidding interval were found to be significantly better in both medium and large flocks than the smaller flocks. There was no significant difference between medium and large flocks with regard to these traits. This may be due to the fact that, the small flocks with less than 10 heads usually do not have a breeding buck. In contrary the larger flocks often own a buck, hence, the female in estrus gets successful service at

grazing, which the female in smaller flock usually miss, resulting in delayed days open.

The heritability estimates of all the reproductive parameters in the present study were found to be moderate ranging from 0.18 to 0.36, indicating existence of substantial additive genetic variance in the population and can be utilized for improvement of the sought traits (Table 2). The low heritability estimate observed for age at sexual maturity may be explained by the differential nutritional level of the does, resulting in a large environmental variation. The heritability estimate of age at first kidding was 0.26±0.19. This result is in close agreement with the findings of Haque *et al*. (2013) in Black Bengal goats, Kebede *et al.* (2012) in indigenous Arsi-Bale goats of Ethiopia, Bariha *et al.* (2008) in indigenous goats of Keonjhar and Rao *et al.* (2002) in Ganjam goats. The heritability estimate of kidding interval in the present study was 0.36±0.12. Lower estimate of 0.06 and 0.14±0.96 was reported by Kebede *et al.* (2012) in their study with indigenous Arsi-Bale goats and Bariha *et al.* (2008) in indigenous goats of Keonjhar district, respectively.

It was observed that the genetic correlation between age at sexual maturity with weight at sexual maturity and with age at first kidding were 0.78±0.14 and 0.66±0.11, respectively. The genetic correlations of kidding interval with all other reproductive traits were found to be very low. The phenotypic correlations of age at sexual maturity with weight at sexual maturity, age at first kidding and weight at first kidding were found to be high and positive.

CONCLUSION

Goats in north eastern part of Odisha were found to be better than those of north western part with regard to reproduction potential. Hence, there may be two separate genetic groups, which may be characterized and evaluated separately. As flocks with more than 10 heads were better in reproduction, recommendation may be made to rear at least 10 females to obtain optimum efficiency in reproduction. The heritability estimates, being moderate, indicated that selection for reproduction performance may be done on the basis of individual selection with proper nutrition and other managemental care. A positive response could be expected in almost all traits owing to the moderate to high and positive genetic correlations among the economic reproductive traits which gives a scope for simultaneous selection of more than one trait at a time.

ACKNOWLEDGEMENTS

REFERENCES

Bariah SP, Rao PK, Patro BN, Dash SK, Panda P (2008) Genetic analysis of indigenous goats of Keonjhar district of Orissa. Indian Vet J 85: 843-845.

Chowdhury SA, Bhuiyan MSA, Faruk S (2002) Rearing Black Bengal goat under semi-intensive management. Asia Austral J Anim Sci 15: 477-484.

Dash SK, Mohanty GP,Kanungo S, Palai TK, Sahu S (2011) Factors influencing body weight of indigenous goats of Mayurbhanj district in Orissa. J Res Orissa Univ Agric Tech 1(1): 196-199.

Dash SK, Rao PK, Patro BN (2010) Selection index for improvement of production performance in goats. Indian Vet J 87: 359-362.

Devendra C, Burns M (1983) Goat Production in the Tropics 2nd edn., Commonwealth Agricultural Bureaux: Farnham Royal, UK.

Das AK, Manna MK, Sahoo AK, Deb R, Paul RK (2008) Studies on reproductive traits of Bengal goats in a part of West Bengal. Indian J Small Rumin 14(2): 259-261.

Fahim A, Singh M, Patel BHM, Mondal SK, Dutt T (2013) Reproductive performance and milk yield of rohilkhand goat . Indian J Small Rumin 19(1): 32-35.

Faruque, S, Chowdhury, SA, Siddiquee, NU, Afroz MA (2010) Performance and genetic parameters of economically important traits of Black Bengal goat. J Bangladesh Agric Univ 8: 67-78.

Livestock Census (2012) Government of India. Available on www.http://dahd.nic.in/LStock.htm.

Halim MA, Kashem MA, Mannan A, Ahmed SSU, Hossain MA (2011) Reproductive and Productive performances of Black Bengal Goats reared by the NGO Beneficiaries under semi intensive system in Bangladesh. Intern J Natural Sci 1(2): 39-43.

Haque MN, Husain SS, Khandoker MAMY, Mia MM, Apu AS (2013) Selection of Black Bengal Buck Based on Some Reproductive Performance of Their Progeny at Semi-Intensive Rearing System. J Agri Sci 5(8): 142-152.

Harvey WR (1990) User's Guide for LSMLMW, PC-2 Version, Mixed Model Least Squares and Maximum Likelihood Computer Program, Mimeograph, Columbus, Ohio, USA.

Kebede T, Haile A, Hailu D, Alemu T (2012) Genetic and phenotypic parameter estimates for reproduction traits in indigenous Arsi-Bale goats. Trop Anim Hlth Prod 44: 1007–1015.

Kempthorne O (1957) An introduction to genetic statistics. John Wiley and Sons, Inc. New York. USA.

Kharkar K, Kuralkar SV and Kuralkar P (2014) Growth, production and reproduction performance of Berari goats in their native tract. Indian J Small Rumin 20(1): 12-15.

Kumar MU, Nagda RK, Sharma SK (2012) Reproductive status of Sirohi goats under field conditions. Indian J Small Rumin 18(1): 143-144.

Patel AC, Pandey DP (2013) Growth, Production and Reproduction Performance of Mehsana Goat. J Livestock Sci 4: 17-21.

Paul RC, Rahman ANMI, Debnath S, Khandoker MAMY (2014) Evaluation of productive and reproductive performance of Black Bengal goat. Bang J Anim Sci 43(2): 104-111.

Rao PK, Dash SK, Patro BN, Nayak S (2002) Studies on Ganjam, Black Bengal goats and their crosses found in Orissa. Indian J Anim Prod Mgmt 18 (3-4): 135-138.

Rao PK, Dash SK, Singh MK, Rai B, Singh NP (2009) Ganjam goat of Orissa and its management practices. Indian J Small Rumin 15(1): 44-50.

Singh KP, Dixit SP, Singh PK, Pandey DP, Ahlawat SPS (2009) A note on growth and reproduction traits of mehsana goats under farmer's flocks. Indian J Small Rumin 15(2): 271-273.

Yadav CM, Khada BS (2009) Management practices and performance of goats in tribal belt of Dungarpur district in Rajasthan. Indian J Small Rumin 15(1): 131-133.