Selection Indices for Genetic Improvement in Malabari Goats

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In the present study an attempt was made for the formulation of selection indices incorporating body weights and biometrics in different combinations to know which traits combine best in an index that gives maximum relative efficiency and genetic progress in Malabari goats from the data recorded on farmers' flocks.

Materials and Methods

This study was conducted on 845 kids over a period of four years from 2005-2008 maintained at farmers flocks of All India Coordinated Research Project (AICRP) on Malabari Goat Improvement. The selection indices were constructed incorporating the important traits (body weights and body measurements like chest girth, body length and height at withers at below one, three and six months of age) associated with growth.

Henderson's modification of Hazel's method (Karam et al., 1953) was adopted for the construction of selection indices using genetic and phenotypic covariances matrices and weighing coefficients with the help of SPAB-2 (Sethi, 2002).

Relative economic values were calculated according to the method presented by Singh et al. (1969). The relative economic value of six month body weight kept at unity as the main objective of constructing selection indices was to bring about maximum improvement in sixth month body weight. The relative economic value for body length, height at withers and chest girth at below one, three and six months of age and

body weight at below one month were estimated on the basis of simple regression of sixth month body weight on these traits. The relative economic value of third month body weight was calculated as the ratio of cost value for per unit body weight of kids at three months of age and cost per unit of body weight at sixth month.

The r_{IH} value which is the correlation between selection indx (I) and aggregate merit (H) was calculated (Kempthorne and Nordskog, 1959). Expected aggregate economic genetic gain (ΔG) and the expected genetic gain (Δx_i) in a trait were also calculated. Relative efficiency of the index was also calculated (Hogsett and Nordskog, 1958). These were used to compare the efficiencies of different indices.

Results and Discussion

Derivation of economic values were carried out on the basis of costs incurred on feed given to the goats, labour, supervisory and miscellaneous charges, and the average market rates at which the products were sold. For this purpose the animals were categorized as kids (up to three months of age) and young stock (three to six months of age). Relevant information was collected for a period from August 2005 to August 2008. Information on such items as the amount of grass grazed in the pasture, expenses on housing and shelter provided, and medicinal charges of goats were not directly available and not collected. Appropriate cost for different varieties of feed and fodder fed during the period to the various categories of animals were

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Table 1. Cost/head/day for rearing kids up to six months of age.

Category	Feed items (daily ration)			Cost of labour	Cost/head/day
	Concentrate feed (gm)	Fodder (gm)	Milk (gm)	labour (Rs)	(Rs)
Kids (0-3 M)	77.94	208.33	587	1.9756	11.25
3-6 M	258.33	791.67		1.9756	4.62

calculated. To these the labour charges calculated separately for each category of animals were added. The organization of labor was such that one labourer was engaged for every 50 animals. The relative economic value of body weight at below one, three and six months of age were 0.80, 1.31 and 1.00 respectively.

Eleven indices incorporating 12 traits were developed. The r_{IH} values ranged from 0.5226 to 0.7324. As in the case of r_{IH}, the index involving all the traits had maximum aggregate economic genetic gain of 6.2974. This was

followed by the 11variate index (5.9443). The lowest economic genetic gain was with the two variate index $I=0.1907X_1 + 0.1429X_2$ (1.9653).

Selection index constructed with body weight and chest girth had lowest relative efficiency of 31.21 per cent. From there onwards addition of each variable resulted in almost ten per cent increase in relative efficiencies in most cases. Excluding body length at below one month of age from the index incorporating all the traits results in 5.61 per cent reduction in efficiency, but exclusion of both height at withers and body

Table 2. Relative economic value of body weight and body measurements at below one, three and six months of age in Malabari goats.

Age	Trait	Cost/Unit (Rs)	Relative economic value
Below one month	Body weight	72.87	0.7978
	Chest girth	19.76	0.2163
	Body length	17.06	0.1868
	Height at withers	18.41	0.2015
Three months	Body weight	119.84	1.3100
	Chest girth	23.32	0.2553
	Body length	21.16	0.2316
	Height at withers	23.82	0.2608
Six months	Body weight	91.35	1.0000
	Chest girth	35.46	0.3882
	Body length	31.20	0.3415
	Height at withers	35.56	0.3893

Table 3. Selection indices for Malabari goats with their correlation coefficient between index and aggregate genetic worth (r_{IH}), aggregate economic genetic gain and relative efficiencies.

Indices	r_{IH}	Aggregate economic genetic gain	Relative efficiency (%)
I=0.1907 x_1 + 0.1429 x_2	0.5226	1.9653	31.21
I=0.2084 x_1 + 0.1085 x_2 + 0.1693 x_3	0.5349	2.6297	41.76
I=0.2711 x_1 + 0.1449 x_2 + 0.2214 x_3 - 0.0140 x_4	0.5339	3.3520	53.23
I=0.3198 x_1 + 0.2652 x_2 + 0.2674 x_3 - 0.1114 x_4 - 0.5116 x_5	0.5960	3.7389	59.37
I=0.2373 x_1 + 0.3272 x_2 + 0.2880 x_3 - 0.1274 x_4 - 0.2777 x_5 - 0.1465 x_6	0.6221	3.8694	61.44
I=0.2247 x_1 + 0.2905 x_2 + 0.4314 x_3 - 0.1410 x_4 - 0.2879 x_5 - 0.057 x_6 - 0.1906 x_7	0.6417	4.0177	63.80
I=0.2451x_1 + 0.3038x_2 + 0.4701x_3 - 0.1978x_4 - 0.3551x_5 - 0.0286x_6 - 0.2295x_7 + 0.1374x_8	0.6475	4.1416	65.76
I=0.160x_1 + 0.3958x_2 + 0.3793x_3 - 0.1757x_4 - 0.4961x_5 - 0.0931x_6 - 0.1743x_7 + 0.014x_8 + 01.4926x_9	0.7082	4.8445	76.92
I=0.0875x_1 + 0.4509x_2 + 0.3696x_3 - 0.1769x_4 - 0.5155x_5 - 0.0936x_6 - 0.2011x_7 + 0.073x_8 + 01.0543x_9 + 0.2082x_{10}	0.7123	5.3312	84.65
I=0.1113x_1 + 0.4997x_2 + 0.4320x_3 - 0.3085x_4 - 0.5862x_5 - 0.0338x_6 - 0.2861x_7 - 0.027x_8 + 0.8867x_9 + 0.0807x_{10} + 0.3244x_{11}	0.7257	5.9443	94.39
I=0.1222x_1 + 0.4857x_2 + 0.4635x_3 - 0.3158x_4 - 0.5832x_5 - 0.0308x_6 - 0.2979x_7 - 0.038x_8 + 01.2742x_9 + 0.106x_{10} + 0.5035x_{11} - 0.2857x_{12}	0.7324	6.2974	100

X_1=body weight at six months, X_2=chest girth at six months, X_3=height at withers at six months, X_4=body length at six months, X_5=body weight at three months, X_6=chest girth at three months, X_7=height at withers at three months, X_8=body length at three months, X_9=body weight at below one month, X_{10}=chest girth at below one month, X_{11}=height at withers at below one month, X_{12}=body length at below one month and I=Index.

length at below one month resulted in 15.35 per cent reduction in efficiency. Exclusion of body weight and body measurements at below one month caused a reduction of 34.24 per cent in efficiency.

The expected genetic gains for each trait was positive in all cases. When selection was based on index number 11(12 variate), 10(11 variate) and 9 (10 variate), the expected genetic progress in body weight at six months of age were 1.490, 1446. and 1,408 kg respectively.

On the basis of r_{IH} value and aggregate economic genetic gain the most efficiency index was I = 0.1222X_1 + 0.4857X_2 + 0.4635X_3 - 0.3158X_4 - 0.5832X_5 - 0.0308X_6 - 0.2979X_7 - 0.0.038X_8 - 01.2742X_9 + 0.106X_{10} + 0.5035X_{11} - 0.2857X_{12} which incorporated all the traits under study. The expected genetic gains by the application of this index for body weight, chest girth, height at withers and body length at six months of age were 1.490 kg, 2.817 cm, 2.029 cm and 2.635 cm respectively. The r_{IH} value and aggregat: economic genetic gain for this index were 0.7324

Table 4. The genetic gain expected in the economic characters with different selection indices in Malabari goats

Indices	X₁(kg)	X₂(cm)	X₃(cm)	X₄(cm)	X₅(kg)	X₆(cm)	X₇(cm)	X₈(cm)	X₉(kg)	X₁₀(cm)	X₁₁(cm)	X₁₂(cm)
I_1	1.041	2.380										
I_2	1.118	2.294	1.574									
I_3	1.122	2.304	1.579	2.110								
I_4	1.212	2.465	1.650	2.402	0.082							
I_5	1.247	2.537	1.639	2.441	0.103	0.119						
I_6	1.271	2.557	1.645	2.417	0.143	0.092	0.297					
I_7	1.258	2.474	1.669	2.367	0.166	0.129	0.344	0.537				
I_8	1.426	2.655	1.828	2.429	0.215	0.259	0.479	0.453	0.336			
I_9	1.408	2.635	1.836	2.462	0.218	0.305	0.536	0.560	0.371	1.920		
I_{10}	1.446	2.706	1.933	2.458	0.268	0.371	0.592	0.673	0.378	1.809	2.017	
I_{11}	1.490	2.817	2.029	2.635	0.227	0.374	0.662	0.693	0.354	1.673	2.026	1.318

X_1=body weight at six months, X_2=chest girth at six months, X_3=height at withers at six months, X_4=body length at six months, X_5=body weight at three months, X_6=chest girth at three months, X_7=height at withers at three months, X_8=body length at three months, X_9=body weight at below one month, X_{10}=chest girth at below one month, X_{11}=height at withers at below one month, X_{12}=body length at below one month and I_1 to I_{11} - selection indices

and 6.2974 respectively. As this index produced maximum genetic gain for individual traits also, this seemed to be the best index and can be applied for selection of Malabari goats under field conditions. Similar results were observed by Khadanga *et al.* (1987) in Ganjam goats, Singh and Singh (1999) in Jamunapari x Black Bengal goats and Rai *et al.(loc cit.)* in Marwari goats.

Summary

Data on 845 kids from the farmer's flocks of All India Co-ordinated Research Project for Malabari goats were analysed for the development of selection indices. Eleven selection indices were constructed by incorporating growth traits (body weight, chest girth, body length and height at withers at below one, three and six months of age in different combinations). These were developed by assigning economic weights to the traits. Index I_{11} involving all the traits was found most appropriate with an aggregate economic genetic gain of 6.2974 and an expected genetic gain of 1.490kg for body weight at six months of age followed by I_{10} and I_9.

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