

Simulated genetic and economic gains from a designed closed nucleus breeding program for Eritrean Barka cattle

This study evaluated the feasibility of establishing a structured breeding program for genetic improvement of Barka cattle in Eritrea by assessing expected genetic and economic responses under a two-tier nucleus breeding scheme. The breeding objective comprised of traits related to, productivity, growth, fitness, and longevity, namely milk yield (MY) at 305-days, lactation length (LL), birth weight (BW), live weight (LW), calving interval (CI), age at first calving (AFC), pre and post weaning daily gain (PrDG, PDG), pre and post weaning survival rate (PrSR, PSR), and productive lifetime (PLT). Economic values were derived from Eritrean Barka cattle under local production conditions, while genetic parameters were obtained through a meta-analysis of published estimates from comparable indigenous zebu breeds raised under similar production systems in the tropics. Genetic parameter estimates were pooled using inverse-variance weighting and heterogeneity was assessed to ensure practical relevance and applicability. The derived economic values were 0.32 (MY), -0.09 (LL), 0.36 (BW), 0.37 (LW), 0.18 (CI), -0.01 (AFC), 0.10 (PrDG), 0.63 (PDG), 1.34 (PrSR), 1.19 (PSR), and 0.00 (PLT). A deterministic simulation approach (SelAction) was used to simulate a two-tier nucleus breeding program and evaluate the breeding program. A population of 2,500 animals representing 0.25% of the total Barka population in Eritrea was considered because it can be supported by the existing nucleus infrastructure in Eritrea. Selection was practiced exclusively within the nucleus using overlapping generations with truncation selection. Sixteen sires and 300 dams were selected annually, corresponding to 96 active sires (six-years use) and 2,404 active dams (eight-years use). The genetic response for traits MY, LL, BW, LW, CI, AFC, PrDG, PDG, PrSR, PSR, and PLT were 34.71, 2.37, 0.22, 4.94, 0.90, -1.85, 0.76, 0.84, 0.35, 0.20, 7.15, respectively, with corresponding economic gains of 11.12, -0.21, 0.08, 1.83, 0.16, 0.02, 0.08, 0.53, 0.47, 0.23, and 0.001. Reduction in genetic variance due to selection was modest (9.1%). The findings demonstrated that genetic improvement of Barka cattle in Eritrea based on the existing genetic resources and infrastructure would be feasible and economically sustainable.