Genetic Improvement And Monetary Returns In Alternative Closed And Open Nucleus Breeding Programs For Boran Cattle Reared In Semi-Arid Tropics

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Introduction

In the semi-arid tropics where cattle provide a reliable source of meat protein as well as livelihood, evaluation of alternative cattle breeding programs is important to inform the choices for sustainable investment. The production systems within this region have been shaped by prevailing biophysical and socio-cultural environments (Steinfeld et al. 2006) consequently resulting in the formation of farmer groups. Large and medium scale ranching co-exist with low-input cattle production systems that are supported by a growing demand for beef in urban centres (Mwacharo and Drucker 2005). Following an evaluation of genetic and economic efficiency of a basic two tier closed nucleus breeding program based on the Boran Cattle Breeders Society (BCBS) (Rewe et al. 2009), the current paper focuses on the merits presented by the establishment of a breeding program incorporating herds from the BCBS as well as from an expanded population of Boran cattle producers, the majority of whom are non-members of BCBS.

Material and methods

Two alternative breeding programs were modeled, breeding program for the entire group members of BCBS (ENTIRE), and EXPO, simulated as an attempt to expand ENTIRE by incorporating adaptation traits to suit the needs of both, the commercial ranchers and the low-input producers. The economic values of the breeding objective traits for ENTIRE were obtained from the study on Boran cattle breeding programs by Rewe et al. (2009). Economic values for the EXPO breeding objective were obtained from Rewe et al. (2009) and from Janssen-Tapken et al. (2006) and Pitchford (2007). Table 1 presents the economic values for breeding objective traits alongside the selection criteria applied. The ZPLAN computer program was used to calculate the annual genetic gain for the breeding objective, genetic gain for single traits, and returns on investment adjusted for costs using the gene-flow and selection index methodology (Willam et al. 2008). The production, economic and biological parameters as well as the genetic and phenotypic parameters for closed (CNS) and open (ONS) nucleus breeding programs were simulated following Rewe et al. (2009). Comparing the genetic and economic merits of the breeding programs directly was not possible because of the differences in the production systems as well as the economic values applied. However, evaluation of the merits of ENTIRE as well as the expanded program (EXPO) defines the general direction towards which inclusive breeding programs can be designed.

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Table 1: Economic values (KSh)[α] for breeding objective traits and selection criteria applied in the alternative breeding programs for Boran cattle

Traits	Alternative breeding programs[β]	
	ENTIRE	EXPO
Sale weight	18.36	18.36
Cow weight	8.87	8.87
Dressing	210.36	-
Consumable meat	158.53	-
Cow weaning rate	138.52	-
Calving interval		-1.80
Age at first calving	-1.56	-1.56
Cow survival rate	108.81	-
Post-weaning survival	79.79	79.79
Test day milk yield	-0.003	-
Feed intake	-0.50	-0.50
Trypanotolerance	-	628.90
Selection criteria		
Birth weight (kg)	√	√
Weaning weight (kg)	√	√
Yearling weight (kg)	√	√
Age at first calving (days)	√	√
Calving interval (days)	√	√
Packed cell volume (%)	-	√

[α]1 US$ = 77 KSh. as at 13.12.2008.
[β]See text for description of breeding program.

Results and discussion

Table 2 shows the overall genetic gains per year and monetary returns per trait for the CNS and ONS. With respect to genetic gains in ENTIRE, the ONS was superior to the CNS. For example, SW and CoWT obtained gains of 4.1 kg and 2.2 kg, respectively in the ENTIRE of ONS compared to 3.2 kg and 1.8 kg in ENTIRE of CNS. In ENTIRE, the AFC was reduced by 8 and 7 days for ONS and CNS, respectively. The superiority of ONS to CNS in response to selection has been reported to be approximately 10 -15% depending on the total population sizes (Mueller and James 1984). Shepherd and Kinghorn (1992) indicated that ONS utilise a higher proportion of exceptional progeny from the whole population for assortative matings in the nucleus contributing to its higher genetic performance.

Table 2: Overall genetic gain per year and monetary returns in Kenya shillings (in brackets)[α] after one generation of selection for traits of economic importance for ENTIRE and EXPO[β]

Traits	Closed nucleus		Open nucleus	
	ENTIRE	EXPO	ENTIRE	EXPO
Sale weight (kg)	3.2 (409)	1.8 (207)	4.1 (426)	2.5 (202)
Dressing (%)	0.01 (7)	-	0.01 (6)	-
Consumable meat (%)	0.02 (17)	-	0.02 (18)	-
Cow weaning rate (%)	0.04 (17)	-	0.04 (13)	-
Cow survival rate (%)	-0.002 (-0.53)	-	-0.002 (-0.48)	-
Cow weight (kg)	1.8 (49)	1.2 (27)	2.2 (51)	1.5 (25)
Age at first calving (days)	-7 (28)	-3 (12)	-8 (27)	-4 (17)
Milk yield (kg)	-0.4 (0.01)	-0.8 (-4)	-0.8 (0.01)	-
Feed intake (kg/dry matter)	0.63 (-2)	0.3 (-1)	0.82 (-2)	0.5 (-1)
Post-weaning survival (%)	0.004 (3)	0.01 (3)	0.01 (3)	0.01 (3)
Calving interval (days)	-	-0.7 (3)	-	-1.1 (10)
Flight speed (s/100m)	-	-	-	-
Tick count (count)	-	-	-	-
Packed cell volume (%)[2]	-	0.2 (684)	-	0.2 (506)

[α]1 US$ = 77 KSh. as at 13.12.2008.
[β]See text for description of breeding program.

The advantages conferred by introducing disease tolerance traits (EXPO) are long term and would benefit ENTIRE. This could allow the breeders to accommodate the tradeoffs between growth and adaptation considering land, feed and climate limitations. Wasike et al. (2006) reported that fluctuations in growth and fertility performance of improved Boran cattle were a function of the harsh environmental conditions in the semi-arid tropics of Kenya. The breeding focus therefore, could be changed from concentrated improvement on SW to faster finishing of steers. For example, the sale age could be reduced to 27 or 30 months to increase off-take and cover for any losses from reduction in SW. The gains in PSR (0.01% in EXPO) would also contribute to this objective. Table 3 shows the monetary genetic gains, total returns to investment, costs (variable and total costs) and profit for the CNS and ONS breeding programs. Monetary genetic gains from the breeding programs were an important indicator of the role of genetic gains in determining the profitability of the breeding programs. In some cases, programs with higher monetary genetic gains returned lower profits. For instance, ENTIRE of ONS returned higher annual monetary genetic gain of KSh117 and a lower profit of KSh404 while ENTIRE of CNS had lower monetary genetic gain of KSh93 with a higher profit of KSh431. The ONS had higher costs, showing that the influence of monetary genetic gains on profits was minimised by the effects of costs.

Table 3: Annual monetary genetic gain, total monetary returns, cost and profit per cow from the basic breeding programs for ENTIRE and EXPO

Economic Parameters (KSh) [α]	Closed nucleus[β]		Open nucleus[β]	
	ENTIRE	EXPO	ENTIRE	EXPO
Monetary genetic gain	93	161	117	188
Total returns	527	934	541	761
Total cost	96	84	137	134
Profit	431	850	404	627

[α]1 US$ = 77 KSh. as at 13.12.2008.
[β]See text for description of breeding program.

Conclusion

The characteristics of a production system determine the ability of a farming group to undertake the tasks of running a breeding program especially the definition of breeding objectives and selection criteria. Simultaneous simulation of economic and genetic merits was important in revealing differences between the alternative breeding programs. To benefit from the genetic superiority of ONS schemes, recording in the commercial herds could be avoided to lower the breeding costs and the selection of bulls done subjectively based on set standards. Long term gains with short term costs are expected to be a limiting factor in the adoption of the breeding programs studied.

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