ECONOMIC VALUES FOR BIOLOGICAL TRAITS IN THE BREEDING OBJECTIVE OF CARACU CATTLE

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INTRODUCTION

Nowadays, the prediction of breeding values for a great number of traits is a routine task for most of cattle breeders associations and the future sires and dams can be made from designed mates. However, the right choice of the traits, which suit breeders or commercial producers expectations, has become even more difficult. Many traits, which are measurable on animals, do not directly affect profit. In addition, several economically relevant traits in a cattle production system have multiple indicator traits. The choice of the right selection criteria and the way they should be weighted seem to be the most important decisions to be taken by the breeder. The definition of a breeding objective is the first step to solve this problem. The next step is the construction of an index to identify the list of traits that influence the goal and to determine the relative importance of each of the traits in this list (Golden *et al*., 2000). Hazel (1943) elaborated the theory for predicting the aggregate economic merit of each animal. This methodology enables the determination of the economic value of each trait in the index. The economic value reflects the change in profit for a unity change in the trait, since all other traits in the index remain unaltered (Amer, 1994). The aim of this paper was to estimate the economic values for biological traits in the breeding objective of a Brazilian double purpose cattle breed Caracu.

MATERIAL AND METHODS

The Caracu is a native cattle breed formed by unplanned crossbreeding among animals of several European breeds brought to Brazil by the Portuguese settler. The data used in this research came from a production system based on double purpose cattle. The breeding objective for this herd was to produce milk and seedstock to be sold at yearling. Herd size was near 2200 heads in all animal categories. Animals were fed on pasture during the whole year receiving also mineral salt *ad lib*. Corn silage was offered during the dry season, i.e., from June to September. Lactating cows received in addition 2kg/day of a concentrate mix based on wheat meal, ground ear corn and cottonseed meal during the lactation length. The calves received 1 kg/day of the same concentrate mix gave to cows about 60 days after calving until weaning. They also suckled the milk left in one teat of their mother after milking and received pasture or silage before weaning. The cows were milked twice a day and calves were kept near their mother during milking. Milk production was measured weekly. The health care practices included only the routine vaccines, medications to control parasites and the milking hygiene care. The mates were carried out with sires in natural service. One sire was kept with a group of 50 cows during the breeding season (from April to February) in each module. The farm had 10 modules composed by employees, animals, milking barn and pastures. The heifers were bred when they reached 300 kg or 17 months. Around 200 heifers entered the herd each year. The total production costs were calculated using the farm accounting information from 1994 to 2000 supplied by the breeder, according to Martins and Borba (1995). The prices were deflated using the index IGP – DI base December 2000 (Conjuntura econômica, 1979-2001) and converted to US dollar (1 US$ = R$ 2.53). Biological traits affecting income and expenses considered in this research were: total milk yield (MY), lactation length (LL) and dry period (DP) - as specific dairy traits, age at first calving (AFC) and number of services per conception (NS) - representing reproductive traits; weaning weight (WW) - as growth trait; and Productive lifetime (PL) - as lifetime trait. Male and female calves sold at yearling, milk yield, culled cows and culled sires were identified as sources of revenue. Sale prices for each one of them are presented in table 1 that also shows feed (grazing, silage and ration) costs, health costs and reproductive costs which were identified as sources of expenses. Reproductive costs were estimated considering the total cost of sires (health and feed costs) per cow and per service. The identification of these sources of income and expenses enabled the development of a profit equation, where profit was defined as the difference between income and expenses. The profit equation was set to an annual base using annual averages (from 1994 to 2000) for number of animals per category, biological traits and prices. The information used in the profit function is presented in table 1. The economic values (EV) of each trait were derived by partial differentiation of profit equation (P) with respect to each trait in the breeding objective. The derivative is then evaluated at the mean value of all other traits (Moav and Hill, 1966; Harris, 1970). This approach allowed fixed costs to be ignored (Ponzoni, 1988). Therefore, only terms involving that trait need to be considered, as other terms are vanished on differentiation. A sensitivity analysis was performed increasing milk and weaning weight prices in 20%. On the other hand, the sensibility of the EVs to the increase of 20% in dry matter price was also observed.

RESULTS AND DISCUSSION

From the values given in table 1 a profit of US$ 76,949.2323 per year can be earned from the Caracu herd. However, in the derivation of the profit, fixed costs were not taken into account because they did not affect the magnitude of the economic values. The economic value estimated for the traits in the breeding objective can be seen in table 2. They are expressed in US$ per unit change in each trait, in a milk yield EV base and per unit of additive genetic standard deviation ($EV\sigma_A$). Economic value indicates the change in P resulting from a unit change for the trait in question. The trait PL had great impact on profit. This trait is close related to the costs of raising heifers and also to the income provided by lactation cows. Longer PL would provide more income (milk and weaned calves) and also could reduce the raising costs of heifers.

Table 1. Average values for biological traits and average prices used in the profit equation for derivation the economic values for the traits in the breeding objective of Caracu cattle breed

Trait/Indicator	Value	Item	Price US$
Number of lactating cows N_L	567.43	Milk (kg)	0.12648
Proportion of weaned calves	0.69	Ration (kg)	0.13834
Milk Yield MY (kg)	1812.70	Dry Matter (kg)	0.01456
Lactation Length LL (Days)	273.23	Health costs – Lact. cows	1.53360
Dry matter Ingestion of lact.cows (kg /day)	16.50	BW weaning (kg)	0.49407
Number of services NS	7.57	Health costs – Calves	0.80237
Days open (days)	157.52	Health costs – Heifer	1.96047
Number of dried cows N_D	228.00	Health costs – Young sire	0.97233
Dry matter Ingestion of dried cows (kg /day)	9.75	Cost breeding service	0.5494
Weaning weight (kg)	239.36	Voluntary culled cows	345.84980
Dry matter Ingestion of calves (kg /day)	1.78	Involuntary culled cows	163.71540
Dry matter Ingestion of heifers (kg /day)	8.32	Culled sire for reproduct.	1110.67100
Productive life PL (years)	4.10	Culled sire for beef	272.72730
Age at first calving AFC (days)	1004.70	Milk +20% (kg)	0.15178
Number of sires N_{YS}	61.57	BW weaning +20% (kg)	0.59288
Dry matter Ingestion of young sires (kg /day)	8.44	Dry Matter +20% (kg)	0.01747
Number of voluntary culled cows N_{VC}	106.00		
Number of involuntary culled cows N_{IC}	88.00		
Number of culled sire N_S	2.00		
Number of culled sire as beef NB	60.00		
Dry period DP (days)	143.02		
Proportion of replacement heifers b_1	0.36		
Proportion of replacement steers b_2	0.12		

The reproductive trait AFC had negative effect on profit. Each extra day as a heifer decreased profit in US$ 22.0767. Vercesi *et al.* (2000) reported similar results in a dairy system using crossbred cows. As expected MY and WW traits presented positive impact on profit. For the first case using current prices, WW was 2.7083 times more expressive than MY. The expression of economic values per unit of additive genetic standard deviation is important because not all traits were measured in the same unit and also it provides a figure of the economic genetic variation available. Table 2 shows that milk yield was one of the traits of major economic importance to this herd. Efforts should be made to increase it by selection. PL and WW also should be increased and AFC is the trait which selection could be done in a downward direction. Increasing the prices related to income traits (+20%) would modify the relative importance of each trait in the breeding objective. EV of all traits would be less important than in the previous situation. In the third situation, the addition of 20% in dry matter price did not provoke a great change in the economic values for the traits. The results showed that EVs were sensitive to prices of income traits mainly the price of milk.

Table 2. Economic values (EV) for the traits in the breeding objective of Caracu cattle

Traits	MY (kg)	WW (kg)	AFC (days)	PL (years)
1st case- Economic values considering current prices				
EV (US$)	53.8273	145.7824	-22.0767	3956.4450
EV/EV MY	1.0000	2.7083	-0.4101	73.5025
EVσ_A	8649.2600	1604.6269	-1068.2187	4439.1313
2nd case – Economic values adding 20% to the prices of milk and weaning weigh				
EV (US$)	88.7035	174.9389	-23.5011	3956.4408
EV/EV MY	1.0000	1.9722	-0.2649	44.6030
3rd case – Economic values adding 20% to the price of dry matter				
EV (US$)	53.8273	145.7824	-28.2026	4690.0143
EV/EV MY	1.0000	2.7083	-0.5239	87.1307

σ_A = additive genetic standard deviation

CONCLUSIONS

MY and PL had great impact on profit. The reproductive trait AFC had negative effect on profit and, as expected, WW increased profit. EVs were more sensitive to prices of income traits mainly the price of milk. The improvement of animal performance in biological traits without increasing costs or changing the production system could result in a great impact on profit.

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