Economic Values For Production And Reproduction Traits In Uruguayan Pasture Based Dairy Systems

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Introduction

Located in the temperate zone of South America, Uruguay has doubled its milk production in the last twenty years. With a similar consumption per capita to developed countries, the production has been increasingly export-oriented, with milk powder and cheese as the chief products. The competitiveness of its dairy industry has been based on the efficiency of the primary sector and its ability to produce high quality milk at low cost on pasture-based production systems. The national herd is based on the Holstein breed (95%), and the main breeding strategy is the use of imported semen, principally from USA and Canada.

It is recognized that the production circumstances strongly affect the economic value of the traits having incidence on the profit of dairy production systems (Groen (1989)). The pasture based dairy production systems have, though, singularities even in the same region. Economic values (EV) for Brazilian dairy production system were calculated by Cardoso, Nogueira, Vercesi Filho et al. (2004). These authors found positive values for milk yield and negative values for fat and protein yield, demonstrating the effect of payment scheme on the traits' EV. For mature live weight, the EV was moderately negative and age at first calving, the single trait related to reproduction, presented values close to cero. Pruzzo, Danelon and Cantet (2001) derived EV of milk components (protein, fat and volume) for Argentinean dairy production systems. In this case, with a payment scheme based on protein and fat content, protein had the highest EV, followed by fat yield; the EV of volume was negative but small. For Uruguayan dairy production systems, Rivero (2004) calculated the EV of milk components (protein, fat and volume) and mature live weight. The EV of protein and fat were positive, while those of volume and mature live weight were moderately negative.

Changes in the productions systems related with the payment scheme and relative prices of production factors have occurred in the last five years. Therefore, the objective of this paper was to calculate the economic values of milk components, mature live weight and calving interval in the new production scenarios.

Material and Methods

The model applies a deterministic normative approach based on the economic and productive information of national data bases. The production parameters used in the model were 5600 l/cow/year, 3.6 % fat content, and 3.11% protein content. Replacement rate was 28% and an average calving interval of 420 days was defined. Rates for adult and calf mortality (until one year) were 4 and 10 %, respectively; average age at first calving was 30 months, and average mature body weight 550 kg. Calving was mainly in autumn (66%).

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Metabolisable Energy (ME) requirements were derived using the AFRC (1993) guidelines. An increment of 30 % of energy was considered for grazing activity and it was assumed that cows could at all times consume sufficient quantities to meet the specified energy demands. The production system was based on a rotational pastures system which supply annually 2750 kg/ha of dry matter (DM) consumed by direct grazing and 1125 kg/ha of DM of sorghum silage. Additionally, 1125 kg/ha/year of concentrate was incorporated. Contents of ME were assumed to be an average of 2.42 Mcal/kg for pastures, 1.94 for silage and 2.74 for concentrate brought. With these parameters, a stocking rate of 0.75 cows per ha was assumed. Male calves were sold at calving; females were raised until 100 kg and then sold. Pregnant heifers were purchased for herd replacement. Farm profitability was calculated as the difference between gross income (milk, beef and female calves) and farm production costs. The latter were divided into feeding and other direct production costs. Prices and average farm production costs are shown in Table 1.

Table 1: Prices and average farm production costs

Prices	***Unit***	***Value***
Protein	US$ / kg	3.692
Fat	US$ /kg	1.430
Volume	US$ / l	- 0.0185
Culled Cow	US$ / kg live weight	0.75
Females Calves	US$ / head	75
Males Calves	US$ / head	30
Costs	***Unit***	***Value***
Labour	US$ / ha	104
Electricity	US$ / ha	22
Animal Health	US$ / ha	25
Breeding	US$ / cow	20
Replacement Heifer	US$ / head	600
Other expenses	US$ / ha	9
Feeding Costs	***Unit***	***Value***
Pastures	US$ / kg DM consumed (2.42 Mcal)	0.045
Sorghum silage	US$ / kg DM consumed (1.94 Mcal)	0.07
Concentrate	US$ / kg DM consumed (2.74 Mcal)	0.21

The economic values (EV) of traits were calculated by the partial budgeting method. The EV's of protein yield (P), fat yield (F), volume (V), mature live weight (LW) and calving interval (CI) were obtained as the change of farm profitability resulting from a unit change for the trait in question, assuming that all other traits remained constant (Urioste, Ponzoni, Aguirrezabala et. al (1998)). Discounted gene flow techniques (McClintock and Cunningham (1974)) were applied, to account for different time and frequency of trait expression. Trait expressions were calculated over 25 years and 8 generation, using a 5 % discount rate. The discounted economic values (DEV) were obtained by multiplying EV times the trait number expression, and they were expressed in USA dollars (US$) per cow and also in units of additive genetic standard deviations (σ_a). The $DEV * \sigma_a|$ expression (EGV) enables the comparison of traits in terms of economic-genetic variation (Urioste, Ponzoni, Aguirrezabala et. al (1998)) and it was expressed on P basis. The sensitivity of the calculated DEV´s was analyzed considering different prices of concentrate scenarios (1, 1.2, 1.5, 2 and 3 times the average price of 1 litre of milk).

Results and Discussion

The EV's, DEV's and EGV's for the current situation and for different concentrate prices scenarios are shown in Table 2.

Table 2: Economic Values, Discounted Economic Values and Economic-Genetic Values of Volume (V), Fat (F), Protein (P), Mature Live Weight (LW) and Calving Interval (CI) for different feed price scenarios

Concentrate Price		**Economic Values (EV)**				
l milk/ kg	***US$ / kg***	**V**	**F**	**P**	**LW**	**CI**
1	*0.17*	-0.0734	0.6642	3.8563	-0.3576	-0.4496
1.2	*0.21*	-0.0839	0.4553	3.7542	-0.4673	-0.4436
1.5	*0.26*	-0.0992	0.1526	3.6061	-0.6264	-0.4348
2	*0.35*	-0.1249	-0.3896	3.3560	-0.8952	-0.4199
3	*0.52*	-0.1765	-1.3821	2.8557	-1.4328	-0.3901
Concentrate Price		**Discounted Economic Values (DEV)**				
l milk/ kg	***US$ / kg***	**V**	**F**	**P**	**LW**	**CI**
1	*0.17*	-0.0278	0.2514	1.4597	-0.0449	-0.1688
1.2	*0.21*	-0.0318	0.1723	1.4211	-0.0586	-0.1666
1.5	*0.26*	-0.0375	0.0578	1.3650	-0.0786	-0.1633
2	*0.35*	-0.0473	-0.1475	1.2703	-0.1123	-0.1577
3	*0.52*	-0.0668	-0.5232	1.0810	-0.1798	-0.1465
Concentrate Price		**Economic-Genetic Variation (EGV) referred to P ($DEV * \sigma_a \|$)**				
l milk/ kg	***US$ / kg***	**V**	**F**	**P**	**LW**	**CI**
1	*0.17*	-0.6199	0.2017	1	-0.1347	-0.1349
1.2	*0.21*	-0.7278	0.1421	1	-0.1808	-0.1367
1.5	*0.26*	-0.8959	0.0496	1	-0.2524	-0.1395
2	*0.35*	-1.2121	-0.1360	1	-0.3875	-0.1448
3	*0.52*	-2.0129	-0.5669	1	-0.7289	-0.1581

According with the current payment scheme, the EV of V was always negative, while the EV P was always positive; P had the highest EV in most scenarios. For F, a moderate positive value was found with current prices, but EVs turned negative for high prices of concentrate, suggesting that genetic improvement of this trait is not profitable for such scenarios. The EV of LW was negative in all scenarios: larger LW increases herd maintenance requirements, which are not compensated by the extra kg sold as culled cow.

When the DEV´s were expressed in terms of economic-genetic variation, V showed an increasing relative weight at highest concentrate prices (doubled the EGV of protein in the 3:1 concentrate/milk price ratio scenario). The EV's of LW and CI were moderately negative with favourable prices of feed. With unfavourable (increasing) concentrate/milk price ratio, EV of LW increased its negative value; the EV of CI did not have significant variation, although the trend was to decrease the negative value. An increase of CI implies fewer calves per year, but it is partially compensated with a smaller quantity of more expensive feed.

The trend of the EV's and DEV's obtained are in accordance with the results by Rivero (2004), even though the estimated EGV´s (mostly for F and LW) indicated changes in the relative weight of each trait. The relative decrease of importance for F may be a direct consequence of changes in the payment scheme in the last years. Variation in LW importance is more complex; although the current beef prices had a remarkable increase; it is probably not the only reason. LW affects the incomes through culled cows but also influence cow and replacements maintenance (and growth) requirements. Changes in its relative weight are consequence of interactions between effects on cow and replacement stock, where pasture use and other price factors (e.g. land availability) also affect the results. Similar considerations should be extended to CI: in seasonal dairy production systems, one day more in days open imply an increase of the probability of discarding animals. In Uruguay, farmers have received extra prices for producing milk in winter, which promote a more even distribution of calvings along the year. Our study assumed no effect of larger CI in the probability of a cow being culled, but changes in the extra pricing system could have effects in the future seasonality of the production system and a consequent effect on the EV of CI.

Conclusions. For the production circumstances modelled, DEV's consistently indicated the importance of improving protein production without increasing the volume proportionally. They also indicated the inconvenience of increasing LW. The relative importance of F was found decreasing with higher concentrate input, and DEV of CI has a significant value; further analysis considering other reproductive traits should be considered.

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