DERIVATION OF ECONOMIC VALUES OF MILK PRODUCTION TRAITS: A LITERATURE REVIEW.

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SUMMARY

Literature on the economic values for milk production traits is reviewed. Emphasis is put on reviewing choices made on the methodology of derivation and the components included in calculating cost and revenue.

INTRODUCTION

Using selection index theory, a breeding goal can be defined in terms of an aggregate genotype (Hazel, 1943) which represents the aggregated sum of the genotype traits, each trait being weighted by its value. The value of a trait is determined by (Brascamp, 1978): (1) the economic benefit of genetic superiority at the moment of expression (economic value), and (2) time and frequency future expression of genetic superiority in offspring (cumulative discounted expression).

In literature, economic values on traits are presented, showing a large range in (relative) levels. Part of the differences in levels are due to different methodologies used in deriving economic values. Methodologies are discussed by Brascamp et al. (1985), Smith et al. (1986), Groen (1989a) and Gibson (1990b). Groen (1989a) denotes the choices on basic aspects to be made in deriving (economic) values and expressed the economic values in concepts of economic production theory when different choices on selection and base of evaluation are made. This approach might be used to assign systematic differences in levels of economic values.

The purpose of this paper is to review literature on economic values of milk production traits in order to test the applicability of the concepts on methodology as given by Groen (1989a).

THEORY

Groen (1989a) denotes that choices on five basic aspects are to be made in deriving (economic) values: (1) the definition of efficiency: in economic or biological terms; (2) the interest of selection: maximize profit, minimize cost price or maximize revenue on investment; (3) the definition of production system in terms of level (e.g. animal, farm or sector) and size (fixed number of animals, fixed input or fixed output); (4) planning term: strategic (long-term) or tactical (short-term); (5) method: positive (data-analysis) or normative (data simulation).

The choices made on interest of selection and base of evaluation determine the concept of economic production theory in which economic values can be expressed. For four perspectives these concepts are given in table 1. From these concepts, it can be concluded that different cost and revenue components should be included when different perspectives are used. Also, systematic differences in economic values can be assigned. E.g., considering profit maximization, when the marginal revenue of a product exceeds average variable cost of production, the economic value with fixed output will be lower than the one with fixed number of animals.

RESULTS

References being original sources of economic values are summarized in table 2. Sources using methodology or economic values based on these original ones are not given. It is tried to appoint only the components finally included in revenue and cost terms. When this was not possible, i.e. with positive analyses and linear programming, all components in modelling are given (marked by +). All literature
Table 1. Economic values expressed in concepts of economic production theory.

<table>
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<tr>
<th>Base</th>
<th>Profit</th>
<th>Interest</th>
<th>Cost per unit</th>
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<tr>
<td>fixed number of animals</td>
<td>marginal revenue - marginal cost</td>
<td>average total cost - marginal cost</td>
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<tr>
<td>fixed output</td>
<td>average variable cost - marginal cost</td>
<td>average variable cost - marginal cost</td>
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Items reviewed concern economic efficiency. References can be divided in four groups: Dutch, American, German and Scandinavian.

Dommerholt (1979) calculates the economic values of carrier, fat and protein. Carrier (i.e. milk without fat and protein) has a negative price in the Dutch paying system. Economic values are calculated as the margin between gross prices and feed cost per unit product (see also Dommerholt and Wilmink, 1986). After introduction of the quota system, the influences of output limitations are studied by Van Arendonk et al. (1985b). Changing from fixed number of animal to fixed output while assuming a profit interest, means that average variable cost are to be included in the calculations. Therefore, more cost components are included in the calculation of economic values (see table 2). Van Arendonk et al. (1985) used a profit equation and partial differentiation to derive economic values (see also Van Arendonk et al. (1985a), and Wilmink (1988)). Groen (1989b, 1989c) used an extensive herd enterprise model to study theoretical aspects of the influences of production circumstances (including limitations) on economic values of milk production traits. Zijlstra et al. (1988) included detailed modelling of grassland production in a model for derivation of the sensitivity of economic values.

Economic values used in Scandinavian countries are largely based on subjective desired gains for the different traits (Gravir, 1983; Christensen, 1984; Mäntysaari et al., 1984; Philipsson, 1984). Petersen (1985) defined the economic value of milk, butterfat and milk protein as the net income per kilogram (price - variable feeding cost). More recently, Juga (1989) derived economic values for the Finnish index as the difference between gross prices and feed cost.

Andrus and McGilliard (1975) analysed data of a research station by regressing economic margin per cow on different cost and revenue components. Van Vleck (1978), Mbah and Hargrove (1982) and Hillers (1984) define the economic value as market price minus (feed) cost of producing. Gibson (1990a, 1990b) is the only one that includes calculation of the economic value of lactose. Gibson (1990a) includes situations where multiple production quota applies. Gibson (1990b) includes (inter)national aspects in calculating the value of the product (e.g. industrial processing cost).

Adelhelm et al. (1972) calculated the economic values of fcm and fat using a single equation for modelling profit of a farm. Henze et al. (1980) developed a linear programming model to calculate the economic values of carrier, fat, protein and fcm. This sector model includes linear programming models of different farms types for which profit is maximized. Zeddies (1985) directly calculated the economic values as 'average variable cost minus marginal cost'. Luna et al. (1987) defined a profit equation and derived economic values by partial differentiation.

**DISCUSSION AND CONCLUSIONS**

It appears from table 2, that methodologies in literature can well be categorized according to the choices on five basic aspects. A uniform choice is made on the interest of selection: profit maximization. The choice of a system size is always justified by actual production circumstances, as is appropriate (Groen, 1989a). Only
one reference uses positive (data) analyses. This method is theoretically less suitable because it analyses 'past' instead of predicting 'future' as should be done in calculating benefit of breeding. It is apparent that only few references made a concrete choice on the planning term. The choice of a planning term should be included in deriving economic values regarding the price parameters and the distinction between variable and fixed cost (Groen, 1989a).

Influences of limitations are clearly expressed in table 2: with limitations more components are to be included. However, also within a certain methodology, differences appear in components included. These differences originate from different model assumptions, regional differences in production circumstances (e.g. pricing systems) and the planning term assumed.

No references can be found that differentiate between economic values for subsequent lactations, as suggested by Dempfle and Ponzoni (1986).

This study shows that different methodology is used by different authors in deriving economic values. The approaches presented by Groen (1989a) seem helpful in categorizing methodologies and appointing systematic differences in the levels of economic values in literature.

REFERENCES

Hohenheimer Arbeiten, Heft 64, Verlag Eugen Ulmer.


CHRISTENSEN, L.G. 1984. IDF/EAA symposium Prague, Chechoslovakia.


Table 2. A summary of original sources of economic values on milk production traits.

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<td>2. interest</td>
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<td>3. system level</td>
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<td>5. method</td>
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<tr>
<th>revenue component</th>
<th>milk/fcm</th>
<th>carrier</th>
<th>fat</th>
<th>protein</th>
<th>lactose</th>
<th>beef</th>
<th>costs components</th>
<th>feed</th>
<th>concentrate</th>
<th>replacement</th>
<th>buildings</th>
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Abbreviations used:
p-max = profit maximization; strat = strategic; norm = normative; pos = positive; ≠ not a concrete choice in reference, but interpreted from results given; ? not given; fcm = fat-corrected-milk