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ECONOMIC EVALUATION OF REPLACEMENT RATES IN DAIRY HERDS I. REDUCTION OF REPLACEMENT RATES THROUGH IMPROVED HEALTH

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ABSTRACT

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A model is presented with which two questions have been elaborated:
(a) what is the economic significance of improved health, permitting a longer herd life?
(b) which cows should be removed from the herd during the first lactation in view of their milk yield?

This paper is confined to the first question; the second will be worked out in a subsequent paper.

First, the principle underlying the replacement decision is discussed. Then, the basic data of the model are given. The age-associated probability of disposal has also been included in the model.

A reduction of the involuntary replacement rate was found to be of major importance on the farm level. In the model a herd showing average production and an average herd life of 5.3 lactations will have approximately 20% more earned income each year than a similar herd with an average productive life of 3.3 lactations. However, the yield resulting from a longer herd life is subject to the law of diminishing returns.

The economic importance of a long herd life appeared to be remarkably stable, i.e., hardly affected by:
(a) the average productive capacity of the herd as regards milk and/or meat;
(b) the presence or absence of a moderate genetic improvement (1% per annum) in milk yield; or
(c) changes in price ratios between milk and meat.
In every case, cows showing an average production, and which did not have to be removed because of disease, had an optimum calculated herd life of 10—14 lactations.

Some further potential uses of the model are stated.

INTRODUCTION

The age at which Dutch Friesian cows are removed from the herd for slaughter or because of death, averages about 6.5 years. Thus, with a first calving at the age of 2 years, the average productive life-span (herd life) is 4.5 years and the corresponding replacement rate is about 22% per annum (Hoekstra, 1959; Stellingwerf, 1977).

From the literature, it can be concluded (Renkema and Stelwagen, 1977a—c) that about 70% of the disposal in The Netherlands is caused by disease in a broad sense. The most important specific reasons within this category are unsatisfactory reproduction (25%) and udder trouble (20%). The risk of disposal associated with disease increases strongly with age. This holds especially for metabolic diseases and locomotion diseases, but to a lesser extent also for unsatisfactory reproduction and udder trouble. About 15% of the disposal is made up by culling because of poor productive capacity, mainly in the first lactations. Another 15% of the disposal is connected with other reasons such as hard milking, character, conformation and 'unknown'.

In other countries the situation regarding the replacement of dairy cows is not much different (O'Bleness and Van Vleck, 1962; O'Connor and Hodges, 1963; White and Nichols, 1965; Andrus et al., 1970; Milk Marketing Board, 1972; Amiel and Moodie, 1973; Pearson and Freeman, 1973; Allaire et al., 1977), although the relative importance of the specific reasons for disposal varies.

Concerning the economic aspects of replacement rates, two questions arise.

(a) What is the economic significance of improved health, permitting a longer herd life?

(b) Which cows should be removed from the herd during the first lactation in view of their milk yield?

In this paper the first question is elaborated, using an economic model; the second will be worked out in a subsequent paper.

AN ECONOMIC MODEL

Economic principle of replacement

Except for those cows that die suddenly or are expected to die soon because of serious illness, a decision has to be made for each cow whether she should be kept in the herd for another year or should be replaced. Assuming a constant herd size, the marginal future profit of a present cow has to be weighed against the average annual profit of a replacement young cow (Zeddies, 1972). (The profit meant in this paper can be stated more precisely as earned income, i.e., gross revenue minus all costs except the cost of labour.) This is illustrated in Fig.1.

The marginal profit is the profit in one particular productive year, the change in slaughter value included. The average profit is the sum of profits in the whole productive life, divided by the number of productive years. However, both are expected values. Thus, the economic criterion of the replacement decision in a herd with constant size is: a cow of a particular age should be kept in the herd as long as her expected marginal profit is higher than the expected average profit during a replacing young cow's life. In this paper, the replacement cow is taken to be the average of all replacement cows.

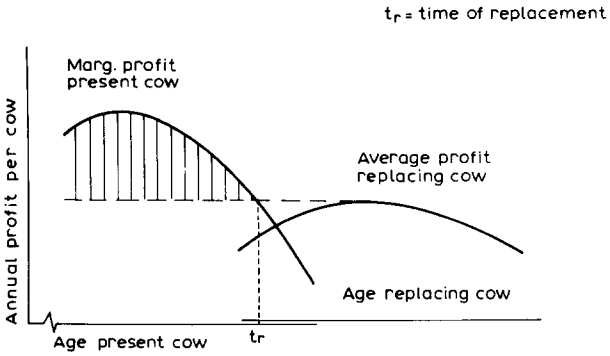

Fig.1. Determination of the moment for replacing (t_r) a dairy cow (excluding the risk of involuntary disposal).

Model and reality

Most dairy farms in The Netherlands include three interdependent activities: production of roughage, rearing young stock, and milk production. These activities are interdependent in two ways: they deliver products to each other, and they compete for scarce production factors. In the model, the milk-production enterprise is isolated from the rearing of young stock, as it is the idea to buy pregnant heifers through the market or from an own-rearing enterprise. In both cases the heifer price includes an allowance for the labour cost. From other calculations it is known that the opportunity cost of own-reared heifers may be higher than the market price, especially in the case of farms with a small area of grassland. Therefore, in addition, calculations were made with a higher price of the heifer, representing the situation of small farms with own rearing of replacements.

Unless otherwise stated, the area of grassland per cow is taken to be such that the cows can eat grass or conserved grassland products up to their intake capacity in summer as well as in winter. Thus, the income per cow results partly from the production of roughage and partly from the dairy enterprise in a strict sense, but not from rearing young stock.

As compared with the model of Zeddies (1972), which was the initial basis for our calculations, the probability of disposal in each productive year has been introduced into our model.

Data

Special attention must be paid to the data associated with age — such as milk production, the value of new-born calves, the slaughter value of the cows, the feed cost and the probability of disposal — and to the cost of a 2-year-old heifer just before calving. These are presented in Table I, except for the probabilities of disposal that are given in Table II.

TABLE I

Calculation of the earned income from Dutch Friesian cows in successive lactations, in the case of uniform and untroubled course of production

Item	Age (years):	2	2—3	3—4	4—5	5—6	6—7	7—8	8—9	9—10	10—11	11—12	12—13	13—14	14—15	15—16
Milk yield[1]	(kg)		3823	4426	4933	5202	5317	5383	5400	5349	5277	5202	5122	5046	4969	4890
Fat content[1]	(%)		4.08	4.08	4.07	4.06	4.03	4.01	3.98	3.95	3.93	3.90	3.87	3.85	3.82	3.80
Protein content[1]	(%)		3.35	3.40	3.38	3.37	3.36	3.34	3.33	3.31	3.30	3.28	3.27	3.25	3.24	3.22
Milk receipts[2]	(Dfl.)		1760	2051	2278	2396	2437	2455	2451	2412	2370	2322	2275	2229	2184	2138
Calf sales[3]	(Dfl.)		291	341	366	366	366	366	366	366	366	366	366	366	366	366
Gross revenue[4]	(Dfl.)		2051	2392	2644	2762	2803	2821	2817	2778	2736	2688	2641	2595	2550	2504
Feed cost[5]	(Dfl.)		778	801	809	851	868	878	880	873	862	851	837	826	815	802
Sundries[6]	(Dfl.)		500	500	500	500	500	500	500	500	500	500	500	500	500	500
Total cost[7]	(Dfl.)		1278	1301	1309	1351	1368	1378	1380	1373	1362	1351	1337	1326	1315	1302
Margin	(Dfl.)		773	1091	1335	1411	1435	1443	1437	1405	1374	1337	1304	1269	1235	1202
Heifer price[8]	(Dfl.)	1960														
Carcass weight (c.w.)[9]	(kg)	227	255	270	275	277	276	275	273	272	270	266	260	256	252	248
Price p.kg of c.w.[9]	(Dfl.)	5.98	5.77	5.28	5.16	5.11	5.01	4.93	4.89	4.86	4.85	4.83	4.81	4.79	4.77	4.75
Slaughter value	(Dfl.)	1327	1439	1392	1383	1377	1343	1314	1291	1276	1262	1235	1199	1172	1146	1120
Marginal earned income[10]	(Dfl.)		252	1044	1326	1405	1401	1414	1414	1390	1360	1310	1268	1242	1209	1176

[1] Based on the annual report for the year 1973 of the Central Milk Recording Service (CMD, 1973).
[2] The price of milk was calculated as: Dfl. 3.50 per 100 kg of milk, plus Dfl. 5.50 per % fat, plus Dfl. 6.00 per % protein.
[3] In the net value, the following factors were taken into account: weight and sex of the calf, age of mother, season of calving and calf mortality rate.
[4] Excluding slaughter value.
[5] Depending on age and level of milk yield as explained in the text.
[6] Costs of buildings and machinery, interest, veterinary cost, etc., but excluding cost of labour.
[7] Excluding cost of labour and price of heifer.
[8] Price of a 2-year-old heifer, just before calving.
[9] Based on: De Boer et al. (1970).
[10] Calculation for lact.1: margin, plus slaughter value at the end of lact. 1, minus heifer price. Calculation for other lactations: margin, plus slaughter value at the end of lact. n, minus slaughter value at the end of lact. n—1.

A calving interval of 12 months was assumed, the age at first calving being 24 months.

The milk yield was taken from the annual report of the Dutch Central Milk Recording Service (CMD, 1973) for the year of 1973, and corrected for length of lactation. Extrapolation was necessary for the highest age classes.

The CMD-figures concerning the milk yield in the different age classes are influenced by culling and by genetic improvement. When these figures are applied to a particular cow, the first effect leads to an over estimation of the progress in milk yield with age, and the second to an under estimation, but none of them is known quantitatively. In this paper no correction has taken place for these effects.

The slaughter value of the cows was calculated as (carcass weight × price per kg of carcass weight) minus (cost of transport and insurance). The carcass weight and the price per kg at different ages were based on a large survey of slaughter cows by De Boer et al. (1970).

The feed cost depends on age and level of milk yield. Unless otherwise stated, the requirements (CVB, 1973) for maintenance and 10 kg milk per day are met by grass (cost Dfl. 0.20 per SE) in summer, and hay and wilted silage in winter (Dfl. 0.30 per SE, excluding cost of labour). The requirements for the rest of the milk yield are met by concentrates (Dfl. 0.66 per SE) in winter, and for 50% by grass and 50% by concentrates in summer. First and second lactation cows receive an extra allowance for growth. During the dry period, the cows are fed according to a production of 10 kg of milk. Sundry costs have been taken as stable with age. Health related costs, however, could readily be supposed to increase with age. This relation is not known quantitatively. In the model, this aspect has been taken into account by assuming an arbitrary loss of Dfl. 400 (also meant for other losses connected with disposal, such as the cost of an idle period between disposal and replacement) for the lactation during which the cow must be disposed of. Since the marginal probability of disposal by disease increases with age, this procedure also results in a higher negative correction of the marginal earned income for older cows.

The prices were based on the year of 1974, as far as possible. Some prices had to be normalized because of price fluctuations. The rest of the data are explained in Table I.

Model structure

The basic structure of the model used is presented in Table II. The calculation leads to the comparison (column 12) of the marginal earned income of the present cow and the average earned income of a replacing young cow, taking into account the probabilities of disposal. The way this is done is shown in Table II. The sums of expected differences during the remaining life are presented also (column 13). These sums of expected differences (SED) have been calculated for the end of each lactation, up to and including the

TABLE II

Calculation model for identical replacement of dairy cows, including the probability of disposal

1	2	3	4	5	6
Lactation no.	Margin in lact. n. (see Table I)	Sum of margins ($=\sum_{1}^{n}$ column 2)	Slaughter value at the end of lact. n (see Table I)	Marginal earned income in lact. n, without risk of disposal (see Table I)	Probability of completing n lactations[1]
1	773	773	1439	252	1.000
2	1091	1864	1392	1044	.790
3	1335	3199	1383	1326	.651
4	1411	4610	1377	1405	.527
5	1435	6045	1343	1401	.414
6	1443	7488	1314	1414	.313
7	1437	8925	1291	1414	.226
8	1405	10330	1276	1390	.158
9	1374	11704	1262	1360	.105
10	1337	13041	1235	1310	.066
11	1304	14345	1199	1268	.039
12	1269	15614	1172	1242	.022
13	1235	16849	1146	1209	.012
14	1202	18051	1120	1176	.006
					4.329

[1] The probabilities of completing n lactations, and of disposal at the end of lactation n, have been taken from an earlier reported study of literature (Renkema and Stelwagen, 1977).
[2] An arbitrary loss of Dfl. 400 is assumed for the lactation during which the cow has to be disposed of.
[3] The average earned income per cow per year (AEI) at an average productive life of 4.329 years is calculated as follows:

$$\text{AEL} = \frac{\sum_{n=1}^{14} (\text{column } 3_n + \text{column } 4_n) \times \text{column } 7_n - \text{price heifer} - \text{loss at disposal}}{\text{av. prod. life}} =$$

[4] See text.

last lactation with a positive difference between marginal and average earned income (= lact. k), in the following way:

for lact. k : $\text{SED}_k = 0$
for lact. $k-1$: $\text{SED}_{k-1} = \text{column } 12_k + \text{SED}_k \times (1 - \text{column } 10_k)$
for lact. $k-2$: $\text{SED}_{k-2} = \text{column } 12_{k-1} + \text{SED}_{k-1} \times (1 - \text{column } 10_{k-1})$, etc.

For the moment just before the beginning of lact. 1, this calculation leads to SED = 0 in case of identical replacement. At each age, the SED plus the slaughter value represents the asset value of the cow.

In Table II, a cow can be replaced only 365 days after calving. Here, the present cow and the replacing heifer have identical genetic capacity for milk production. Separate genetic capacities were used in case of non-identical replacement.

7	8	9	10	11	12	13	14
Probability of disposal[1] at the end of lact.n; seen from the age of 2 years (= column 6_n — column 6_{n+1})	Marginal probability of disposal[1] (seen from the beginning of each successive lact.) associated with:			Marginal earned income in lact.n (= column 5_n — column 10_n × Dfl. 400)[2]	Marginal earned income minus average earned income at 4.329 lactations (= column 11_n — Dfl. 963)[3]	Sum of differences[4] between marginal and average earned income	Lactation no.
	Productive capacity	Other reasons (mainly disease)	Total				
.210	.120	.090	.210	168	-795	1007	1
.139	.051	.125	.176	974	10	1210	2
.124	.031	.160	.191	1249	286	1142	3
.113	.019	.195	.214	1319	356	1000	4
.101	.014	.230	.244	1303	340	873	5
.087	.013	.265	.278	1302	339	739	6
.068		.300	.300	1294	330	583	7
.053		.335	.335	1256	293	437	8
.039		.370	.370	1212	249	298	9
.027		.405	.405	1148	184	191	10
.017		.440	.440	1092	128	111	11
.010		.475	.475	1052	89	42	12
.006		.510	.510	1005	42	—	13
.006		.545	.545	958	-5	—	14
1.000							

$$\frac{\text{Dfl. } 6529 - \text{Dfl. } 1960 - \text{Dfl. } 400}{4.329} = \text{Dfl. } 963$$

RESULTS

Individual cows

A reduction of the forced replacement rate was found to be of major economic importance on the farm level. The income earned from a fifth lactation of a cow showing an average production is approximately Dfl. 440 higher than the earned income per annum over the average herd life of 4.3 lactations (Table III, column 2). The profit of an additional lactation in the 4th up to and including the 7th productive year is on the same level. Thereafter it decreases.

The profits as expressed in column 2 of Table III have been calculated 'ex post', that is, after the lactation in question has been completed without

serious disease. When the profits of an additional lactation are calculated beforehand, the risk of forced disposal has to be taken into account. These expected profits of additional lactations (column 4) are on a somewhat lower level than those in column 2, because of the assumed loss of Dfl. 400 when a cow has to be removed from the herd due to disease. Cows which did not have to be removed because of disease have an optimum calculated herd life of 13 lactations (as shown in Table II, column 12).

The economic importance of a long productive life of cows showing above average production, is very high as shown in Table III (columns 3 and 5).

The profit that can be gained by a reduction of the forced replacement rate, is the upper limit of the cost that could be spent in order to achieve this longer herd life. Thus, Table III can be used to see what cost may be spent on extending the productive life-span by 1 year.

We also calculated the gain per lifetime, in terms of additional lactations and profit, that is expected to be realized when a cow of a particular age can be saved from premature removal. Here, it was assumed that the cow in question will have the same possibilities for the rest of her life as before she fell ill. The results from this calculation are shown in Table IV. The amounts in

TABLE III

Net profit[1] of an additional lactation of a cow showing an average productive capacity (prod. level 100) and of a cow showing a higher productive capacity (prod. level 120)

1	2	3	4	5	6
	Calculation 'ex post' (without risk of disposal in the lactation concerned)		Calculation "ex ante' (with risk of disposal in the lactation concerned)		With 1% genetic annual progress in milk yield (calculation ex ante)
Production level[2]:	100	120	100	120	100
Lactation	Net profit (Dfl.)		Expected net profit (Dfl.)		
2	81[3]	356	11[4]	286	− 4
3	363	667	286	591	257
4	442	762	356	676	313
5	438	763	340	665	282
6	451	777	339	666	267
7	451	775	330	657	243
8	427	746	293	612	192
9	397	710	249	562	133
10	347	652	185	490	54

[1] Amount by which the marginal earned income from an individual cow in lactation *n* surpasses the annual earned income (Dfl.963 per cow) from a herd showing an average production and an average herd life of 4.3 lactations.
[2] Milk yield as a percentage of the herd average at the same age.
[3] Column 2 = column 5, Table II − Dfl. 963.
[4] Column 4 = column 12, Table II.

TABLE IV

Remaining life expectancy, with net profit, seen at the end of lactation *n*. With average probabilities of disposal (only because of disease) and at different milk-producing capacities

Number of completed lactations	Expected milk yield in the remaining lactations (as percentage of the herd average for the same age)									
	80	90	100	110	120	80	90	100	110	120
	Remaining life expectancy (years)					Sum of expected net profits (SED) (Dfl.)				
0	4.6	5.1	5.2*	5.2	5.2	−1160	−440	316	1078	1839
1	4.0	4.5	4.6	4.6	4.6	− 196	467	1168**	1876	2583
2	3.4	4.0	4.1	4.1	4.1	55	655	1299	1951	2602
3	2.9	3.5	3.7	3.7	3.7	73	606	1192	1786	2380
4	2.3	3.2	3.3	3.4	3.4	37	500	1029	1568	2107
5	1.7	2.8	3.0	3.1	3.1	21	411	887	1376	1865
6	1.0	2.5	2.8	2.8	2.8	5	313	739	1181	1624
7		2.1	2.5	2.6	2.6		208	583	984	1384
8		1.6	2.3	2.4	2.4		113	437	799	1162
9		1.0	2.1	2.2	2.2		32	298	625	952
10			1.9	2.0	2.0			191	483	776
11			1.5	1.8	1.8			111	366	623
12			1.0	1.5	1.5			42	250	461
13				1.0	1.0				134	273
14										

*A highly pregnant heifer, with average productive capacity, is expected to be kept in the herd for 5.2 years on average before she has to be removed because of disease. If the cow has survived the first lactation, the remaining life expectancy is 4.6 productive years (next figure in the same column), so that her total productive life will become 5.6 years and her total life 7.6 years.

**Calculated at the end of the first lactation, a cow with average productive capacity is expected to give Dfl.1168 more earned income during the remaining life expectancy (4.6 years, see above note) than the average earned income of the herd in the same number of years. The sums of expected net profits for production level 100 are somewhat higher than those of Table II (column 13) up to and including the end of the fifth lactation, since culling for production has not been included in Table IV. Negative values mean that such cows could better be replaced. It is assumed that cows in later lactations with a negative sum of expected net profits (blanks) will be replaced. This makes clear why the life expectancy changes with production level.

For a cow of the same age, the milk yield of which is expected to be 10% over the herd average, the sum of expected net profits is Dfl.1876 (in 4.6 years as well). So, the additional profit per remaining year of life in that case amounts to Dfl.1876 / 4.6 = Dfl.408. This quotient can be considered an important criterion for determining the order within a herd concerning the expected net profits per cow per annum.

this table represent the sum of differences between the expected profits of the present cow and the profits of an average replacing cow, calculated over the same number of years and weighted by the probability of disposal as has been explained in the section 'Model structure'.

Herd as a whole

While calculating the economic importance of a longer average herd life resulting from improved health, the profits of an additional lactation have to be spread over the whole productive life-span.

In a herd showing average production, the annual earned income per cow increases by Dfl. 121 (Table V, column 5) if the average herd life moves from 3.3 to 4.3 years. An increase from 4.3 to 5.3 years offers another Dfl.71 per cow per annum. Thus, a farm with a herd of 50 cows and an average herd life of 5.3 years will have approximately Dfl.9600 more income each year than a similar farm with an average herd life of 3.3 years. These results are hardly affected by differences in the average productive capacity of the herd as regards milk (see Table V) and/or meat.

Long-term effects

The profit of additional lactations is reduced a little in case of a genetic progress in milk yield of 1% per annum, as can be seen in Table III (column

TABLE V

The economic effect of differences in length of productive life caused by differences in disease induced removal rate, at varying genetic capacity of the herd for milk production

1	2	3	4	5	6	7
Milk yield of the herd (base level = 100)	Removal because of disease (base level = 100)	Average herd life (years)	Av. annual earned income per cow (Dfl.)	Calculated av. earned income minus av. earned income at 4.3 years (Dfl.)	Av. annual milk yield per cow (kg)	Av. slaughter value per cow (Dfl.)
80	157[1]	3.3	560	−113	3676	1379
80	100	4.3	673	—	3792	1356
80	69	5.3	793	66	3862	1333
80	0	11.3	875	202	3996	1186
100	157	3.3	842	−121	4595	1379
100	100	4.3	963	—	4740	1356
100	69	5.3	1034	71	4828	1333
100	0	11.3	1174	211	4995	1186
120	157	3.3	1125	−128	5514	1379
120	100	4.3	1253	—	5688	1356
120	69	5.3	1328	75	5794	1333
120	0	11.3	1473	220	5994	1186

[1] The multiplication of 157/100 times the marginal probabilities of disposal connected with disease (Table II, column 9) at each age leads to an average herd life of 3.3 years.

6). Of course, this effect increases with the difference in age between the present cow and the replacing young cow.

On the other hand, a decrease in the forced replacement rates could have an effect on the genetic progress in milk yield. The comparison of some alternative policies in selection for milk production and breeding of calves for replacement, indicated a slightly positive effect of a reduced removal by disease on the rate of genetic progress in milk yield (Renkema and Stelwagen, 1977a—c).

Price sensitivity

Of course, variations in milk price affect the income of a dairy farmer substantially. This effect is about six times greater than that of a similar relative change in slaughter value of the cows. However, the economic importance of a long herd life is affected more by changes in slaughter value than by changes in milk price of the same relative magnitude. Yet, both effects are small at price variations of about 10%. Only a very heavy fall in milk price and a simultaneous increase in slaughter value will reduce the importance of a long herd life considerably.

If the price of a 2-year-old heifer, just before calving, is Dfl.200 higher than mentioned before, the profit of additional lactations increases as the average annual profit of a replacing cow decreases by Dfl.200 divided by the average herd life. In that case the optimum calculated herd life is lengthened by 1 year. A decrease of the heifer price by Dfl.200 causes exactly the opposite.

Further potential uses of the model are:
(a) Determining the economic importance of different diseases and of herd health programmes. In that case, the marginal probabilities of disposal for that particular disease have to be included in the model; with and without the health programme. This has been done for mastitis (Dijkhuizen and Renkema, 1977).
(b) The economic evaluation of various breeds of cattle.

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RESUME

Renkema, J.A. et Stelwagen, J., 1979. Evaluation économique du taux de réforme dans les troupeaux laitiers. I. Réduction du taux de réforme par une amélioration de l'état sanitaire. *Livest. Prod. Sci.*, 6: 15—27 (en anglais).

On a construit un modèle pour répondre à deux questions:
(a) quelle est la signification économique d'une amélioration de l'état sanitaire permettant un allongement de la durée de vie du troupeau?
(b) quelles vaches doit-on réformer d'après leur production laitière au cours de la première lactation?
Ce mémoire examine la première question; on examinera la deuxième dans un mémoire suivant.

On discute d'abord le principe qui détermine la décision de réforme puis on expose les données de base du modèle. On a aussi inclus dans le modèle la probabilité d'élimination liée à l'âge.

La réduction du taux de réforme involontaire apparaît d'une importance majeure au niveau de l'exploitation. D'après le modèle, un troupeau de production moyenne ayant une durée de vie de 5,3 lactations apportera un gain annuel de 20% plus élevé qu'un troupeau de production comparable ayant une durée de vie de 3,3 lactations. Cependant, la production associée à l'allongement de la durée de vie sui la loi des rendements décroissants.

L'intérêt économique d'une longue durée de vie du troupeau paraît être remarquablement stable. Il est à peine modifié par:

(a) la capacité moyenne de production du troupeau quant au lait et, ou, à la viande;
(b) la présence ou l'absence d'une amélioration génétique modérée (1% par an) de la production laitière; et
(c) les modifications des rapports de prix entre le lait et la viande.

Dans tous les cas les vaches de production moyenne, qui n'ont pas à être éliminées pour maladie, ont une durée de vie productive optimum calculée de 10 à 14 lactations. Quelques autres utilisations potentielles du modèle sont soulignées.

KURZFASSUNG

Renkema, J.A. und Stelwagen, J., 1979. Ökonomische Bewertung der Remontierungsraten in Milchrinderherden. I. Verlängerung der Nutzungsdauer durch verbesserte Gesundheit. *Livest. Prod. Sci.*, 6: 15—27 (in Englisch).

Es wird ein Modell aufgestellt für die Beantwortung der beiden folgenden Fragen:

(a) welche ökonomische Bedeutung hat eine verbesserte Gesundheit, welche die Nutzungsdauer der Milchkühe erhöht?
(b) welche Kühe sollten während der ersten Laktation auf Grund ihrer Milchleistung aus der Herde entfernt werden?

Dieser Beitrag befasst sich lediglich mit der ersten Frage. Die zweite Frage wird in einem späteren Beitrag behandelt werden. Als erstes wird das Prinzip diskutiert, welches der Ersatzentscheidung zugrunde liegt. Dann werden die grundlegenden Daten des Modells gegeben. In das Modell wurde auch das altersbedingte Abfuhrrisiko eingeschlossen.

Aus einzelbetrieblicher Sicht zeigte eine Verminderung der unfreiwilligen Remontierungsrate sich als besonders wichtig. In dem Modell wird ein Bestand mit durchschnittlicher Leistung sowie mit einem Durchschnittsalter von 5,3 Laktationen jedes Jahr ein um etwa 20% höheres Einkommen erzielen als eine ähnliche Herde mit einer durchschnittlichen produktiven Lebensdauer von nur 3,3 Laktationen. Die Vorteile einer erhöhten Nutzungsdauer folgen jedoch dem Gesetz vom abnehmenden Ertragszuwachs.

Die ökonomische Bedeutung einer hohen Lebensdauer der Herde erscheint bemerkenswert stabil, das heisst wenig abhängig von:

(a) die durchschnittliche Produktionskapazität der Herde hinsichtlich Milch und/oder Fleisch;
(b) Vorhandensein oder Fehlen einer mittleren genetischen Verbesserung der Milchleistung (1% pro Jahr);
(c) Änderung des Preisverhältnisses zwischen Milch und Fleisch.

In jedem Falle hatten Kühe, die eine Durchschnittsleistung erbrachten und nicht wegen Krankheit gemerzt werden mussten, eine als optimal errechnete Nutzungsdauer von 10—14 Laktationen.

Einige weitere Verwendungsmöglichkeiten dieses Modells wurden angegeben.