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Conference paper

STRATEGIES OF EUROPEAN FLECKVIEH CATTLE BREEDING TO OPTIMIZE DUAL-PURPOSE BREEDING PARTICULARLY FOR BEEF PRODUCTION

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Introduction

The Fleckvieh breed, while internationally recognized as a dual-purpose breed is primarily used as a beef production animal in Ireland. However because of ever increasing pressure to improve efficiency, it is now accepted in Irish cattle breeding that beef production characteristics should be included in the national dairy cattle breeding programme. This development was accepted following a comprehensive review of the national cattle breeding programme. This review was initiated by the Irish Cattle Breeding Federation (ICBF) which was established in 2000 to organize and coordinate all cattle breeding functions. These breeding functions were conducted by the Irish Department of Agriculture up until that time. ICBF is owned by the main organisations which make up the cattle breeding industry. These are:

- Commercial and Pedigree Farmers
- Breed associations
- Milk recording organizations and
- Artificial Insemination bodies

The federation is funded by Government grant, a proportion of ear tag sales revenue and fees for services provided. Its mission is to 'achieve the greatest possible genetic improvement in the national cattle herd for the benefit of Irish farmers, and the Dairy and Beef industry and members'. Since its creation, ICBF has undertaken a major review of the organization of all cattle breeding functions in Ireland. Research was initiated immediately in three main areas. These were, genetic evaluation, data management and breeding scheme design. Some of the material described in this paper resulted from this review, which is

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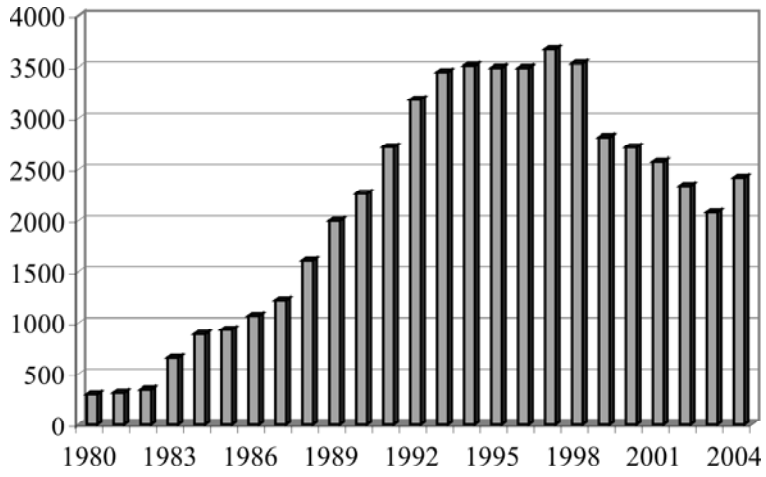
still ongoing. Some of the findings may have application for dual purpose breeds such as the Simmental/Fleckvieh.

The Simmental/Fleckvieh breed in Ireland

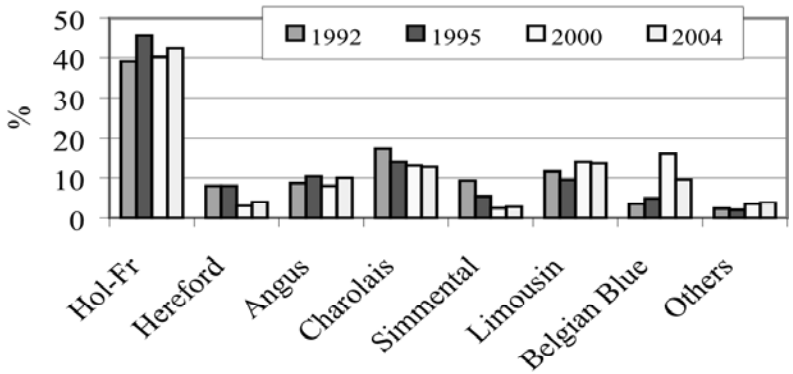
The Simmental/Fleckvieh breed was first introduced into Ireland from Austria in early 1971. Simmentals were later imported from Switzerland, Germany and France. Figure 1 shows the expansion of the pedigree Simmental/ Fleckvieh herd in Ireland since 1980. Ireland traditionally does not produce commercial beef from pure breeds. Beef is produced through cross breeding which exploits the benefits of hybrid vigour and the long-established availability of replacement suckler beef cows produced as a byproduct from the matings of beef sires on the dairy herd. However with the ever-increasing infusion of Holstein genes into the dairy herd, change is underway and increasing numbers of beef cows are now being bred from within the beef herd. This holsteinisation of the dairy herd has had some influence on the use of the Simmental/ Fleckvieh breed which has resulted in a decline in the registration levels of Simmentals over the last number of years as shown in Figure 1. This decline in registrations has now been halted as a result of a coordinated approach undertaken by the Simmental herdbook and its breeders in conjunction with ICBF. This has resulted in a significant improvement in beefing quality.

Figure 1 - REGISTRATIONS BY YEAR



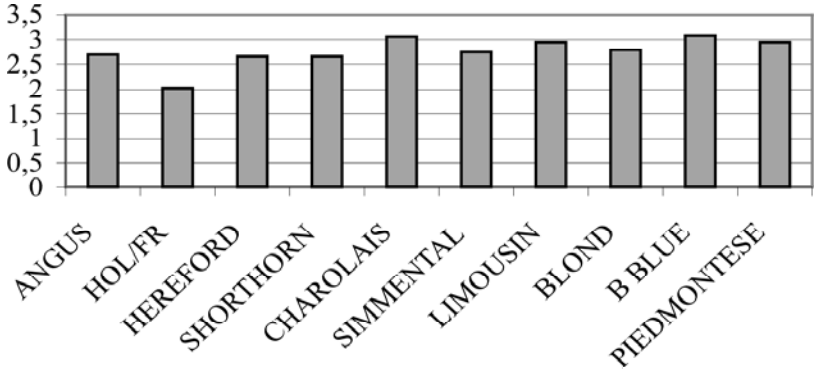
Artificial insemination usage is given in Figure 2, and compares the trends since 1992 for the Simmental/ Fleckvieh breed. Though usage levels for Simmental are now relatively low the declining trend now appears to have been reversed.

Figure 2 - TREND IN AI USE BY BREED



This decline in the use of Simmental/ Fleckvieh was taken up by more extreme beef type breeds such as the Belgian Blue where usage in the dairy herd has increased significantly. Figure 3 shows the breed effects for conformation based on the EURO classification grid when beef breeds are crossed with Holstein Friesian cows. Conformation is an important determinant for sire selection in the commercial herd. The Simmentals main competitors are the Charolais, Limousin and Belgian Blue breeds.

Figure 3 - COMFORMATION



Developments such as these and the major reform of the common agricultural policy, with the introduction of a fully decoupled support system for beef in Ireland, fully justified ICBF's strategy of comprehensively reviewing and updating the genetic evaluation system to best serve the needs of Simmental/ Fleckvieh and other breeds in Ireland.

Features of the Beef industry

ICBF sought tenders for and contracted consultants to assist it in the review of the beef industry's requirements. In undertaking this task it was important to recognize that beef production in Ireland has a number of unique features which determined the choices made:

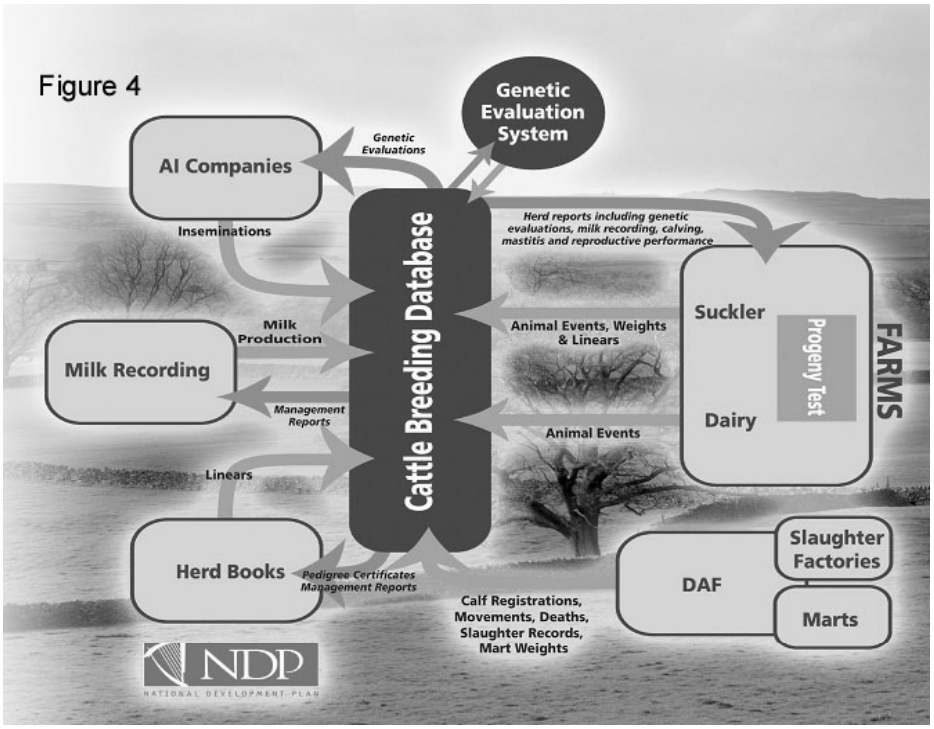
- 90% of production must be exported
- Beef production from the beef cow herd is based on cross bred cows mated to a variety of breeds, hence the need for an across breed common evaluation system;
- About 600,000 dairy cows are mated to beef sires;
- A large proportion of animals are exported live at approximately nine months of age for finishing in Europe and thus there is a need for a weaning index;
- Beef bulls must satisfy a wide variety of roles in beef production as they will be used in both the dairy and the beef herds hence a range of traits must be evaluated;
- Bulls must be evaluated for a wide variety of traits and hence the selection of sires at farm level can become complex. Sub-indices are therefore considered most useful here;
- Breeding herds are small necessitating the use of crossbred data in the evaluation process generated from many locations as shown in Figure 4;

Central Cattle Breeding Database

A core requirement resulting from the review of the national genetic evaluation system was the need to establish a central cattle breeding database to manage the capture and storage of data. This was the first major task to be undertaken by ICBF. Historically cattle breeding activities were disjointed and used a number of databases which were very poorly linked. Up to forty unlinked sources of data were identified in the integration process. In addition there was excessive duplication of activities in the system. There were multiple animal identification systems in existence often with duplicate ID's, which

needed to be standardised. The model agreed upon to record much of the primary data was that of the "single point of entry" concept which would load data only once to a central database either directly in respect of animal recording details or though the Identification and Registration system operated by the Department of Agriculture in the case of registering newly born animals.

In 1996 Ireland introduced an Identification and Registration database system, which is managed by the Department of Agriculture and where it is obligatory for all cattle to be registered at birth. More recently this I&R database was augmented by a Central Monitoring and Movement System (CMMS), which tracks all of the movements of an animal in Ireland from birth to death or export. With an increasing number of the activities in cattle breeding becoming electronically based, the opportunity was now available to create a fully integrated national cattle breeding database with minimum manual recording and no duplication of recording activities or data storage. The overall design of the system is outlined in Figure 4.



The information relating to all breeding animals is now stored on this central cattle breeding database. The registration of a calf, whether pedigree or

non-pedigree, is initiated by the completion of an event record. This can be undertaken by the breeder on paper using a standard event recording sheet, or by email from the farm computer. This single event satisfies the legal requirement of identification and registration and the herd book requirements of registering a calf. The distinction between pedigree and nonpedigree animals is achieved by simply inserting a name for the animal. All animals are now identified in the system by their National Identity Number (NID) as assigned by the Department of Agriculture. As it is a legal requirement that all movements, exports and deaths of animals must be notified to the Department of Agriculture, a lot of basic information is now available which can be used to derive important economic traits such as longevity. By agreement with the Department of Agriculture, all members of ICBF can have all of this movement and mortality information synchronized automatically to the cattle breeding database once notified. This has provided great opportunities for expanding the level of data capture, as the location of every animal at all stages of its life is now known. It also provides the basic information needed to implement efficient data capture in the field based on electronic technology such as the PDA handheld.

There are, in addition to the Department of Agriculture databases, a number of other sources of information available which can provide useful data to the cattle breeding database as detailed in Figure 4. These include AI centers, commercial sales yards, and slaughter plants.

Event Recording of Data

Through the use of an event recording data capture recording sheet, the opportunity is provided for recording a variety of genetically important activities in the herd in addition to the legally required birth notification. These include:

- Insemination details and/or 'Bull in' 'Bull out' dates;
- Calving ease at time of birth notification;
- Multiple keeper recorded weights through the life of the animal;
- All health events;
- Pregnancy diagnosis for management reports;
- Weaning details and culling decisions,
- Disposal and death details.

The commercially available farm computer systems are also adapted to email this information to the cattle breeding database. The experience to date

with this event recording single point of entry concept has been most satisfactory.

A new genetic evaluation system for use in beef cattle breeding in Ireland

Following the review, the strategy adopted in respect of animal evaluation was to develop a genetic evaluation system, which would:

- Be simple to use at farm level;
- Allow all breeding animals to be compared across breed;
- Account for the full impact of matings in the succeeding generations where appropriate;
- Provide comprehensive breeding values for specialist breeders with individual requirements;
- Report breeding values in an overall index and sub-index format using EU ROS (€'s) as the comparative measure;
- Use all available data;
- Produce a rapid turnaround of evaluations, ideally every week.

The Approach

Following detailed consultations with the industry, a new genetic evaluation system was designed and a contract was entered into for its development and implementation. The core of the system is the generation of the following four sub-indices:

- Calving
- Weaned calf production
- Beef production
- Maternal/Reproductive

Calving Index

The calving sub-index for each beef bull provides for two situations, reflecting the bulls use on dairy cows and on beef cows. This is necessary as the economic consequences of a difficult calving on a dairy mating are much more serious than on a beef mating where the quality of the calf is relatively more important.

The calving sub-index includes calving difficulty direct (CD), gestation length (GL) and calf mortality (Mort). Table 1 shows the relative importance of the component traits based on Irish production costs and market returns as measured by the genetic standard deviation times the economic weight.

Table 1 - CALVING SUBINDEX

Trait	Relative importance dairy	Relative importance beef
Calving difficulty direct (% serious difficulty)	-4.9	-2.7
Gestation length (days)	-5.3	-0.5
Calf mortality (% dead)	-1.1	-1.3

The relative importance of the traits in percentage terms for the dairy index are 43%, 47% and 10% for CD, GL and Mort respectively. The corresponding values for beef are 60%, 11% and 29% respectively.

Calving difficulty is significantly more important in the beef calving index than gestation length. Calving difficulty is economically more important in dairy herds than in beef suckler herds. Gestation length is substantially more important in dairy herds, because of the need in Ireland for optimal management of cheap seasonal feed on dairy farms.

Weaned calf production Sub-index

The weaned calf production sub-index shown in Table 2 includes weaning weight and calf quality. This index was considered necessary as there is a major trade in weaned animals to European markets and animals slaughtered do not reflect the same price differential for conformation quality as is found in the market for weaned calves. Calf quality is a prediction trait derived from linear scores and carcass conformation scores. The relative importance is 42% and 58% for Weaning Weight and Calf Quality respectively.

Table 2 - WEANED CALF PRODUCTION SUB-INDEX

Trait	Relative importance
Weaning weight direct (kg)	19.4
Calf quality (% high quality)	26.4

Beef Production Sub-index

The traits included in the Beef Production sub-index are shown in Table 3. An interesting feature of this index is the ability to apply separate weightings to component cut weighs. Currently these are based on dissection analysis. However Ireland has recently introduced mechanical grading as a carcass classification tool. A feature of the system is its ability to generate component cut yield data. This aspect of the index development is currently still evolving.

Table 3 - BEEF PRODUCTION SUBINDEX

Trait	Relative importance
Weaning weight direct (kg)	2.1
Dry matter intake (kg)	-13.5
Carcass weight (kg)	21.8
Loin cut weight (kg)	2.6
Hind quarter cut weight (kg)	2.5
Other cuts (kg)	1.9
Carcass conformation	3.7
Carcass fat score	-1.8

Maternal Sub-index

The maternal or reproductive sub-index, which includes survival, calving interval, maternal calving difficulty, maternal weaning weight and cull cow value traits in its determination, are shown in Table 4. Calving interval and survival are significant contributors to this index.

Table 4 - MATERNAL SUBINDEX

Trait	Relative importance
Cow survival	6.3
Calving interval	-3.6
Calving difficulty maternal (% serious)	-9.9
Weaning weight maternal (kg)	4.4
Cull cow carcass weight	-1.3

Overall Beef Merit Index

For most breeders, the sub-indices will be the focus for consideration. An overall beef merit index will also be generated. This will be constructed based on:

- Proportion of animals sold at weaning for live export (P_E) (currently 0.16)
- Proportion retained for slaughter in Ireland (P_S) (currently 0.68)

- Proportion sold or retained as replacement females (P_R) (currently 0.16)

Thus the TOTAL BEEF MERIT INDEX is:

P_e(Weaning Index)+P_s(Beef Index)+(P_e+P_s)Beef Calving Index+P_f(Maternal Index)

or

TBMI=0.16 x (WCSI)+0.68 x (PSI)+0.84 x (BCSI)+0.16(RSI)

These new beef breeding indices are currently being implemented for beef AI bulls. It is planned to expand the use of these indices to all breeding animals by the end of 2005.

Economic Values

The generation of economic weights for traits requires the combination of the economic value of a unit change in a trait for each expression, multiplied by a factor, which reflects the number of expressions of the genes of a bull for the trait per calf born, all discounted forward. Discounted genetic expression coefficients are used to achieve this, as described by Amer et al 2001.

Discounted genetic expression coefficients account for the delay in, and frequency of expression of, various categories of traits. For example, maternal traits are only expressed in replacement females, but the expression of many of the traits are repeated annually through the productive life of the cow. Other traits are expressed in all calves born (e.g. calving ease), while others are only expressed in slaughtered animals after a delay of several years. The number of discounted genetic expressions of a sire's genes are shown in the accompanying table.

Trait	Discounted genetic expression coefficients
Terminal	
Birth	0.50
Weaning	0.43
Slaughter	0.39

A revised Economic Breeding Index for dairy cattle

As part of the overall review of cattle breeding, the economic breeding index (EBI) for dairy cattle has undergone a number of updates as the results of the necessary research and development work became available. The findings here may have interest for dual purpose breeds such as the Simmental/Fleckvieh. In 2002 the first revised EBI based on the traits, milk yield, fat yield, protein yield, calving interval and survival was published. Prior to that, calving interval and survival were not included. It was recognized that the omission of calving interval and survival did not reflect the true economic

realities to the dairy farmer. Based on the ongoing development work on beef, it was apparent that significant improvement in dairy farm profitability could be achieved if calving performance (i.e. gestation length, calving difficulty and calf mortality) and beef performance traits (i.e. carcass weight, carcass conformation and carcass fat score) were included in the overall Economic Breeding Index for dairy cattle.

In including these new traits it was important to accurately determine the economic value of each. This involved detailed consultation with the industry to establish real costs and returns in dairy production. The economic value for a 1% change in the proportion of cows requiring severe calving assistance or worse was -€3.35, when the costs of reduced milk production and impaired reproduction were included. It dropped to -€1.31 when these were excluded. The economic value of gestation length (day) was found to be -€7.09 reflecting the importance of having cows calve when low cost grass could be efficiently utilised. The economic value of calf mortality was found to be -€1.94 for every 1% change in calf mortality. The economic values of calf carcass weight, conformation score and fat score were €1.22, €5.24 and -€8.19 respectively. Table 5 details the relative importance of each trait in the various sub-indices.

Table 5 - RELATIVE IMPORTANCE OF COMPONENT TRAITS IN THE DAIRY ECONOMIC BREEDING INDEX

Trait	Relative Importance			Sub-index
	Base EBI	Base EBI with calving	Base EBI with calving and beef	
Milk (kg)	-17%	-14%	-14%	
Fat (kg)	12%	11%	10%	Production
Protein (kg)	32%	29%	28%	
Calving interval (day)	-22%	-20%	-19%	Fertility
Survival (%)	18%	16%	16%	
Direct calving difficulty (%)		-4%	-3%	
Maternal calving difficulty (%)		-1%	-1%	Calving
Gestation length (day)		-3%	-3%	
Direct calving mortality		-1%	-1%	
Cull cow carcass weight (kg)			0.20%	Beef Cull Cow
Calf carcass weight (kg)			3%	
Calf carcass conformation			1%	Beef Calf
Calf carcass fat score			-1%	

In Table 6 details of the change in emphasis as calving and beef traits are sequentially introduced into the base Economic Breeding Index are shown.

Table 6 - RELATIVE EMPHASIS OF THE SUB-INDICES IN THE DAIRY EBI'S IN TABLE 5

Sub-index	Base EBI	Base EBI with calving	Base EBI with calving and beef
Production	60%	55%	52%
Fertility	40%	37%	35%
Calving		11%	8%
Beef cull cow			0%
Beef calf			5%

Table 7 summarises the relative emphasis of traits within the various sub-indices. Protein contributes most to the variation in the production index while calving interval is most influential in the fertility index. Both direct calving difficulty and gestation length have a large effect on the calving sub-index while surplus calf carcass weight has the strongest influence on the beef sub-index value of an animal.

Table 7 - RELATIVE IMPORTANCE OF TRAITS WITHIN EACH SUB-INDEX

Trait Sub-index	Production	Fertility	Calving	Beef
Milk (kg)	27%			
Fat (kg)	20%			
Protein (kg)	54%			
Calving interval (day)		55%		
Survival (%)		45%		
Direct calving difficulty (%)			41%	
Maternal calving difficulty (%)			10%	
Gestation length (day)			37%	
Direct calving mortality			12%	
Cull cow carcass weight (kg)				4%
Calf carcass weight (kg)				62%
Calf carcass conformation				15%
Calf carcass fat score				19%

Selection on Sub-indices

Table 8 summarises the impact of selection on each sub-index on genetic response after 10 years assuming a genetic response of 0.89 genetic SD after 10 years.

Table 8 - EXPECTED GENETIC GAIN IN ANIMAL MERIT € AFTER TEN YEARS OF SELECTION ON ALTERNATIVE SUB-INDICES

Trait / Index	Production	Fertility	Calving	Beef
EBI Base	27.5	30.89	11.95	5.57
EBI Calving	27.77	33.22	22.62	4.72
EBI Beef	29.7	28.66	11.04	13.58
EBI Calving + Beef	29.97	31	21.72	12.72
Production index	43.15	-16.75	1.15	12.04
Fertility index	-15.66	47.63	10.79	-6.47
Calving index	0.28	2.34	10.68	-0.85
Beef index	2.2	-2.23	-0.9	8.01
Milk kg	173.67	-218.1	-50.72	113.01
Fat kg	8.04	-5.11	-0.46	2.26
Protein kg	9.6	-4.43	-0.18	3.3
Calving interval day	1.69	-4.27	-1	0.69

As expected, selection on each sub-index maximises gain for that respective index. Selection on production results in a large reduction in the fertility index which is attributed to an increase in the calving interval and a reduction in survival. This is consistent with internationally found antagonistic correlations for the milk and fertility traits. Selection on fertility alone has a significant negative effect on beef performance while selection on calving performance reduces carcass weight, improves fertility and has minimal effect on milk. Selection on the beef index reduces calving performance and increases the production index. The response therefore to selection in milk production is expected to increase with the inclusion of calving and beef performance in the EBI. This is attributed mainly to the positive correlations observed between beef performance and milk production and the positive economic weight attributed to beef performance. It is important to note that these findings are based on the population of dairy bulls tested in Ireland.

It is now planned to introduce the extended EBI which will include calving and beef traits. It is estimated that this will result in an increased return of €1.6 million per year to dairy farmers. Failure to do so would reduce the genetic gain for overall profitability by 3% per annum.

Possible strategies for Simmental/Fleckvieh

The Simmental/Fleckvieh, if it is to remain a dual-purpose breed will need to continue to improve beef and dairy traits concurrently. Endeavoring to agree and then sustain two alternative breeding strategies within one breed is fraught with difficulties. It may become difficult to administer within the herdbook in terms of reaching agrement and then, on how the herdbook is maintained. Will it be necessary to have two sections in the herdbook and if so where will animals, the result of matings between selected dairy and beef strains be recorded?

This question has arisen in Ireland. The issue has been resolved by asking how the needs of the cattle industry are best served. This led to the identification of a series of traits followed by a number of sub-indices based on these, which commercial cattle breeders can use whether they are in dairy or beef production. The genetic evaluation system was then designed to identify the breeding value of all animals for the different sub-indices. Breeders and farmers are free to make economic breeding decisions that best serve their particular needs. In Ireland for example it is expected that some degree of specialization will evolve as a result of the generation of these sub-indices, in conjunction with the general trends in the industry after decoupling. Some producers may specialise in producing replacement breeding females based on the maternal sub-indices, while other pedigree breeders will concentrate on producing terminal sires for use in beef production, for which only direct calving ease in addition to beef production indices will be important. The introduction of two breeding objectives for one breed can only result ultimately in two distinct sub-breeds.

Acknowledgements

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STRATEGIJE EUROPSKOG UZGOJA GOVEDA FLECKVIEH ZA OPTIMIZIRANJE UZGOJA DVOSTRUKE NAMJENE OSOBITO ZA PROIZVODNJU GOVEDINE

Sažetak

Želimo li da Simentalac/Fleckvieh ostane pasmina dvostruke namjene morat će se nastaviti istodobno poboljšavati mesne i mliječne osobine. Nastojanje da se odobre i zatim održavaju dvije alternativne uzgojne strategije unutar jedne pasmine povezano je s poteškoćama. Možda će biti teško raditi unutar rodoslovnika u smislu postizanja sporazuma a zatim kako se rodoslovnik održava. Da li će biti potrebne dvije sekcije u rodoslovniku i ako je tako gdje će se bilježiti životinje, te rezultati parenja među odabranim mliječnim i mesnim značajkama?

Ovo se pitanje pojavilo u Irskoj. Problem je riješen pitanjem kako najbolje poslužiti potrebama mesne industrije. Tako se došlo do prepoznavanja niza osobina te na toj osnovi do pokazatelja što mogu poslužiti komercijalnim uzgajivačima goveda, bili oni u proizvodnji mlijeka ili mesa. Osnovan je, zatim, sustav genetske procjene za identificiranje uzgojne vrijednosti svih životinja za različite pokazatelje. Uzgajivači i farmeri slobodno donose odluke o ekonomskom uzgoju, najboljem za njihove određene potrebe. U Irskoj, na primjer, očekuje se da će se razviti određeni stupanj specijalizacije kao rezultat stvaranja ovih pokazatelja u vezi s općim trendovima u industriji nakon parenja. Neki se proizvođači mogu specijalizirati za proizvodnju zamjenskih uzgojnih ženka na temelju na osnovi majčinskih pokazatelja, dok će se drugi uzgajivači za priplod koncentrirati na proizvodnju rasplodnih bikova za upotrebu u proizvodnji govedine, gdje će biti važna samo lakoća izravnog telenja uz indekse proizvodnje govedine. Uvođenje dvaju uzgojnih ciljeva za jednu pasminu može konačno dati samo dvije izrazite pod-pasmine.

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