An information infrastructure for facilitating the delivery of improved profits on Irish cattle farms and improving the commercial viability of the Irish breeding industry.

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Abstract

ICBF was formed fifteen years ago in an effort to increase the rate of genetic gain in the national cattle herd and to benefit the breeding industry. This goal has large elements of industry and national good while its achievement depends on services from a number of organisations that operate with a strong focus on financial returns. ICBF is owned by a unique partnership of cattle breeding organisations and farmer representative organisations. It is recognised as a charity and is funded by a combination of government supports, an industry "levy" and service fees. It has focused its efforts on establishing a cattle breeding infrastructure covering genetic evaluations, information systems and breeding schemes. The ICBF database is the core of this infrastructure, it replaced some 40 semi-independent computer systems with a single integrated system and, it provides a wide range of information services to Ireland's cattle industry. The focus of this paper is on the way this system has been organised and structured to deliver national, industry and commercial benefits to farmers and to the Irish dairy and beef industries.

Introduction

Animal recording and the resulting genetic evaluations are used by cattle breeders to provide cattle producers with better animals.

The milk and meat supply chain involves a number of steps – typically at least five (refer to table 1) for milk and meat but, often more – with each step typically involving payment from the next step and payment for inputs. Each step involves many individuals and organisations nationally and internationally. There are also large numbers of suppliers of inputs at each step. With increasingly open economies suppliers can, and do, operate nationally and internationally.

Table 1. Supply chain for meat and milk.

Step	Inputs	Outputs
Breeder	Information Elite genetics	Semen, Bulls, Embryos, Females Data
Producer	Information Breeding stock Land, labour, feed, …	Milk Slaughter animals … Data
Processor	Information Milk Animals	Dairy products, … Meat products, … Data
Distributor	Information Transport Products	Products Data
Retailer	Information Products	Products for consumption Data

Better breeding can potentially impact on all steps and all individuals and organisations. Each individual in this supply chain that receives a greater increase in income than any increase in costs (to suppliers), as a consequence of genetic improvement or information arising from recording and genetic evaluations is a net beneficiary. Every step and every individual is a potential beneficiary. With such a complex and long supply chain is can be difficult, if not impossible, to clearly quantify the beneficiaries of recording and genetic improvement. By

taking the overview and considering the whole supply chain, as one, the problem is greatly simplified. In other words, do the records and genetic evaluations available to breeders result in a net benefit to consumers?

I suggest that it is most important that any future structure for recording and genetic evaluation be empowered to take this overview. Failure to do so, runs the risk of the benefits not be fully realised or, worse still, one step or organisation capturing benefits at the cost of another step or organisation and there being no net benefit.

Time periods

Recording and genetic evaluations tend to give relatively long term gains. So, while the steps in the supply chain are relatively constant the individuals and organisations involved are continually changing.

One year to the next will see new breeders, new producers and certainly a different group of consumers.

Many of the benefits from recording and genetic evaluation are only fully realised after several generations, 10 to 20 years in the case of cattle breeding.

It is thus imperative that the decision making mechanism for recording and genetic evaluations be able to give due consideration to the breeders, producers and consumers who currently are not involved in the supply chain. Any future organisational structure must be able to, and be motivated to, consider future generations of breeders on the one hand and future consumers on the other.

Benefits

Who benefits? The answer is potentially; breeders, producers, processors, distributors and consumers. That is, all steps in the supply chain. To make the best decisions in the interests of these beneficiaries we need organisational structures that consider the whole supply chain in both the short and long term. Anything else is likely to result in the self-interest of one step in the structure taking priority over the interests of the entire supply chain.

Contributors

Who contributes to recording and genetic evaluations?

For simplicity I have broken this into two headings:

- **Data & knowledge** – recording is fundamentally about the collection of **data**, be it identification, ancestry, milk yield, carcass, and the **knowledge** to interpret it for decision making. For example; in breeding, feeding or animal health.
- **Funding** – is firstly to cover operating costs and secondly, for ensuring that resources are available for investing in research to develop new and improved products and services relevant to recording and genetic evaluations. If there is not sufficient funding to cover both of these needs then recording and genetic evaluation activities will fail.

The focus of animal recording data has traditionally been on the herds of breeders – the seed stock producers. However, increasing amounts of data are now routinely collected from commercial producers, especially in dairy and increasingly in beef. Data from meat processors is a feature of recent developments in Ireland. We have yet to see significant developments in the flow of relevant animal data from distributors and consumers although quality assurance systems and point of sales information are increasingly linking data on animals with data on consumers. Watch this space!

The big impetus for the future development of recording and genetic evaluation is coming from **research**. Research is typically using data collected through recording service providers, and data

from dedicated research facilities. Research builds on existing knowledge and gives rise to new knowledge and improved products and services. Farmers gain access to new and improved products and services from the suppliers of farm inputs.

Improvement Process

This improvement process for animal recording and genetic evaluations operates on a world-wide basis with new developments resulting in new and modified services over quite short time periods. One of the most spectacular recent examples has been the use of genomic information in cattle breeding. In Ireland's case the time from availability of the Illumina 50K SNP chip to implementation of genomic selection was less than 12 months (Wickham *et al* 2011). Similarly rapid implementation has occurred in a number of other countries.

The key question is: what is the best way of organising data recording in order to facilitate research and the development of new and improved animal recording and genetic evaluation products and services?

While data and knowledge is fundamental to the rapid development of recording and genetic evaluations there is also a need for a substantial financial investment. That is, resources have to be committed with the returns being in the future and spread over a wide range of beneficiaries.

Funding R&D

The funding of research and development (R&D) in our industry can be simplified into two main sources:

- **Private funding** – with the funds coming from; profits from services to various steps in the supply chain, or being provided on the basis of expected future profits, and
- **Public funding** – either from general taxation, or from industry levies, and often from a combination of both.

The key difference between these two types of funding is one is linked to service income where there is often an element of competition, resulting in a desire to restrict the distribution of the new knowledge that resulted from the research, and the other is more open with few if any restrictions on access to research findings. This is the contrast between commercial and industry or public good R&D.

The key question for today is: what is the best balance between these two ways of funding R&D relevant to animal recording and genetic evaluations for the species we are dealing with?

Irish Model

Our animal recording and genetic evaluation service model is based around the ICBF database as the single shared repository of all data relevant to cattle breeding, and the information services provided by the Irish Service providers who operate with varying degrees of competition.

Data collection is through a network a data sources based on two key principles:

- Electronic capture as close to source as possible, and
- Single point of capture without duplication.

Genetic evaluations are an integral element of the database – evaluations are computed by ICBF and all results stored into the database from whence they are published. ICBF is, and is recognised to be, an independent source of genetic evaluations for all cattle in Ireland.

Note that at this stage in the development of the ICBF database no data is coming from the distributor and consumer steps in the supply chain. In principle there is no reason why this could

not change in the future. Similarly, for the services supported by the database, they could at some time in the future be extended to processor, distributor and consumer steps in the supply chain.

It is easy to see how this structure has been able to take an overview and develop an infrastructure which is beneficial to the entire supply chain.

The Irish model has proven to be **particularly strong in stimulating and supporting innovation and service development**. The three key elements in this respect include:

1. Researchers have ready and rapid access to the full contents of the ICBF database subject to data protection and a limited set of other conditions. The scope of data **available for use in research is extensive** including as it does;
    - some 90% of all dairy and beef herds,
    - AI services from often competing organisations,
    - Data from seed stock herds,
    - Data from commercial herds, and
    - All genotypes and phenotypes recorded in Ireland.

    This means research can be, and is, much more comprehensive in terms of traits and number of animals, than could be readily achieved with the service provider specific databases available previously in Ireland.
2. **Implementation of research findings is rapid**, relatively **straight forward** and **rarely limited by the availability of relevant data**. This aspect contrasts sharply with a service provider specific database model. The contrast with a competing service provider model, where sharing of data is severely limited is even greater.
3. The combination of 1 and 2 mean scarce financial and human resources can be more productive.

Relevance of ICAR

The Irish model relies heavily on the activities of ICAR. We support and participate in the activities of ICAR to, amongst many other benefits, gain access to data and information from other countries and populations that we can use with confidence in our research & development and in our routine services. We have no ambition to provide services outside of Ireland but it is very important for us, that we can work in an open partnership in which we can share data, with like-minded organisations in other countries.

Of particular significance for our mission of genetic improvement of the Irish cattle herd are Interbull, for dairy and Interbeef (Wickham & Durr 2011), for beef. These two ICAR activities do, and will in the future, play a very important role in helping ensure the Irish cattle supply chain has access to the genetics from around the world that deliver the best economic returns for Ireland.

Funding & Industry Benefits

That a relatively small, 1.1 million cows, dairy cattle population has been able to go from a net importer of genetics based largely on foreign information to having used genetics to largely solve a major problem in dairy cattle reproduction and removing its reliance on imported genetics, in a period of some 14 years, is ample demonstration of the technical capability of the Irish model.

One of the keys to the Irish model is funding for both operations and research & development. A large part of the funding for ICBF has come from public sources – a combination of industry and tax payer funding. The split of the years is illustrated in Table 2 as reported by ICBF (Anon 2011).

Tax payer funding, (DAFM & NDP), was initially the main source of ICBF funds. The contribution of service income (Services), has been growing steadily and now covers much of the ICBF's operational costs. The industry contribution (Farmers via Tags) is collected by a levy on ear tags, and has remained constant for the last nine years.

Table 2. ICBF funding trends from 2003 to 2012. DAFM & NDP are funds from Irish taxes.

Source of Income (€ million)	Income in financial years (€ million)			
	2003	2006	2009	2012 Est.
DAFM & NDP	€1.44	€2.22	€2.95	€2.87
Farmers via Tags	€0.69	€0.84	€0.77	€0.75
Services	€0.39	€0.80	€1.45	€2.32
Total	€2.52	€3.85	€5.17	€5.94

The key point is that public and industry funding ensures that ICBF can focus on delivering benefits for the industry and wider community, and especially future farmers.

The benefit to farmers is clear as shown, for example, by these genetic trends for dairy replacement females (figure 1).

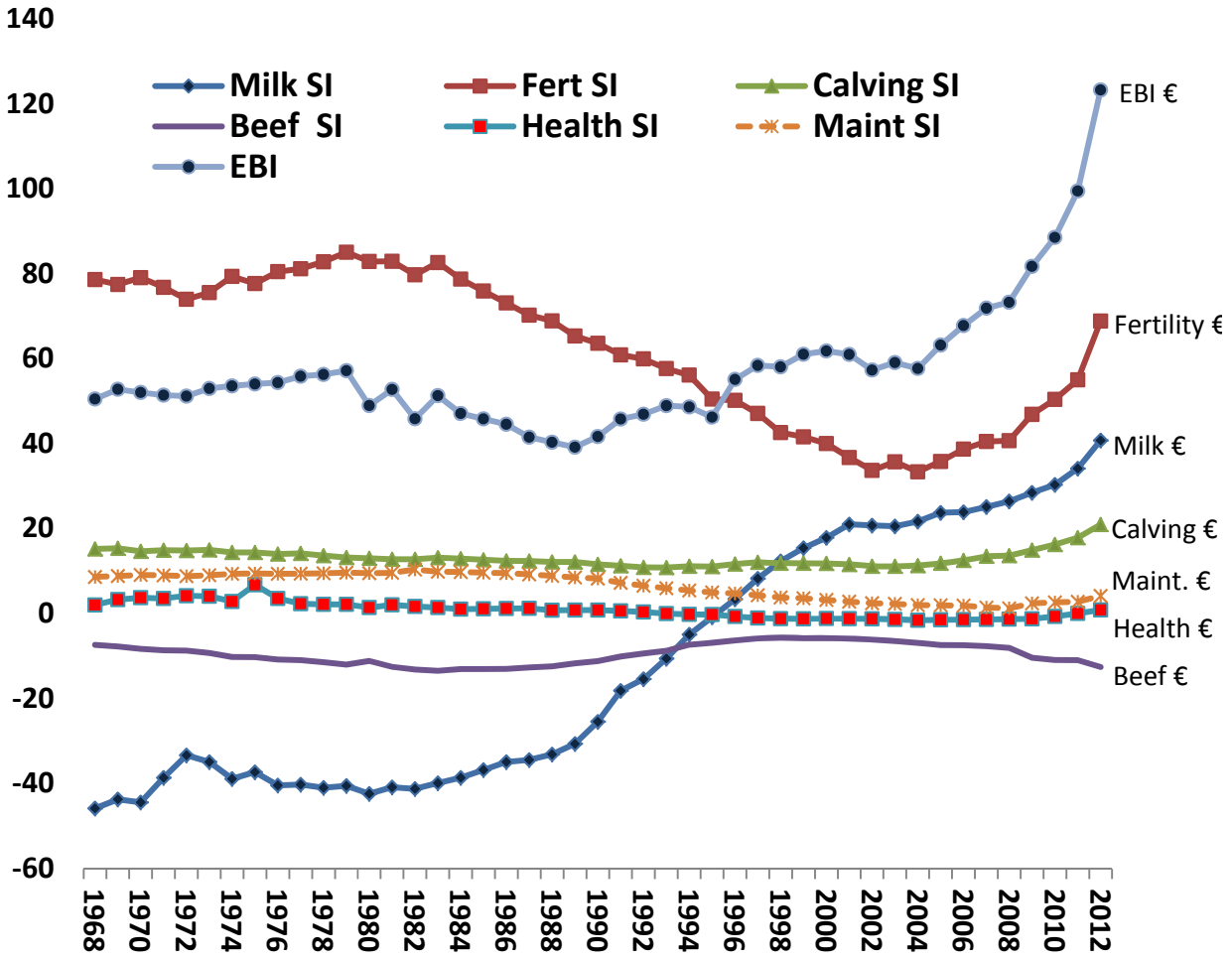

Figure 1. Genetic trends in the overall economic index for Ireland (EBI) and contributing sub-indexes for dairy female replacements by year of birth.

These trends are for dairy female replacements by year of birth. The EBI is the sum of the sub-indexes, also expressed as a financial (€) contribution to farm profit for each set of traits on a per lactation basis.

The negative trend in fertility traits (calving interval and survival), which was associated with the

large scale introduction of Holstein cattle of North American origin from 1980 to 2000, has now been largely reversed without any adverse impact on the contribution of milk to farm profits.

Service Provider Benefits

How have the breeding industry service providers benefited?

Milk recording has increased from 410,000 cows in 2004 to 540,000 cows in 2011.

Herd Book pedigree registrations, across all breeds, dairy and beef has increased from 90,000 to 120,000 between 2004 and 2011.

Animal Events registrations have shown spectacular growth due in part to the Suckler Cow Welfare Scheme introduced for suckler (beef) cows in 2008. This scheme is a taxpayer funded initiative to improve the welfare and quality of data for breeding beef cattle. It is an example of how tax payer funding has been used to improve the prospects for an entire industry. This scheme, and the benefits that resulted, has been presented elsewhere (DAFM 2011)

The number of artificial insemination sired dairy replacements identified, on the ICBF database, has doubled in the last fourteen years. The AI companies have access to comprehensive information for identifying and selecting bulls as well as for managing the operation of insemination services.

The source of bulls used in AI has changed to predominately Irish and NZ born animals from predominately Holsteins of North American origin albeit directly or via European countries.

Conclusion

Ireland has established a new infrastructure for recording and genetic evaluations. It is a partnership between service providers, farmers and Government.

Funding has been provided by a mix of taxpayer, industry and service income.

This has resulted in rapid innovation and substantial short and long term benefits for farmers and service providers.

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