Info Card A01

Genomic selection is not genetic modification

Selecting which cattle to breed using genomic information is not like genetic modification (GM). GM adds external genes in the laboratory. It is used in crops but was never used in livestock production.

BovReg : Genome Editing

Info Card A02

Traditional Animal Breeding

Since ancient times, farmers have been selectively breeding animals (and plants), largely based on visible characteristics, like an animal's physical appearance or obvious traits like number of offspring or milk yield.

BovReg : Breeding

Info Card A03

Modern selection using measurements and statistics

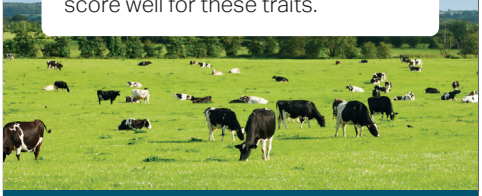
Modern selective breeding uses advanced statistics to turn data about relevant traits of parents and siblings into 'breeding values', which are then used to make small progressive changes in inherited traits.

BovReg : Breeding

Info Card A04

What is genomics and why is it important in cattle breeding?

Genomics uses complex statistics to identify patterns in the genomes of animals that represent inheritable traits, without knowing how all the individual genes work. These patterns are used in breeding to select cows which score well for these traits.



BovReg : Breeding

Info Card A05

What influences priorities in breeding?

Choices in breeding are a complex mix of factors, including what is biologically possible, which traits are easier to change, what commercial, welfare or social influences are brought to bear, by retailers, market forces, governments, NGOs, consumers.

BovReg : Breeding

Info Card A06

Breeding isn't just about more efficient production

For some years, advanced statistics has enabled more traits to be included than just getting more milk or faster growth. Now new knowledge about cattle genomes will enable more accurate selection for different characteristics.

BovReg : Breeding

Info Card A07

What are the main traits bred today in cattle?

In dairy cattle these include: milk yield, milk quality, udder health, ease of calving, lifespan. In beef cattle: growth rate, carcass weight, muscling and fat (meat quality). In both: fertility and disease resistance have become important.

BovReg : Breeding

Info Card A08

Dairy and beef cattle are usually different breeds

Historically the same breeds were used for both milk and meat. But last century distinct breeds were developed for beef or dairy cattle. Most European farmers keep one or the other, but some use mixed breeds for both.

BovReg : Breeding

Info Card A09

Improving inherited traits in cattle is complex

Most characteristics of cattle depend on both genetic and external factors. Some traits are easier to improve, some harder. Changes in one trait might lead to a detriment in another, e.g. increasing milk yield reduces fertility.

BovReg : Breeding

Info Card A10

Breeding for better adaptation to changing environments

One of the aims of the BovReg project is to explore how understanding the cattle genome can give insights on how different breeds are better adapted to challenges they experience through their environment, e.g. heat stress, or disease.

BovReg : Breeding

Info Card A11

Using genomics to maintain minority breeds

Genomic knowledge can inform how best to maintain minority breeds and harness their special qualities, such as making artisan cheese or adapting to local conditions and environments. Some of these qualities might also be introduced into mainstream breeds.

BovReg : Breeding

Info Card A12

Why do high milk yields mean less fertility?

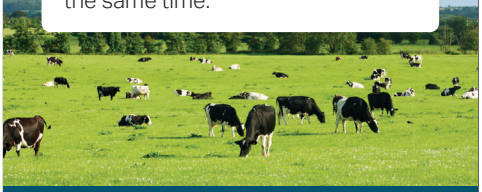
Increasing milk yield of dairy cows has tended to decrease their fertility. A better understanding of cattle genomics might find a genetic basis for why these factors conflict, and perhaps point to solutions?

BovReg : Breeding

Info Card A13

Genomics is helping more traits to be selected

Breeding indexes are a way to score the value of different traits (like points in an athletics decathlon). Advanced cattle genomics is making more refined indexes, enabling breeders to select for a wider variety of traits at the same time.



BovReg : Breeding

Info Card A14

Different types of production system

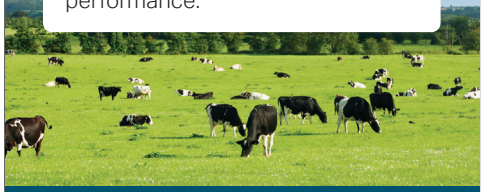
Cattle are farmed in many different ways such as large, mostly indoor dairy units, medium sized family farms, and small-holdings. Most dairy cattle are Holstein-Friesians. There are many beef breeds and some mixed and minority breeds.

BovReg : Production

Info Card A15

What does 'intensive' cattle production mean?

Intensive dairy production can have many forms, but the emphasis is efficiency, usually in large units where cows are indoors most of the time. Their movements may be monitored electronically to maintain better health and performance.



BovReg : Production

Info Card A16

What is 'extensive' cattle production?

Extensive production is a broad concept, emphasising giving animals more access to outdoors and as natural a life possible. Indoor facilities are used for milking and for bad winter weather.

BovReg : Production

Info Card A17

Dairy and beef cows have different lives

Dairy cows are typically kept milking for 3 years once they start lactating. Beef cattle are generally slaughtered for meat after 1-2 years in Europe but up to five years for extensively reared animals.

BovReg : Production

Info Card A18

What do cattle eat?

Cattle naturally live off just grass, but to improve milk or beef production they are often given additional feed, like grain. But cattle may also be fed residues from food and beverage production, like soya oil extraction, brewing or sugar beet pulp.

BovReg : Production

Info Card A19

Improving how feed is converted into milk or meat

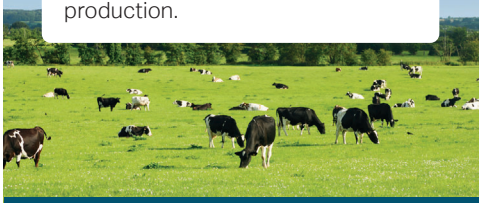
Cattle feed is expensive. A goal in breeding is to improve how well cattle convert their feed into meat or milk. This reduces both the cost to the farmer and the carbon footprint.

BovReg : Production

Info Card A20

The value of local 'minority' breeds

Minority local cattle breeds struggle to compete with dominant breeds on efficiency, but may have advantages like better tolerance to hot or cold climates, resistance to diseases, or suitability for niche markets like local cheese production.



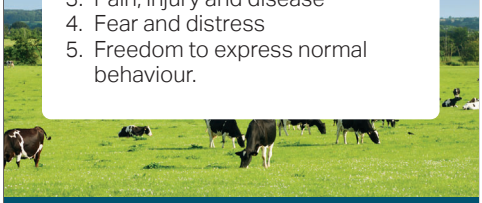
BovReg : Production

Info Card A21

Five freedoms for animals used by humans

One way to express animal welfare is '5 Freedoms' which an animal ought to experience. Freedom from:

1. Hunger and thirst
2. Discomfort
3. Pain, injury and disease
4. Fear and distress
5. Freedom to express normal behaviour.



BovReg : Welfare & Health

Info Card A22

What is animal welfare?

Animal welfare is a balance of many factors of health, well being, mental and emotional aspects. The weighting put on their importance is a matter of ethical values, which will vary among stakeholders and between cultures.

BovReg : Welfare & Health

Info Card A23

What significant diseases affect livestock?

All livestock can get diseases. Two often found among dairy cows are mastitis - a painful udder inflammation due to a bacterial infection - and lameness caused by infections, dermatitis, or cuts and ulcers on soles or hooves.

BovReg : Welfare & Health

Info Card A24

Why are antibiotics used in farm animals?

Farmers use antibiotics to treat bacterial infections in cattle, or reduce their spread within a herd, but are advised to use them only when really needed. Antibiotic use to promote growth was banned in the EU and UK in 2006.

BovReg : Welfare & Health

Info Card A25

Can we breed to reduce diseases in cattle?

The breeding values calculated to select the next generation of cattle can take into account a cow's tendency to conditions like mastitis and lameness, and increasingly resistance to diseases like tuberculosis.

BovReg : Welfare & Health

Info Card A26

Do grazed cattle help or hinder biodiversity?

Beef cattle can have an important role in promoting grassland biodiversity and bird habitats. Reducing the amount of grazed cattle could benefit some species, but not those which are dependent on grazing. It's complex!

BovReg : Land Use & Biodiversity

Info Card A27

Cattle manure : trash or treasure?

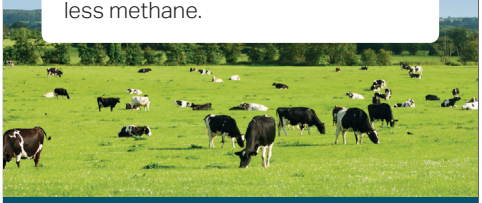
Cattle manure is rich in nitrogen and makes good fertiliser, especially for organic crops, but if it is leached into rivers it leads to nitrate pollution and also releases the greenhouse gas nitrous oxide.

BovReg : Land Use & Biodiversity

Info Card A28

Can we select cows for lower methane emissions?

Scientists are working on different ways to reduce methane emissions from cattle. Its genetic basis is complex and not fully understood. Projects like BovReg may find patterns in cattle genomes for breeders to select cattle emitting less methane.



BovReg : Climate Change

Info Card A29

Why is methane from cattle a concern?

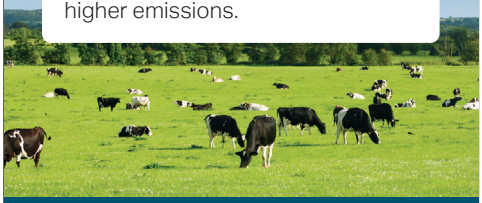
Cattle naturally emit methane in the process of digesting grass. Methane is a greenhouse gas which contributes to global warming. It is also released from landfill and fossil fuel production. It is usually converted into 'CO_2 equivalent' but this may overestimate its impact.

BovReg : Climate Change

Info Card A30

How much do cattle contribute to EU greenhouse emissions?

Agriculture contributes about 10% of EU carbon emissions, about half coming from cattle, compared with 25% from transport (Eurostat 2019 figures). But if we eat beef which involves clearing forests to graze cattle or grow feed, these have higher emissions.

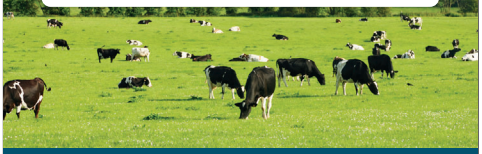


BovReg : Climate Change

Info Card A31

Methane emissions vary depending how cattle are farmed

Greenhouse gas estimates from cattle production vary greatly. Global averages do not reflect differences between localities, geography, climate, soils, methods of farming, different ways cattle are fed, how long an animal lives, etc.



BovReg : Climate Change

Info Card A32

What is genome editing?

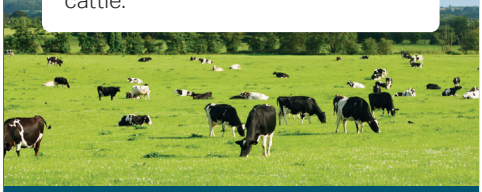
Genome editing is a new and more precise way to make changes in the animal's genome directly, without needing to add 'foreign' genes. Some potential applications in cattle are being reviewed by regulators, but none are in commercial use in Europe.

BovReg : Genome Editing

Info Card A33

Genome editing hornless dairy cattle

Young dairy calves usually have their horns removed to stop them injuring each other or their handlers. Genome editing has been used in the USA to produce hornless dairy cows, using a natural gene variant found in some beef cattle.



BovReg : Genome Editing

Info Card A34

How do scientists know which genes to edit?

As scientists understand the genome of cattle better, they may identify places in the genome where desirable changes can be made by genome editing that would be hard or slow to do by breeding.

BovReg : Genome Editing

Info Card A35

How precise is genome editing : off target effects?

Previous genetic modification methods inserted genes rather randomly into cells, followed by selection. Genome editing is much more precise, but sometimes may also edit parts which were not targeted.

BovReg : Genome Editing

Info Card A36

What effect has reducing methane on global warming?

Methane gradually decomposes in the atmosphere and lasts only 12 years, unlike carbon dioxide which just accumulates. Reducing methane emissions can make a short term impact on global temperatures, but won't reduce them long term (caused by CO_2).

BovReg : Climate Change