



# GenTORE

## *Genomic management Tools to Optimise Resilience and Efficiency*

Grant agreement n°: 727213

**H2020 - Research and Innovation Action**

### **D7.4**

## ***Update of Report of recommendations of stakeholders***

**Due date:** M49 (June 2021)

**Actual submission date:** M49 (June 2021)

**Project start date:** 1<sup>st</sup> June 2017      **Duration:** 60 months

**Workpackage concerned:** WP7

**Concerned workpackage leader:** Cagla Kaya

**Lead Beneficiary:** EFFAB

**Dissemination level:**

- PU:** Public (must be available on the website)
- CO:** Confidential, only for members of the consortium (including the Commission Services)
- CI:** Classified, as referred to in Commission Decision 2001/844/EC

## Revision History

This document contains a revision history log. When changes occur, the document's revision history log will reflect an updated version number, the date of the new version, the author making the change, and a summary of the changes.

<b>Version</b>	<b>Date</b>	<b>Author</b>	<b>Summary of changes</b>
v1	29 June 2018	Cagla Kaya	This is the first version created.
v2	27 June 2019	Cagla Kaya Nicolas Friggens	Updated report with recommendations from two more consultations
v3	30 June 2020	Cagla Kaya, Lotta Rydhmer	Updated report with recommendations from two more consultations
V4	28 June 2021	Cagla Kaya, Isabella Beck Jorgensen	Updated report with recommendations from two more consultations

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## 1. Summary

This deliverable intends to give information on the stakeholder consultations and recommendations during the first and the second year of the GenTORE project as defined under T7.1. Overall there were seven stakeholder consultations; two in the first year, three in the second year and two in the third year. In the first year one consultation was made through a questionnaire on “Resilience and Efficiency” and the second one was carried out face-to-face during the GenTORE Annual Meeting Stakeholder Speed Dating. In the second year, one consultation was carried out through GenTORE Stakeholder Platform as a “DigiWeek”, one with a telephone conference and one during the 2<sup>nd</sup> Annual Meeting of GenTORE project. In the third year first consultation was in the form of a panel discussion at ATF Fitter Livestock Farming session on Climate smart farming “What R&I can deliver to support climate mitigation and adaptation in livestock farming?”, secondly it was through the stakeholder survey carried out by WP6 and the stakeholder workshop organised at 3<sup>rd</sup> Annual Meeting of GenTORE. Stakeholder recommendations intend to get feedback and input on the project results’ applicability and exploitation.

## 2. Introduction

### 2.1 Stakeholder Questionnaire on “Resilience and Efficiency”

A stakeholder questionnaire was prepared using Google Forms at the first half of the first project year. The main purpose of this questionnaire was to understand how the resilience and efficiency and related traits were defined by different stakeholders and their future perspectives on these traits.

The questionnaire was sent to the GenTORE mailing list created at the beginning of the project and which is based on subscription by the stakeholders complying with GDPR principles. This list includes 178 different stakeholder groups including consortium partners, breeding organisations and companies, farm technology and precision farming companies, policy makers, feed industry representatives, extension workers and veterinary representatives and media.

The questionnaire was also sent to the network of Interbull members in a separate email before and after the profile-raising presentation of GenTORE at the Interbull Annual Meeting.

The questionnaire consisted of 6 different questions as given below;

- How do you define a resilient cow?
- What are the main qualities of a resilient cow, please cite at least 3 of them?
- How do you define an efficient cow?
- What are the main qualities of an efficient cow, please cite at least 3 of them?
- Do you think these traits will become more important in the future and why?
- What are your specific needs on these Resilience & Efficiency? Do you expect new indicators? New tools (e.g. for ranking animal? / for reproduction management ...)?

### 2.2 Stakeholder Speed Dating

GenTORE established a stakeholder committee consisting of 16 different experts representing breeding, feeding and farm technology industries, veterinary practitioners, advisory services, policy makers and media. The committee members were invited to the Annual Meeting to get information on the project structure, progress and provide their feedback. A special section for

exchanging information and interaction with the GenTORE WP leaders was organised, namely a speed dating.

A total of 8 non-partner stakeholders were grouped together with 4 GenTORE industrial partners. Therefore, the speed dating included 6 different groups of stakeholders matching with 7 different WP leaders. The WP leaders changed the table of group every 10 minutes to have one-on-one time to discuss about how they can include stakeholders more to their research and what could they offer back to them. It was enlightening to see the project from the eyes of the different stakeholders. The whole speed dating lasted for an hour. Each WP was asked to keep the notes of the speed dating.

The non-partner and partner stakeholders who were present at the speed dating are given below;

Organisation	First name	Last name	Country
<b>EuroGenomics Cooperative</b>	Suzanne	de Roo	The Netherlands
<b>WUR</b>	Henk	Hogeveen	The Netherlands
<b>Quantech Solutions</b>	Sam	Hoste	UK
<b>International Federation of Agricultural Journalists</b>	Lisbeth	Karlsson	Sweden
<b>Interbeef/ICBF</b>	Francis	Kearney	Ireland
<b>Dunbia</b>	Ryan	Law	UK
<b>CRV</b>	Chris	Schrooten	The Netherlands
<b>Evolution</b>	Jessica	Schwarz	France
<b>RAFT</b>	Jonathan	Statham	UK
<b>Noldus</b>	Ben	Loke	The Netherlands
<b>ALLICE</b>	Laurent	Schibler	France
<b>Viking Genetics</b>	Jorn	Thomasen	Denmark
<b>Interbull</b>	Hossein	Jorjani	Sweden

### 2.3 Stakeholder DigiWeek

The digital platform called the “GenTORE Stakeholder E-platform” was created to facilitate the interactive discussions between stakeholders and partners. In M17, a Stakeholder DigiWeek was set up to familiarize the users of the E-Stakeholder Platform with the forum. The WP leaders and GenTORE researchers were available on a scheduled Happy Hour during the week to discuss the main 5 questions asked by the moderators given in the results section.

### 2.4 Stakeholder Telephone Conference

EFFAB organised a Stakeholder Telephone Conference on March 18<sup>th</sup>, 2019 (M22). There were partner stakeholders as well as external stakeholders during the call where the expectations from GenTORE project was discussed. The event was communicated through GenTORE partner and stakeholder emailing lists.

The non-partner and partner stakeholders who were present at the telephone conference are given below;

Organisation	Name	Country
Interbull	Toine Roozen	Sweden
Qualitas	Beat Bapst	Switzerland
Qualitas	Sophie Kunz	Switzerland
IDELE	Florence Macherez	France
Wageningen University	Caludia Kamphuis	The Netherlands
EAAP	Mike Steel	UK
INRA AgroTech Paris	Nic Friggens	France
EFFAB	Cagla Kaya	The Netherlands

### 2.5 GenTORE 2<sup>nd</sup> Annual Meeting Stakeholder Session

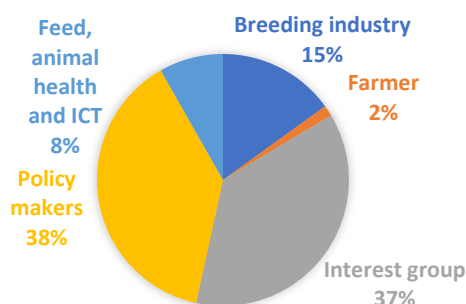
FiBL and EFFAB organised a Stakeholder Session during the 2<sup>nd</sup> Annual Meeting of GenTORE on May 8<sup>th</sup>, 2019 (M24) in the afternoon. There were partners of the project (49) as well as external stakeholders (6 from breeding industry and research, organic livestock farming, herdbook organisation) during the session. The agenda of the session is given below.

13:30-13:40	Stakeholder Session - <b>Brief overview GenTORE</b>	Nic Friggens, INRA
13:40 – 14:40	Plenary: How to measure efficiency without feed intake records	Led by Yvette de Haas, Wageningen
14:40 – 15:10	Plenary: Finding common currencies to describe environments of cattle production systems that suit for calculation of GxE effects? Coffee	Led by Simon Moakes, FiBL
15:40 – 16:00	Resilience & Efficiency: the view of organic livestock agriculture	Anna Bieber, FiBL
16:00 – 16:20	Resilience & Efficiency: the view of the Swiss cattle breeding sector	Beat Bapst, Sophie Kunz, Qualitas
16:20 – 17:20	Panel/Plenary discussion with stakeholders: what are the most relevant scenarios for R&E in cattle we have to consider, and which traits promise the best coverage?	Florian Leiber, Cagla Kaya, Eileen Wall
17:20 – 17:30	Short break	
17:30	Field trip to a Swiss grassland-based dairy farm	
20:00	Lunch at “tibits” in Basel downtown	

### 2.6 Fitter Livestock Farming session at ATF Meeting

The Animal Task Force (ATF; <http://animaltaskforce.eu/>) and the Fitter Livestock Farming Common Dissemination Booster (CDB) GenTORE Cluster projects organised a Stakeholder Session during the ATF workshop on 6 November 2019 in Brussels (M30). GenTORE cluster includes 6 H2020 projects on sustainable livestock production which are GenTORE, IMAGE, SAPHIR, Feed-a-Gene, GPlusE and SmartCow. All projects presented the results that would address “What R&I can deliver to support climate mitigation and adaptation in livestock

farming” question. There were 114 attendees representing different stakeholder groups. The distribution of the participants among different stakeholder groups are given in



**Figure 1** Distribution of attendees among different stakeholder groups

The agenda of the session is given below.

**14.00 Welcome**, by Jean-Louis Peyraud, ATF and Nic Friggens, Fitter Livestock Farming

**14.05 Short introduction**, by *Jean-Charles Cavitte, DG Agri*

**14.10 Insights into projects outcomes: what is in for stakeholders on the common theme?**

**Chair: Nic Friggens, coordinator GenTORE and CDB cluster**

**Introduction**, by Nic Friggens – 5 minutes

**Pitches by 5 projects coordinators** from the **Fitter livestock farming CDB cluster**: Feed-A-Gene (Jan van Milgen), SmartCow (René Baumont), GenTORE (Nic Friggens), IMAGE (Michèle Tixier-Boichard), SAPHIR (Marie-Hélène Pinard), GplusE (Mike Lynch)

Q&A

**15.20 What R&I is needed to support climate mitigation and adaptation in livestock farming**

Discussion with project coordinators and the audience

Moderation: Vivi Nielsen, ATF Vice president for research providers, Aarhus University

**Question to the audience: “Given the project outcomes, what is your recommendation for the next steps?”**

**16.00 Recap and ATF vision**, by Jean-Louis Peyraud-ATF

## 2.7 Questionnaire “What could a future cow look like?”

A questionnaire was prepared by SLU to form the basis of the stakeholder session at the 3<sup>rd</sup> Annual Meeting. Therefore, all participants of the 3<sup>rd</sup> Annual Meeting first received some background material describing the aim of the workshop called “What could a future cow look like?” together with information about possible future scenarios, a short summary of a stakeholder engagement exercise on efficiency and resilience previously performed in GenTORE, a few references describing genetic trends and four questions to reflect on:

- **Which traits will be genetically changed?**
- **How large will the differences be in the expression of these traits?**
- **In which environment will the future animals be raised and kept?**
- **What will be the main differences between today’s production systems and future production systems?**



In the next step, two online questionnaires were sent to all participants in the annual meeting, one about dairy cows and one about beef cows. The results of these questionnaires were discussed at the workshop on the 3rd Annual Meeting.

The respondents were asked to assume that the results coming out of GenTORE will be successfully implemented into breeding programmes in an optimal way, leading to a favourable genetic progress with a well-balanced change in resilience and efficiency. What will then be the genetic differences between today's cattle and the future cattle? Since there are goal conflicts between traits, they were also asked to assume that the genetic potential for milk yield of the future dairy animals and the genetic potential for growth rate of the future beef animals remain at the same levels as today.

Each online questionnaire included approx. 25 traits and the respondents described the genetic potential of future animals by answering on a scale from 'much lower' to 'much higher'. The questions covered a wide range of traits from classical goal traits for dairy and beef cattle (production, reproduction and health traits) to traits related to water consumption, manure production, tolerance to heat stress and demand for knowledge and skills of caretakers. Here is an example:

Prevalence of diseases demanding treatment with antibiotics		
Much lower prevalence	Same as today	Much higher prevalence

The questionnaires also included a question about the main cause for the predicted genetic changes, and a possibility to note additional important traits that, according to the respondent, will change genetically.

### **2.8 GenTORE 3<sup>rd</sup> Annual Meeting Stakeholder Workshop “What could a future cow look like?”**

A workshop called “What could a future cow look like?” was organised at the 3<sup>rd</sup> Annual Meeting in May 2020. The workshop was originally planned as a half-day workshop in real life but due to the restrictions caused by the corona virus it was changed into a one-hour workshop online. All participants of the 3<sup>rd</sup> Annual Meeting, including stakeholders, were invited. They received some background material describing the aim of a workshop together with information about possible future scenarios, a short summary of a stakeholder engagement exercise on efficiency and resilience previously performed in GenTORE, a few references describing genetic trends and four questions to reflect on: Which traits will be genetically changed? How large will the differences be in the expression of these traits? In which environment will the future animals be raised and kept? What will be the main differences between today's production systems and future production systems? In the next step, an online questionnaire was sent to all participants in the annual meeting. It included one part for dairy cows and one for beef cows. The results of these questionnaires were used as a base for the discussions at the workshop on the 3<sup>rd</sup> Annual Meeting.

In the questionnaire, the respondents were asked to assume that the results coming out of GenTORE will be successfully implemented into breeding programmes in an optimal way, leading to a favourable genetic progress with a well-balanced change in resilience and efficiency. What will then be the genetic differences between today's animals and the future animals? Since there are goal conflicts between traits, they were also asked to assume that the genetic potential for milk yield of the future dairy animals and the genetic potential for growth rate of the future beef animals remain at the same levels as today. The questions covered a wide range of traits from classical goal traits for dairy and beef cattle (production, reproduction and health traits) to traits related to water consumption, manure production, tolerance to heat stress and demand for knowledge and skills of caretakers.



There were 60 participants in the workshop. The workshop started with a short introduction of the aim and a presentation of the results of the questionnaires. These results had also been sent out to the participants before the workshop, together with instructions for the group discussion. After the introduction, the participants were divided into nine groups. Some groups chose to focus on dairy cattle, some on beef cattle and in a few groups both were discussed. The workshop participants were asked to discuss:

*The future animals*

- **Comment on the description of the future animals from the questionnaire - Any surprise?**
- **Try to quantify the genetic change in some of the traits; how much is "Very much higher" or "Very much smaller", in 15 years from start of implementation?**
- **For some traits, the genetic change could be either favourable or unfavourable ('it depends...'). Give some examples**

*The future environments*

- **What main differences do you predict between today's production systems (feeding, housing, management routines, market etc) and the future production systems for dairy and beef?**
- **What are the main drivers of these environmental changes?**

We collected notes from the group discussions. There was also a short common discussion with all participants where each group shared some thoughts from the group discussion. The outcome of the workshop will be used as a base for the modelling of future production schemes and future, genetically changed animals in WP6.

## 2.9 GenTORE Online Stakeholder Consultation

From November 2020 to April 2021 the weekly engagement activity "polls" have taken place with the aim of asking different questions related to the future cow. The questions were published on the GenTORE Twitter, Facebook and LinkedIn profile. All the results were presented the week after in pie chart to illustrate what the participants thought on the given questions.

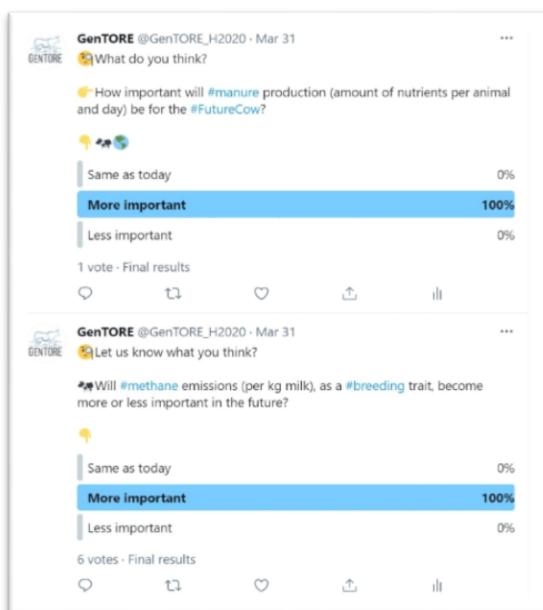


Figure 1 Example what the poll features on Twitter.

The polls that were shared included the below questions:

**1. Birth weight (a trait of the calf)**

*Much lower weight*  
*Lower weight*  
*Same birth weight as today*  
*Higher weight*  
*Much higher weight*

**2. Difficult calvings (a trait of the cow)**

*Much more difficulties*  
*More difficulties*  
*Same degree of calving difficulties as today*  
*Less difficulties*  
*Much less difficulties*

**3. Calf survival; during calving and as newborn (a trait of the calf)**

*Will calf survival (during calving and as newborn) become higher or lower in the future?*  
*Much lower survival*  
*Lower survival*  
*Same survival as today*  
*Higher survival*  
*Much higher survival*

**4. Temperament; docile behaviour towards caretaker**

*How would you describe the temperament (behaviour towards caretaker) of the “The Future Cow”?*  
*Much less docile*  
*Less docile*  
*Same temperament as today*  
*More docile*  
*Much more docile*

**5. Lameness, legs and claws**

*Much less problems*  
*Less problems*  
*Same amount of leg&claw problems as today*  
*More problems*  
*Much more problems*

**6. Temperament; social (non-aggressive) behaviour towards other cows**

*Much less social*  
*Less social*  
*Same temperament as today*  
*More social*  
*Much more social*

**7. Demanding knowledge and skills of caretakers for high production and good health**

*Much less demanding*  
*Less demanding*  
*Same demand of skills & knowledge as today*  
*More demanding*

*Much more demanding*

**8. Milk quality, protein content**

*Much lower protein content*

*Lower protein content*

*Same protein content as today*

*Higher protein content*

*Much higher protein content*

**9. Cow longevity**

*Much lower longevity*

*Lower longevity*

*Same longevity as today*

*Higher longevity*

*Much higher longevity*

**10. Demanding work time of caretakers**

*Much less demanding*

*Less demanding*

*Same demand of work time as today*

*More demanding*

*Much more demanding*

**11. Reproductive ability (oestrus, pregnancy, abortion)**

*Much lower ability*

*Lower ability*

*Same reproductive ability as today*

*Higher ability*

*Much higher ability*

**12. Affected by environmental disturbances (e.g. temporary lack of water or feed)**

*Much less affected*

*Less affected*

*Affected to the same degree as today*

*More affected*

*Much more affected*

**13. Adult size**

*Much smaller size*

*Smaller size*

*Same adult size as today*

*Larger size*

*Much larger size*

**14. Carcass conformation of animals reared for slaughter**

*Much lower score*

*Lower score*

*Same conformation score as today*

*Higher score*

*Much higher score*

**15. Growth rate, from weaning to slaughter**



*Much lower growth rate*  
*Lower growth rate*  
*Same growth rate as today*  
*Higher growth rate*  
*Much higher growth rate*

**16. Sexual maturation**

*Much earlier puberty*  
*Earlier puberty*  
*Same pubertal age as today*  
*Later puberty*  
*Much later puberty*

**17. Feed conversion ratio, on high quality Total Mixed Ration (TMR) diet, kg feed / kg milk**

*Much more feed / kg milk and meat*  
*More feed / kg milk and meat*  
*Same feed conversion ratio as today*  
*Less feed / kg milk and meat*  
*Much less feed / kg milk and meat*

**18. Appetite; voluntary intake of voluminous feed per day**

*Much lower intake*  
*Lower intake*  
*Same voluntary intake as today*  
*Higher intake*  
*Much higher intake*

**19. Feed quality (nutrient concentration) needed to express its genetic production potential**

*Much lower need*  
*Lower need*  
*Same feed quality needed as today*  
*Higher need*  
*Much higher need*

**20. Feed conversion ratio on roughage, kg roughage / kg milk**

*Much more roughage / kg milk and meat*  
*More roughage / kg milk and meat*  
*Same feed conversion ratio as today*  
*Less roughage / kg milk and meat*  
*Much less roughage / kg milk and meat*

**21. Methane emissions per kg milk**

*Much lower emissions*  
*Lower emissions*  
*Same emissions as today*  
*Higher emissions*  
*Much higher emissions*

**22. Manure production, amount of nutrients per animal and day**

*Much less nutrients*



*Less nutrients*  
*Same amount of nutrients as today*  
*More nutrients*  
*Much more nutrients*

### **23. Tolerance to heat**

*Much lower heat tolerance*  
*Lower heat tolerance*  
*Same heat tolerance as today*  
*Higher heat tolerance*  
*Much higher heat tolerance*

### **24. Water consumption, amount of water per animal and day**

*Much lower consumption*  
*Lower consumption*  
*Same water consumption as today*  
*Higher consumption*  
*Much higher consumption*

## **2.10 GenTORE 1st Training Workshop Consultation**

GenTORE's first training workshop called "On-farm tools to phenotype proxies of Resilience and Efficiency" was organised at the 4<sup>th</sup> Annual Meeting on 19 May 2021 aimed at vets, farmers, breeding consultants, academics and students working on the interface between research and livestock farming, equipping participants with the knowledge and skill to develop the potential of precision livestock farming management (PLF) tools.

There were 63 participants at the workshop globally from Brazil to Niger where definitions of both Precision Livestock Farming & Resiliency & Efficiency were explored. Stakeholder feedback was collated both in the form of on-line polls and break-out rooms which will be used to develop the demonstration support tool further.

The workshop participants were asked to respond to the questions given below:

*What do you understand by the term resilience?*

1. High performing cow
2. Long lasting cow
3. Recalves easily/regularly
4. Problem-free
5. Elastic/quick recovery after a challenge
6. Level but moderate production

*What applications of PLF do you think are important in cattle farming?*

1. Heat detection
2. Health alerts

3. Breeding decisions
4. Saving time
5. Sustainable food production
6. Reducing use of antimicrobials
7. Real-time herd monitoring
8. More efficient use of feed sources

*What in theory could you do with information regarding predicting ranking of animals in a herd on resilience & efficiency?*

1. Feed low ranked cows less
2. Breed replacement females from higher ranked animals
3. Cull lower ranked animals
4. Use sexed semen on higher ranked animals
5. Use Embryo Transfer (ET) or In Vitro Production (IVP) on higher ranked animals
6. Sell high ranked animals
7. Stop using genomics

### RESULTS FROM WP3: On-Farm Tools to Phenotype R & E

*What data parameters could be used for making **herd level** breeding and culling decisions?*

1. Daily milk yield
2. Milk yield/ per lactation
3. Resilience & efficiency rank
4. Genomics
5. Health events
6. Stature
7. Calving ease
8. Fertility/regular re-calving

*What parameters would you prioritise if at **individual** animal level?*

1. Daily milk yield
2. Milk yield/per lactation
3. Resilience rank
4. Genomics

5. Health events
6. Stature
7. Calving ease
8. Fertility/regular re-calving

*What is your opinion about the Resilience & Efficiency dashboard that GenTORE is developing as a decision support tool to be used in addition to the existing sensor systems?*

- a. Very useful!
- b. Good idea but must be improved
- c. Neutral
- d. There are already so many sensors available that one more is not needed
- e. I don't see any real advantage

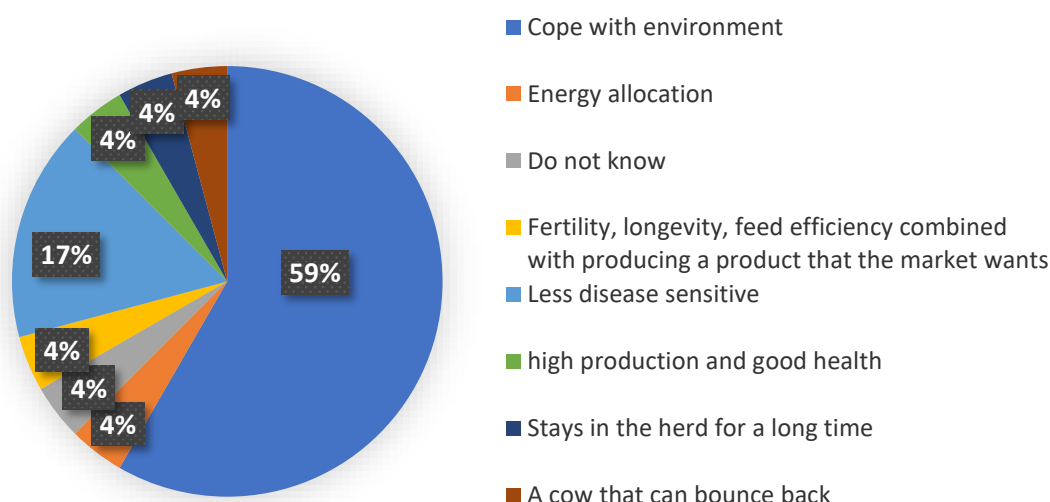
### 3. Results

#### 3.1 Results of Stakeholder Questionnaire on “Resilience and Efficiency”

In total, 27 stakeholders filled out the GENTORE stakeholder survey in which 25 were usable. A summary of answers is given for each of the questions.

##### 1. How do you define a resilient cow?

The majority of the stakeholders (59%) think a resilient cow is a cow that can, at the same



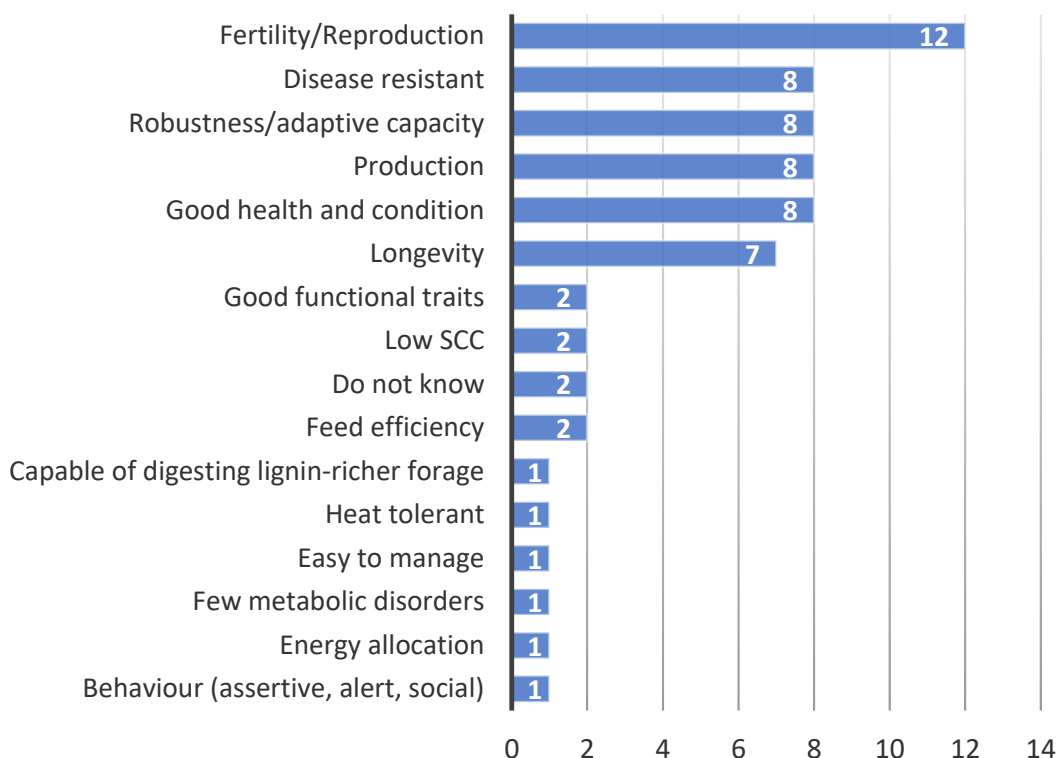
time, easily cope with the environment it is exposed to and maintain its production level. The environment is a broad term here that includes e.g. exposure to heat stress or disease or diet changes. Some of the stakeholders think a resilient cow is defined in terms of a specific environmental exposure (disease) or a specific combination of internal factors (high fertility, high longevity, high feed efficiency). Furthermore, a resilient cow was perceived as a cow that stays in the herd for a long time, a cow that can bounce back, or a cow that has a high production and a good health. One stakeholder defined resilience in



terms of energy allocation; a cow is resilient when it can use its energy when appropriate. One stakeholder did not know how to define a resilient cow.

**2. What are the main qualities of a resilient cow, please cite at least three of them?**

Fertility/reproduction, production, good health and condition, disease resistant, and robustness are mentioned most often as important qualities of a resilient cow (together 66% of the mentioned qualities). Other important qualities are longevity, functional traits, low SCC, robustness, few metabolic disorders, and easy to manage.

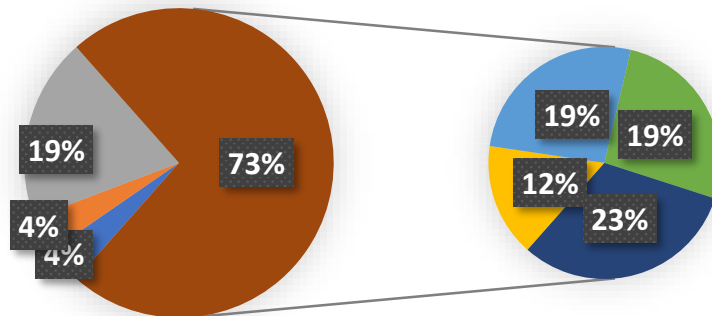


**3. How do you define an efficient cow?**

The majority of stakeholders define an efficient cow in terms of maximum output from minimum input (73%; left hand pie-chart), with *i*) feed and labour as input with high (re)production, *ii*) good FCR, *iii*) high lifetime production and low energy consumption, and *iv*) low nutrient input with high (re-)production (right hand pie-chart).

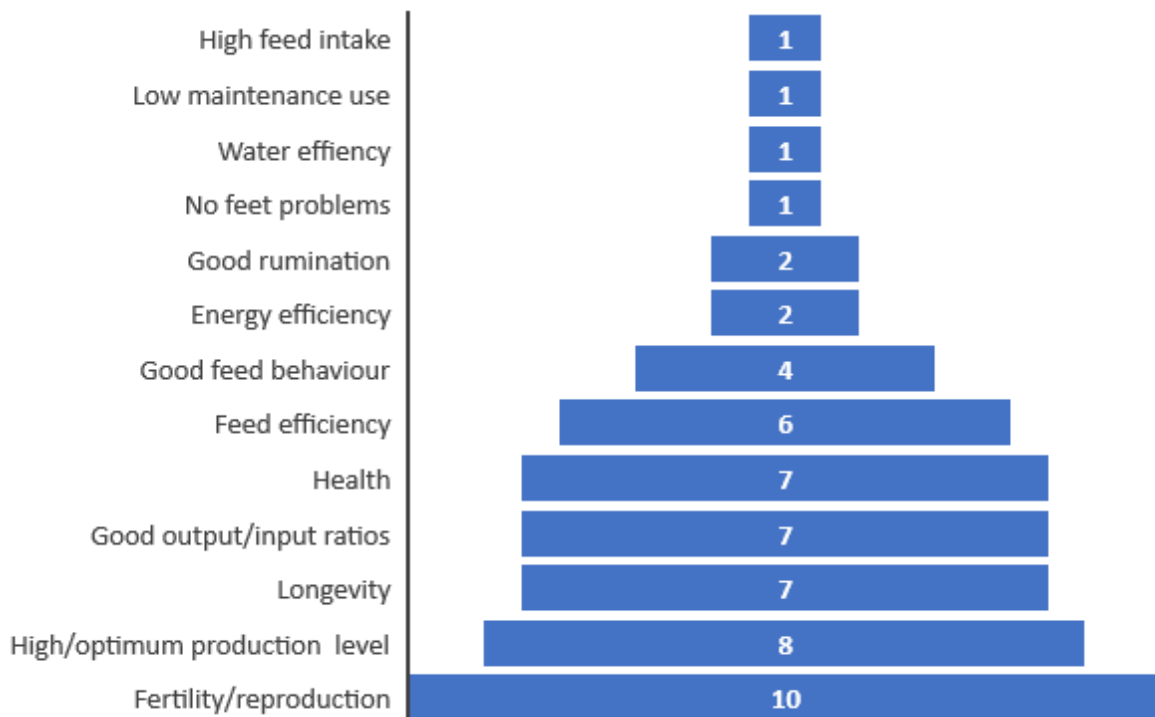
Other stakeholders mentioned that a resilient cow is maintaining high (re)production levels (19%). Other features in the definition of a resilient cow were a proper energy allocation of the cow (“an efficient cow is able to make the proper choices herself to allocate input energy from feed into production”), and to not require any drugs. One of the stakeholders mentioned a resilient cow is solely a high (re)production level.

- Proper allocation of input energy
- No antibiotics
- High (re)production
- Good FCR
- Maximum output for minimum input (feed, labour etc.)
- High lifetime energy efficiency
- Low nutrient input high (re-)production output



**4. What are the main qualities of an efficient cow, please cite at least 3 of them?**

High fertility (18%), high/optimum production level (14%), longevity (12%), and good ratio



between any type of output and input (e.g. nutrition, labor) (12%) and health (12%) are

mentioned most often as important qualities for an efficient cow. This is followed by feed efficiency, and good feed behaviour. It should be noted that stakeholders often mention that these qualities should be maintained across different environments and under any type of environmental stress. Some were very specific in their answer, e.g. an efficient cow gives “at least 6 calves per cow on average, more than 70% of production based on grassland - as much as possible pasture, no extra costs beside of feed and housing.”

**5. Do you think these traits will become more important in the future and why?**

All stakeholders, except one, think these traits will become important in the future. (No reasons given).

**6. What are your specific needs on these Resilience & Efficiency? Do you expect new indicators? New tools (e.g. for ranking animal? / for reproduction management ...)?**

Nearly all the stakeholders mention there is a need for advice and tools to be integrated in farm management and aiming to ensure resilience and efficiency. Furthermore, many stakeholders mention the need for new indicators (e.g. based on genomic index) or new measurable traits. Such new indicators and traits need to be based on data accumulated across a wide range of environments. Particularly mentioned traits:

- **Detection of production diseases**
- **Feed efficiency**
- **Methane production**
- **RFI**
- **Index for health and functional traits**

Such new indicators and traits need to be based on data accumulated across a wide range of environments. Other things mentioned were that we need more field data, and MIR was suggested to be a promising tool.

### 3.2 Results of Stakeholder Speed Dating

All stakeholders had the chance to discuss the GenTORE project and the future plans with all the WP leaders and the Project Coordinator. After having listened to all the WP presentations and one-on-one discussions including a brief overview and it's expected outputs for stakeholders, the overall recommendations of the stakeholders could be summarized as below:

➔ **WP1 Production system metrics: Assessing the systems context**

- System specific advice to advise dairy farmers on genetics and breeding and culling strategies is important.
- Connections to the project and the potential use of system characterization data is needed.
- Possible use for intensity and / or climatic index could be foreseen.
- Emphasis to more organic production would lead to diversity of systems.
- Trials for selecting the best breeding lines in Holstein is important, but also resilient cows should be taken into consideration. Because selection for best is more than just milk yield
- Increasing the link to stakeholders, national contacts and media are needed for better communication to the end-users and the society.
- Assigning a specific person as spokes-person per WP would increase the efficiency of interactions.
- How to use phenotyping data should be made clearer.

- National cattle breeders' evaluations working with different pure and cross-breeds is important for the accuracy of the results.
  - Responding to decreasing beef breed output and increasing dairy X beef output could be considered.
  - Breeding companies could be interested in the possibility to benchmark/rank against other farms.
  - Economics play a key part of efficiency analysis. Can we answer the question about how does capital intensity vary?
  - Climate is variable, use of scales of efficiency per region could make a difference.
  - Providing predictions of the future, e.g. less farms, increased herd size would be interesting for the industry.
  - Linking data across variable environments could be considered.
  - Use of concentrates and assessment methods of heat stress could be included.
- ➔ **WP3 On-farm tools to phenotype proxies of R&E**
- GenTORE needs to start the discussion on data ownership
    - *raw data needs data reduction – towards alerts*
    - *who owns the data, and how do data become accessible for:*
      - *veterinarians: advice on farm*
      - *farmers: save time*
      - *breeding companies: evaluation*
      - *nutritionists*
  - WP3 needs to continue discussion on trait definitions with stakeholders
    - *need to start that discussion with*
      - *farmers*
      - *vets*
      - *nutritionists*
      - *animal breeders*
    - *WP3 needs to develop the method, but parallel this discussion needs to be continued in order to ensure that the results are implementable and applicable and of use*
- ➔ **WP5 Genome-based management indexes; on-farm tools to optimising replacement strategies taking into account expected life-time R&E in dairy and beef cattle**
- The importance of environmental effects shall not to be treated as fixed effect but as a gradient.
  - The importance of the culling index development for beef is stressed.
  - It would be useful to include more parameters especially health in the indexes.
  - The researchers should keep themselves up-to-date on the discovery of the lethal haplotypes for inclusion in the mating advice algorithms.
  - Companies are interested to know what their customers approaches are to mating advice algorithms.
- ➔ **WP6 Modelling tools to predict outcomes of possible future scenarios**
- Farmers' groups, 1-2 group in each country could be set up to build up future scenarios for modelling in WP6.
  - Farmers need straightforward information linked to management action; therefore, WP6 results look more suitable for advisors and could work with larger producers.
  - There are important developments that should be taken into consideration during GenTORE project.

- *Efficient farms will survive, though the efficiency might be arising in other parts of the farm, not within the animal (e.g. feed production).*
  - *Specific for farms/regions, e.g. in Ireland labour is an issue now (more cross-breeding, i.e. more labour needed); veganism and animal welfare (culling calves) is also an emerging issue (the latter particularly in New Zealand, therefore they grow more and more beef x dairy instead of culling, and as a consequence dairy cow numbers are dropping).*
  - *There is more and more demand for higher animal welfare (e.g. development of 'smart floors'), and also for better environment protection.*
  - *The policy and social levers are important, and sometimes they have unintended consequences (e.g. in the Netherlands there is a huge pike in cattle 'twins' as a heifer+2calves = 1 LU, and heifer+calf = 1LU but heifer = 0.5LU).*
  - *WP6 provides motivation to uptake tools in WP5 (WP6 answers the "Why should I?" question) – it can motivate the vets to motivate the farmers; capital investments on a farm is usually once in a generation, in these decision points they guess future herd size, etc., so these are the points when changes can happen.*
  - *WP6 could also speak to banks and insurers as they are important at those decision points. However, banks suggestions/decisions would only be based on financial accounts, as the agricultural financial advisors are now gone.*
  - *It is also important to take into account the change in a generation on how the decision are given differently (e.g. family change, seeing things at peers).*
  - *Social demands on animal welfare, environment is getting more important; volatility of market is also an issue (e.g. milk prices).*
  - *It could be a good idea to find 1-2 real farms which match with the modelled scenarios and results and these can be presented as case studies.*
- ➔ **WP7 Outreach, dissemination and training**
- *Identify national umbrella bodies that are not genetics like Agricultural & Horticultural Development Board (UK) & British Cattle Vet Association (UK) and Nutritional groups to help disseminate info and maybe get feedback. Need to approach consulting vets (talking to farmers) through informal routes.*
  - *In order to report GenTORE activities semen companies (AI Technicians) / Teagasc / cattle breeder associations could be contacted.*
  - *Evolution have 30000 client farmers and 1300 AI Technicians who farmers trust so latter are ideal target for GenTORE info/training. They run meetings 4x's year that could be good for training in French.*
  - *Popular media needs short 'pieces' that can go in international, national, public or farmers specific journals.*
  - *Creating links with popular press journalists (e.g., newflashes) and preparing newflashes after each WP-leader Skype with short updates of each WP to be sent to a selected group of journalists. They can then decide on the right time of publishing (popular press) and contact the appropriate researcher(s).*
  - *Good vet network and regular UK group meetings are organised by RAFT which could be used to contact practitioners. There could also be an opportunity for reporting and training.*
  - *It is important to create strong links with Zoetis who should be encouraged to become a stakeholder to give European network.*
  - *Setting up of a GenTORE Whatsapp group for stakeholders could facilitate instant interaction with each other.*
  - *Using Coops/AI companies for communicating and disseminating the project results to different level stakeholders could be very beneficial.*

### 3.3 Results on Stakeholder DigiWeek

In October 2018 (M17), a DigiStakeholder Week was organised and promoted through all social media channels and website. The idea behind this event was to collect more recommendations and feedback on GenTORE tasks and activities through the discussion forum on the E-Stakeholder Platform.

Several experts within the GenTORE project made themselves available to answer questions and have discussions in this E-Platform. Specific topics were allocated per day for the whole week as given below;

- MONDAY: What is resilience? Is resilience important for the farmers in your production systems?
- TUESDAY: How can we measure resilience, with and without sensors?
- WEDNESDAY: How well can we measure feed intake and efficiency, with and without sensors?
- THURSDAY: Is it worth considering genotype environment interactions for resilience or efficiency?
- FRIDAY: How valuable would be tools that allow the farmer to have a ranking of his animals on their probability of completing the next production cycle?

Discussions on these given topics are available to all new members of the Stakeholder E-Platform.

As a result, the number of stakeholders registered to the forum has increased 64% (46 to 73 members) during the DigiWeek on-line forum discussing stakeholder perceptions of resilience and efficiency and their value in practise. A total of 60 messages were shared during the DigiWeek.

The E-stakeholder platform is facilitated through the service provider Muut which doesn't share the emails and personal information of subscribers due to GDPR. Therefore, it is not possible the map of the audience.

The main results from the discussion are summarized below;

- *Is resilience related to personality ie an animal's attitude and thus should I be selecting the dominant animals in a herd and these probably get the best food and conditions where they have a choice. Could personality be a good indicator of 'best' animal?*
  - An animal's personality (timidity, willingness to explore, etc) affects how it responds to perceived challenges at a behavioural level, not sure if there is a link between this and its ability to respond to perturbations that impact more its physiology (energy deficit etc). Fortunately, a number of the monitoring technologies that are now available directly measure behaviour elements such as time spent feeding.
  - Animal behaviour can be described with coping style. There are differences in traits related to resilience between animals classified as active or passive. An example: Stronger antibody response to an 'antigen cocktail' was found in piglets with a passive coping style than in piglets with an active coping style.
  - Dominant animals get the chance to get the choices in term of space and other environmental factors but in term of feed are often at a risk of overfeeding particularly when the TMR is not well prepared and homogeneous. Rumen acidosis is a greater risk factor for dominant than for subordinate cows.
- *What is a resilient animal in the context of animal breeding? An animal that is able to manage energy and resources to cope with an external aggression with the consequent*



*reduction in production, or an animal that is able to maintain its production at the expense of the deterioration of its fitness.*

- The definition originally proposed in the GenTORE project is: “The capacity of an animal to respond to environmental perturbations... and thus safeguard future ability to contribute genes to the next generation”. It implies abilities to be able to absorb an environmental challenge through buffering mechanisms, and/or modulate the allocation of available resources to life functions, down prioritizing those that are non-vital and up-prioritizing those that are needed to meet the challenge.
- Therefore, a reduction in production ability is expected. Are farmers willing to select more resilient animals? Is this a priority for them or they prefer to increase production (yield and also quality)? When we talk about resilience we are referring to the ability of animals to adapt to future challenges. Will be these animals producing 10'000 kg able to maintain the production if, for instance, temperatures increase 1-2 degrees Celsius?
- GenTORE aims to optimise resilience and efficiency.
- *Is it possible to select for resilience in general? What would be the definition of general resilience and how we could measure it? Could this be a good strategy?*
  - Resilience depends on many things: species, breeds, environment but also on production systems. For the same breed what does make an animal more resilient will depend on the challenges he has to face up, and these will be, for example, different for extensive and intensive systems.
  - The majority of the evidence shows that the environments in which livestock find themselves will become more and more variable so they will need their resilience!
  - Although we can agree on a general concept, I think that we may end up working back from actual measures such as the within-individual variability in liveweight or milk yield or activity profiles across lactation (or the growing period) and seeing whether this variability when examined at population level correlates with animals that lasted longer in the herd. That would probably be a step towards quantifying general resilience.
- *How can we measure resilience, with and without sensors?*
  - Often, on-farm technologies are developed and targeted for monitoring specific events, or they monitor something that is not specific but are affected by more than one event. I expect a combination of a number of (general and specific) sensors will be required to capture very complex traits as resilience and efficiency.
  - I consider absolutely promising the strategy to use sensors in order to provide proxies to measure resilience trait. In my opinion, the big challenge of this strategy will be the harmonization of the outputs from different type of sensors.
  - Incorporating and enhancing farmer impressions would be a very good way to ‘sell’ any new rankings.
- *How well can we measure feed intake and efficiency, with and without sensors? Can on-farm technologies provide reliable proxies of feed intake? or at least allow ranking of animals on feeding characteristics?*
  - A Danish group has presented a method based on 3D-video cameras at WCGALP 2018. This could be an efficient way to record feed intake in all cases where an animal eats from a food-pile (i.e. not on pasture).
  - In an Austrian project they estimated feed intake from cow weight and other parameters that are easily recorded in the field. The use of scales placed in commercial farm feeders, combined with electronic identification is an option in high concentrate diets (as feedlot cattle in the south of Europe with 90% concentrate). They work and provide interesting data though the problem is processing these data and filtering the “correct” information. But its reliability when forage is the base of the ration is questionable.
  - It also seems that accelerometers may be able to provide intake estimates of grazing animals based on head movements.



- *Should we consider genotype-environment interactions for resilience/efficiency? How are GxE interactions going to be measured? And how will it be included in genetic or genomic evaluation?*
  - You could have a trait as the number of times the individual shows a deviation in their performance trajectory, as a function of the number of perturbations in the environment, or any environmental parameter that provides a proxy for the number of perturbations. Alternatively, having a deviation or not on specific moments in time could be modeled (longitudinal) as a function of the presence (or not) of perturbations at this moment. Or, again, as a function of a proxy thereof.
  - The problem is that we do not have a performance recording for deviations caused by perturbations. The first step would be to define and to model those deviations. Then we could set up a recording system and based on the recording a genetic/genomic evaluation. Only then we will be able to modify our genetic/genomic evaluation model to accommodate GxE. So the first challenge is to identify perturbations in a large number of herds and to record the deviations caused by those perturbations. Remember that milk recording is performed once a month and the effect of the perturbation might already have disappeared at the day of milk recording.
  - With the increasing use of daily milk yield recording (and walk-over weighers) we can expect data from many more animals.
- *What about tools for the farmer? How valuable would be tools that allow the farmer to have a ranking of his animals on their probability of completing the next production cycle?*
  - As a farmer I am only interested if I can see a benefit over cost and say the tool identifies the top 40% middle 40% and bottom 30% so I can select. Could a tool eventually identify those animals that would fail to complete the current cycle to a satisfactory standard so I could cull them before they were obvious.
  - Strategic culling decisions is also a breeding activity. And with more resilient animals (higher breeding values for resilience) there will be more room for such culling decisions.
  - A tool that will rank cows and inform farmers decision making on breeding and culling decisions would be a great asset and really promote the breeding of the more resilient animals on that farm.

### 3.4 Stakeholder Telephone Conference

A Stakeholder Telephone Conference focused on the expectations of breeding and data evaluation organisations from GenTORE and its stakeholder activities. A summary of the recommendations given and questions risen are given below;

- The stakeholder session during the 2<sup>nd</sup> Annual Meeting of GenTORE should focus on “What is in the interest of the end-users and how can this be made available?”.
- Data evaluation organisations are interested in learning how they can provide the breeding associations with answers on GxE questions, measuring feed intake and methane emissions. How could GenTORE support end-users in modelling phenotypes to the whole population?
- It is necessary to overcome the gap between research and breeding organisations. There is a need for herd and population level models that could be applicable in genetic evaluations. In particular, operational measures of resilience proxies in large populations is lacking.
- It is necessary to give “take home” messages for next steps in developing new models/phenotypes to overcome culling problems.
- It is important to keep the knowledge exchange between GenTORE and the stakeholders. There could be short poll questions put on the website and sent to stakeholders which they would also disseminate to their own network. Another option could be to prepare online interactive courses to enable the uptake of results. Fact

sheets are also important sources of communication and dissemination in particular in explaining the end-users why is it important for their daily activities. By making use of the power of social media channels like Facebook and Twitter it is possible to reach out to more stakeholders and end-users.

### 3.5 Results of Stakeholder Session

All stakeholders had the chance to listen to WP1 and WP3 presentations and had brief overview of the progress of GenTORE. There were also two different stakeholder presentations followed by a plenary discussion session. Lastly WP1 has presented the survey results. The main discussion questions and comments made during the plenary discussion are given below;

- How can we measure efficiency?
  - Efficiency is input/output. We need input to measure efficiency. The most relevant way to do is through measuring feed intake with different sensors and accelerometers. But there is a need for a comparison for these on accuracy of records vs. volume. It is important to map the important efficiency traits, feed or production efficiency. Feed efficiency is an important trait for the farmer due to its monetary value. The available data sources are needed to measure efficiency. Outcome of the current sensors are mostly used for measuring milk yield. Can we measure feed intake by measuring eating time?
  - If production efficiency is discussed it means how efficient the farm is producing. Then there is the digestion and metabolic efficiency. Therefore, what data do we need for other possibilities to be measured? And what increase of production efficiency should we have?
  - Do we talk about efficiency in animals, area, per unit concentrate, roughage or CO<sub>2</sub>? Or per unit of food competing feed stuff relative to human edible protein, edible protein per product? These are theoretical questions since we can't think it without the economic impact. A solution is binding the economics to efficiency. Therefore, we can define efficiency as the animal which produces with less problems in economic terms.
  - But the question is what is the level of accuracy needed for measuring these. If the heritability is 0.20, can we achieve anything with accuracy of 60% measurement? Even if the correlation is low and it doesn't change the ranking of animals, it is still interesting.
- What are the environments that our breeding takes place in? Are there better breeds that are resilient to future production, organic or conventional?
  - Cattle breeding strategies in Switzerland are healthier, fertile, efficient and roughage adapted cattle. There are some actions to increase R&E like use of dual purpose breeds, functional traits, EBV feed saved and feed efficiency project. Weather data is also controlled and farm networks are created to record pheno & gentotypes intensively. However, heritability, genetic correlation to traits like yield, health, fertility and feasible recording schemes must be fulfilled. Decrease of costs, animals needing less attention time and image of the sector in consumers' eyes are opportunities. On the other hand, there are risks of auxiliary traits, proper data collection, increased costs and IT intensity of further data collection and recording. More information is needed on environmental effect. Including other traits and having them on herd level rather than regions.
  - Can this typology be used at herd level? It could be allocated on herd level. On a genomic level NUTS level must be sufficient. Economic efficiency is from FADN.
  - In the future if GenTORE is able to extract the regional effect it will be a challenge to put it to practice.

- What will we give to the next generation? In 20 years, what do we want to achieve in R&E in the context of sustainable cattle production?
- Clear definitions on resilience traits on beef are necessary for the industry. Field recording schemes and genetic parameters are expected from GenTORE. It could be useful for breeders if they could decide on which semen to select (sexed, beef, dairy) based on on-farm phenotypic data. Decision support tools that T5.2 will provide will be important. In future fertility may change with resilience in the total index.

### 3.6 Fitter Livestock Farming session at ATF Meeting

The discussion with the audience was based on the question “What R&I is needed to support climate mitigation and adaptation in livestock farming?”. The responses from different level stakeholders could be summarized as below;

- *Using data is the key to a holistic approach required to make livestock more sustainable. Linking health and management data with the environmental data is the key issue. Some breeding companies do not share their data, they are hesitant to give their resources.*
- *There is a need of incentives to spread the use of genomics, to facilitate incorporation of data from on farm technologies, to encourage practical use of decision support tools for reducing farm environmental footprint.*
- *There is more support needed for R&I development of methods linking climate data with disease occurrence and further implementation of these applications to prevent and manage climate associated diseases.*
- *The outcome of these projects could be shared with the breeding industries.*
- *The livestock production sector is communicating too little to society. Civil society – citizens and consumers need to be involved actively from the start of the projects. Someone professional is needed to communicate to civil society. Our approach should differ according to different stakeholders. The gap between the citizens and consumers should be reduced through better communication.*
- *A trustworthy regulatory framework is needed.*

Recordings of the session and panel discussion are available from GenTORE website <https://www.gentore.eu/videos.html>

### 3.7 Results of Questionnaire “What could a future cow look like?”

In total, 20 respondents answered the beef questionnaire and 24 respondents answered the dairy questionnaire.

According to the respondents;

- *prevalence of diseases and lameness will decrease for both dairy and beef animals. This result was clearer for beef than for dairy.*
- *Difficult calvings will become less common, but the respondents seem less optimistic about the calf’s ability to survive.*
- *Longevity will improve for both beef and dairy cows, and so will the survival of young beef animals until slaughter or first calving, whereas no clear result was found for the survival of young dairy animals.*
- *Most respondents predicted that age at sexual maturation will not change. For other reproduction traits, a genetic improvement was predicted for beef cows, whereas no clear result was found for dairy cows.*
- *Most respondents predicted that adult size will not change, but some predicted smaller and others larger animals.*
- *Most respondents predicted that dairy cows’ temperament will remain as today or improve (more docile), whereas the result for beef cows was less clear. For the animals’ social behaviour in groups, no clear results were found.*

When it comes to traits related to feed, the results were similar for beef and dairy animals;

- *the ability to thrive on pasture will increase and the animals will become more efficient so that they need less feed (both high nutrient and roughage type of feed) per kg milk or meat.*
- *In accordance with those predictions about efficiency, the manure will contain less nutrients. Methane emissions per kg meat will decrease for beef animals, but the respondents were less optimistic about methane emissions per kg milk for dairy animals.*
- *According to most respondents, the animals' water consumption will not change.*
- *Tolerance to heat stress will increase, as well as the animals' ability to handle other environmental disturbances such as temporary feed shortage.*
- *Most respondents predicted that beef animals will demand the same amount of work hours by the caretakers as today, whereas the result for dairy animals was less clear.*
- *A majority of the respondents predicted that future animals would demand more knowledge and skills of caretakers, but there was a wide range in these answers, especially for dairy animals.*

The main cause for the predicted changes was, according to most of the respondents, developed statistical models for genetic analysis, followed by developed methods such as genomic selection and gene tests, and changed breeding goals. Most respondents did not believe that changed breeding activities, such as dairy-dairy cross and embryo transfer, was a main cause for the predicted changes.

Birth weight and carcass conformation were included in the beef questionnaire but not in the dairy questionnaire. These traits were mentioned as additional important traits likely to change in dairy animals. In parallel, milk quality (nutrition for the calf) was mentioned as an additional trait for beef animals.

### **3.8 Results of Workshop “What could a future cow look like?”**

#### *Future animals*

If the genetic potential for milk yield stays at today's level, smaller cows would need less energy for maintenance and thus be more efficient, at least in the short-term. One group discussed the genetic change in adult size, a trait for which the predictions in the questionnaire showed a wide range from smaller to larger. In a roughage-based system, a lower feed intake may, according to this group, restrict production traits in small cows. The results of the questionnaire indicated that the cows' genetic predisposition for methane emissions will not change and this was discussed as a disappointing and surprising result, since low climate impact is seen as an aim of GenTore. Furthermore, the genetic correlation between longevity and methane emissions is favourable, which would facilitate a favourable trend in methane emissions. New possibilities to select for cows' ability to host a climate friendly microbiome were also mentioned.

Calf mortality has, in spite of a low incidence, a high impact on efficiency at the herd level. If future animals are kept in more extensive systems with less surveillance, both calving ease and calf survival may become more important goal traits. It was therefore surprising that the questionnaire indicated that calf survival will not improve genetically. The results from the questionnaire, pointing towards lower disease prevalence in both beef and dairy animals, were agreed upon in the groups. One group stated that robustness describes how animals stay healthy and resilience how animals recover. In addition to health, resilience also includes reproduction and longevity. Longevity will according to the questionnaire and the group discussions improve for both beef and dairy cows. For reproduction traits, a genetic improvement was predicted in the questionnaire for beef cows, whereas no clear result was found for dairy cows. In the group discussion it was said that GenTore ought to result in an improvement of reproduction. Maybe the need for improved reproduction is more obvious for



beef cows, since the income is more closely connected to calving there than in dairy production. It was also said that in beef production, farmers producing calves ask for genetic improvement in cow traits (reproduction, longevity, calving ease) whereas farmers raising calves for slaughter ask for genetic improvement in growth rate and feed efficiency.

Some groups tried to predict genetic trends resulting from implementation of GenTORE's results. Longevity was predicted to improve with 0.1-0.3 lactations per year. In another group the reasoning was that keeping disease prevalence at today's level would be a good result; these are low heritability traits and a progress in longevity results in older cows which are more prone to disease. It was also mentioned that better recording methods would facilitate genetic improvement in disease resistance.

Some trade-offs between potential goal traits were discussed: longevity – feed efficiency, birth weight – carcass conformation and appetite – methane emissions. The result from the questionnaire, implying that feed conversion ratio would improve in parallel with appetite intake was discussed and a link to decreased reliance on concentrates in the future was proposed. A trade-off between use of low quality feed and pasture on one hand and efficiency and climate impact on the other hand was also discussed.

Several groups questioned the breeding goal for dairy cows which today is focused on milk but not meat. Do we need a future cow for each type of food or rather a dual-purpose cow with a high genetic ability to produce both milk and meat? Such dual-purpose breeds are common in organic production e.g. in Switzerland today. The use of beef semen and sexed semen in dairy herds was also discussed in relation to the combination of meat and milk. One group stated that genetic improvement of meat production traits is a key to improved resilience in dairy herds.

Talking about breeding activities, one group mentioned that although genomic testing is more and more available, competing companies not willing to share data may reduce genetic progress. The importance of recording methods and phenotypic data was also highlighted and several groups saw new possibilities with sensors, cameras, accelerometers and new technology for data recording in the milking robot. New phenotypes will pave the way for new breeding goals. Changed breeding goals is, however, not the most important tool for creating the future cow according to the respondents of the questionnaire. Instead they identified developed statistical models for genetic analysis as the main cause for the predicted genetic changes, reflecting perhaps the high number of participants from breeding companies and genetics research groups.

#### *Future environments*

One group predicted that future feeding systems will include more grass (not necessarily more grazing but less corn silage and less concentrates), due to increased problems with crop diseases but also stronger debate about food-feed competition. Changes in production systems will be driven by consumers (resulting in niche markets) and by politicians aiming for a more sustainable food production. One group described two future systems in the same country: an intensive indoor system with large herds and silage feeding, and an outdoor system with grazing. Longevity would be a key trait in the first system and reproduction in the second system. The proportions will differ between regions; from mostly indoors e.g. in France to mostly outdoors in e.g. Ireland.

Many groups talked about production system differences, both between and within countries. If the questionnaire should be used on a larger scale, it would be interesting to include a question about the 'home country' of the respondent. In one group it was said that easy calving





and disease resistance would have a positive impact on resilience in all systems, but the impact of traits like feed efficiency and nutrient content in manure are highly dependent on the production system. In the questionnaire, the respondents were asked to assume that all questions dealt with the same animal (the same breed). Given that diverse farming systems and region-specific environments exist in Europe – should one type of animal fit all or should different regions and systems have genetically tailored animals in the future? On a question about future cows' water consumption (amount of water needed per animal and day in the future) some respondents predicted 'much lower' and other respondents predicted 'much higher' and it was hypothesised that this reflected different expectations between respondents from northern and southern Europe. The importance of different breeding activities for the genetic progress was also discussed in the perspective of heterogeneous production systems. For a small cow breed like Jersey, sexed semen and beef semen may be more interesting than for e.g. Holstein.

At the short discussion with all participants in the end of the workshop, the importance of including meat production traits in the breeding goal of dairy breeds was highlighted. It was questioned whether the respondents of the questionnaire answered what *will become* the result of GenTORE (as they were asked to do) or if they rather answered what they would *like to see* as a result of GenTORE. Another comment about the future was that for some production systems it is more relevant to change to another breed than to change the current breed by selection. There seemed to be a consensus regarding more diverse production systems in the future and related to that an increased need to select animals for specific production systems. It was also mentioned that the severity of trade-offs between efficiency and resilience is influenced by the production system.

### **Conclusions**

As a result, the stakeholders were consulted twice in year 1, 3 times in Year 2 and Year 3 of the GenTORE project.

During the stakeholder survey, different stakeholders shared their ideas on what resilience and efficiency mean to them, how would a future cow look like and what they expect from these traits.

The stakeholder meeting during the 1<sup>st</sup> Annual Meeting of GenTORE together with the speed dating with WP leaders provided quite a lot of different insights to the planned activities and topics to be considered during carrying out the researches and making up the models and indexes.

The three other consultations that was organised in Year 2 gave the impression that more stakeholders need to be involved at national and regional levels. In particular communication and dissemination activities towards end-users such as breeding associations, breeders, farm managers and vets, and farmers need to be planned and realized.

The consultations in the 3<sup>rd</sup> year were more supportive of GenTORE research to understand how the research needs to be shaped in the coming years to address main societal challenges and need to include the end-users at research projects to better understand the opportunities and barriers for new tools and methods.

The emphasis from the stakeholders during the face-to-face meetings were mostly covering how to better communicate with different groups stakeholders suggesting new methods, routes, links...etc to improve the connection.

The aim for the coming period of the project is to increase the interaction by using more proactive methods to liaise with the right audience groups at the right time. This will become easier as the results of GenTORE research become available for dissemination and discussion.

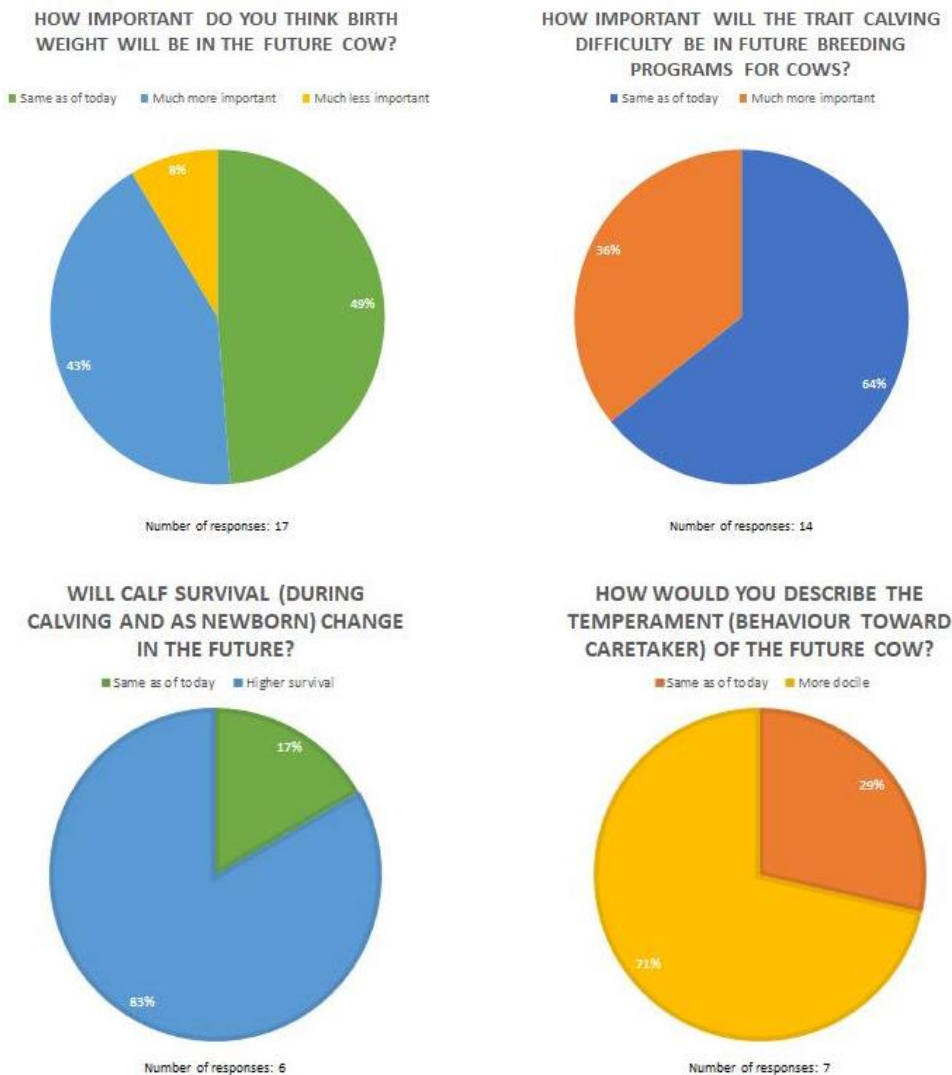
**Partners involved in the work**

All WP leaders were involved in preparation of the questionnaire. Partners involved consist of EFFAB, Project Coordinator and Manager, INRA, SLU/Interbull-FA, EAAP, FiBL, DLOWUR, AU, TEAGASC, SRUC, RAFT, Noldus, Viking Genetics, ALLICE.

**3.9 Results of GenTORE Online Stakeholder Consultation**

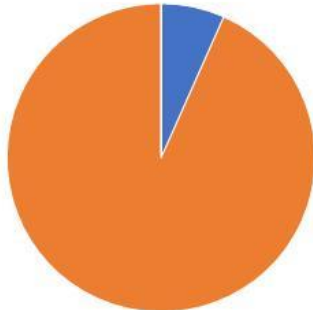
Actively inviting the stakeholders of GenTORE to participate in such polls is a good way of creating awareness on different aspects of cattle breeding, recent scientific developments and project in general. The overall result of posting polls was that we met the audience on an eye level and invited them to participate in the debate about the future cow.

The results to the online consultation were as below;





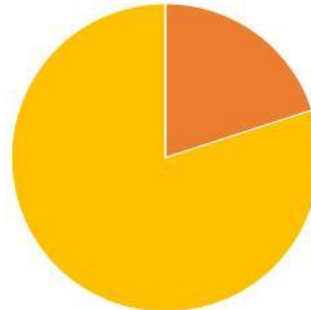
**HOW IMPORTANT WILL THE HEALTH OF LEGS AND CLAWS AND THE OCCURENCE OF LAMENESS BE IN BREEDING PROGRAMS FOR THE FUTURE COW?**



■ Same as of today ■ More important ■ Less important

Number of responses: 15

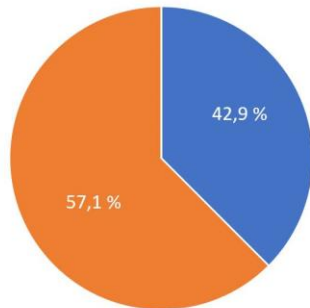
**HOW IMPORTANT WILL THE COW'S BEHAVIOUR TOWARDS OTHER COWS BE IN THE FUTURE?**



■ Same as of today ■ More important ■ Less important

Number of responses: 15

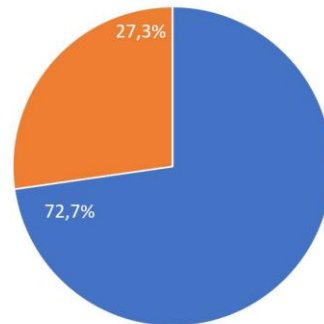
**How important will the knowledge and skills of caretakers be for maintaining health and production levels for the #FutureCow**



■ Same as today ■ More important ■ Less important

Number of responses: 7

**How important will milk quality and protein content be in #breeding programs for the #FutureCow**

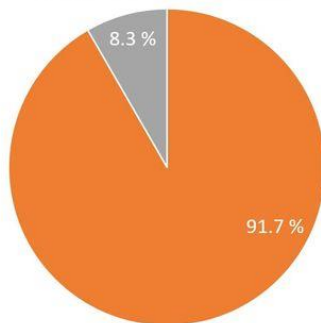


■ Same as today ■ More important ■ Less important

Number of responses: 11



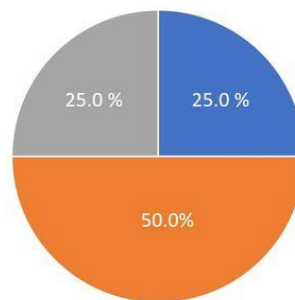
**How important will longevity become in #breeding programs for the #FutureCow?**



■ Same as today ■ More important ■ Less important

Number of responses: 12

**Will the amount of time demanded from #caretakers (e.g. labour efficiency) become more or less important for the #FutureCow?**

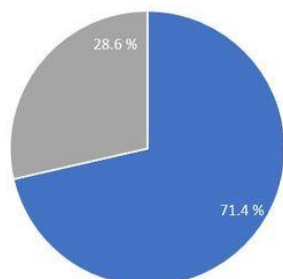


■ Same as today ■ More important ■ Less important

Number of responses: 4



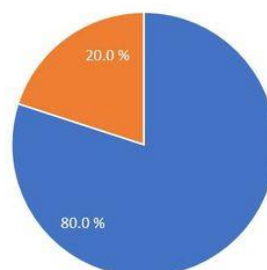
How important will #reproductive ability (oestrus, pregnancy, abortion) become in the #FutureCow?



■ More important ■ Less important ■ Same as today

Responses: 7

Will the #FutureCow be more or less affected by #environmental disturbances (e.g. Temporary lack of water or feed)?

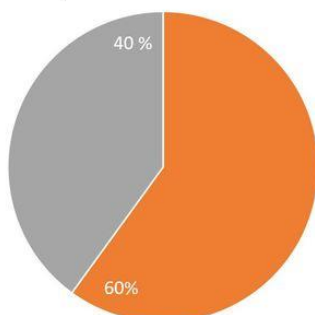


■ More important ■ Less important ■ Same as today

Responses: 5



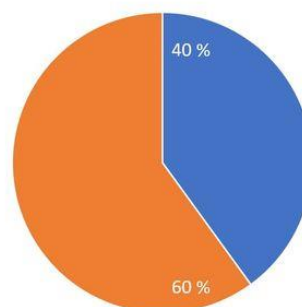
How important will adult size, as a #breeding trait, become in the #FutureCow?



■ Same as today ■ More important ■ Less important

Number of responses: 5

Will #carcass conformation of animals reared for #slaughter, become more or less important in the future?

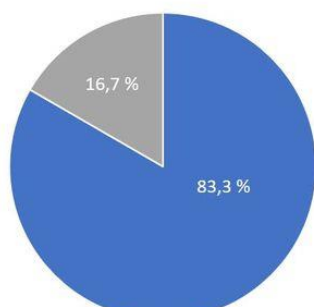


■ Same as today ■ More important ■ Less important

Number of responses: 5

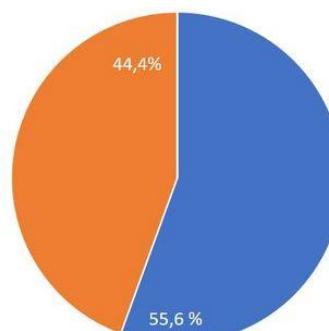


Will growth rate, from weaning to #slaughter, become more or less important in #breeding programs for the #FutureCow?



■ Same as today ■ More important ■ Less important

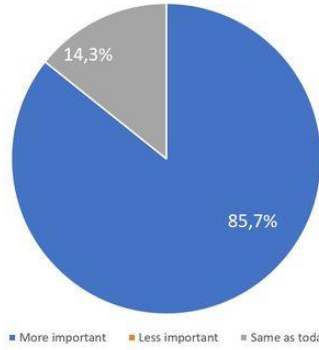
How important will sexual maturation become in the #FutureCow?



■ Same as today ■ More important ■ Less important

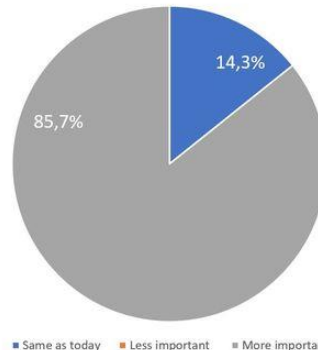


How important will feed conversion ratio (kg feed/kg milk) become in breeding programs for the Future Cow?



Responses: 7

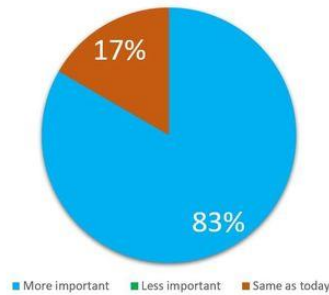
How important will the cow's appetite (voluntary intake of voluminous feed per day) become in the future?



Responses: 7

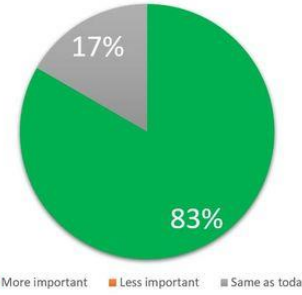


How important will feed quality become in relation to expressing the genetic production potential of the "Future Cow"?



Responses: 6

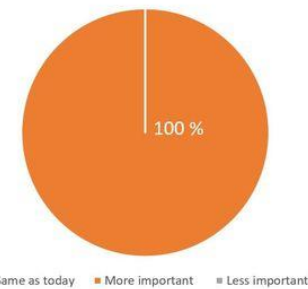
How important will the feed conversion ratio on roughage (kg roughage / kg milk) become for the "Future Cow"?



Responses: 6

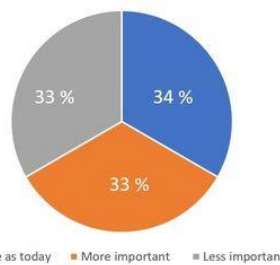


Will methane emissions (per kg milk), as a breeding trait, become more or less important in the future?



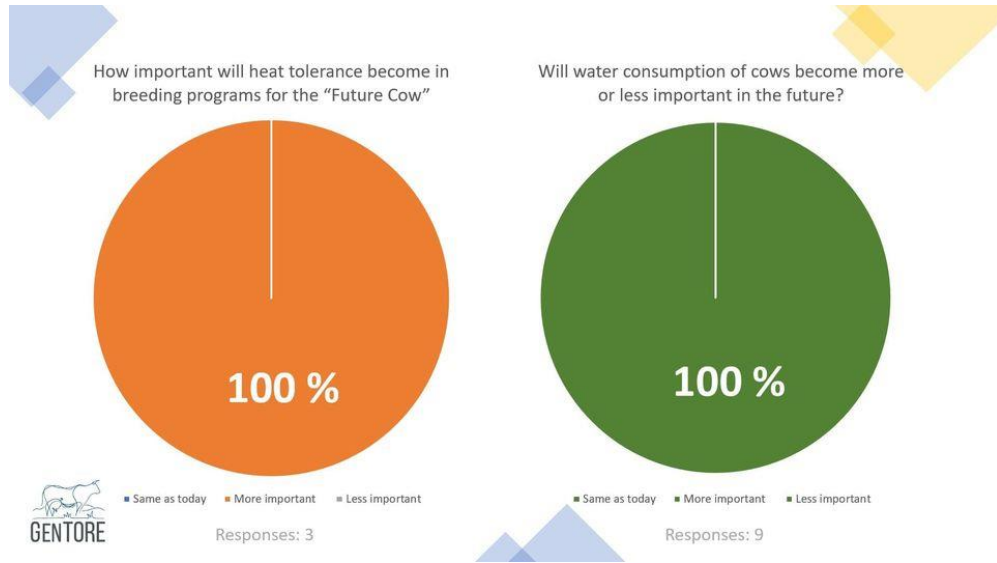
Responses: 12

How important will manure production (amount of nutrients per animal and day) be for the future cow?



Responses: 9

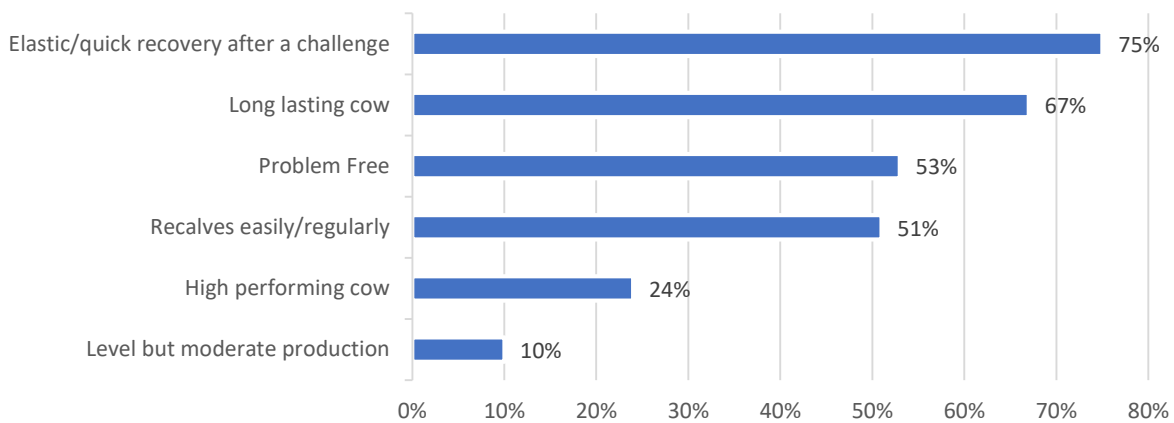




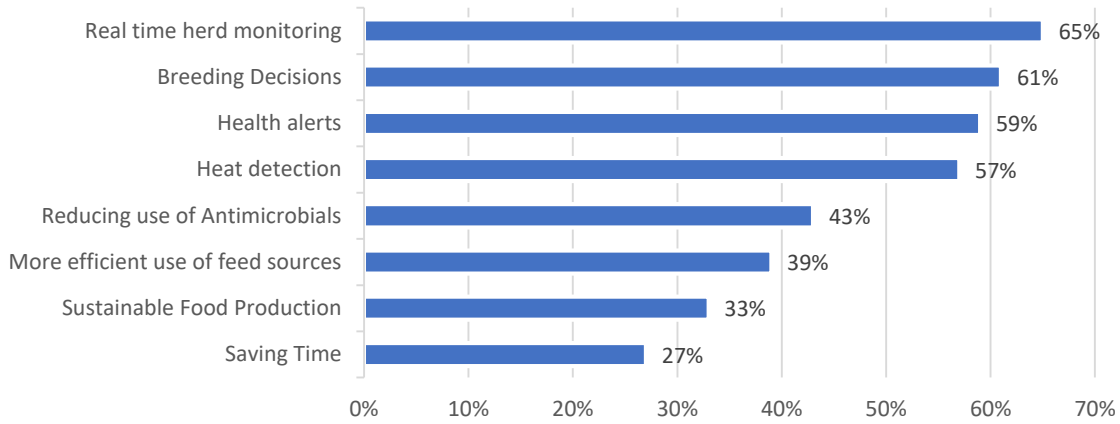
### 3.10 Results of the GenTORE 1st Training Workshop Consultation

During the training, 48 respondents on average answered the questions. The responses are given below;

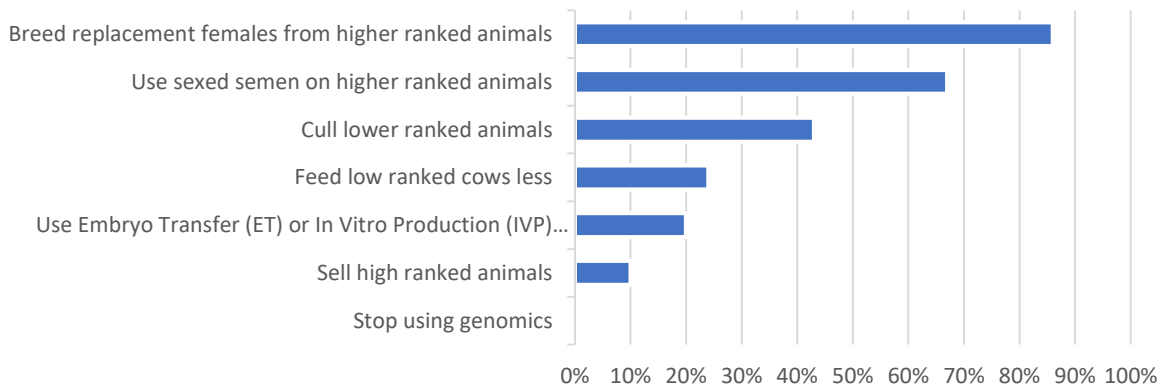
#### Q1: What do you understand by the term resilience?



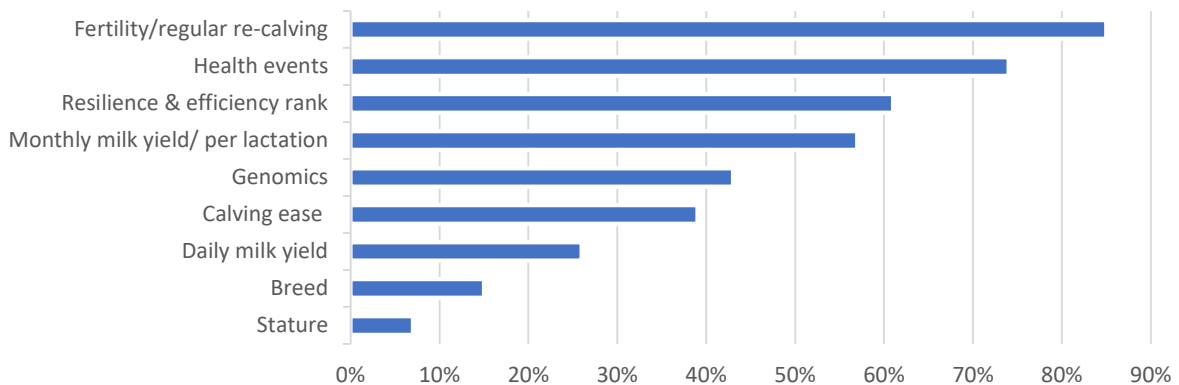
### Q2: What applications of PLF do you think are important in cattle farming?



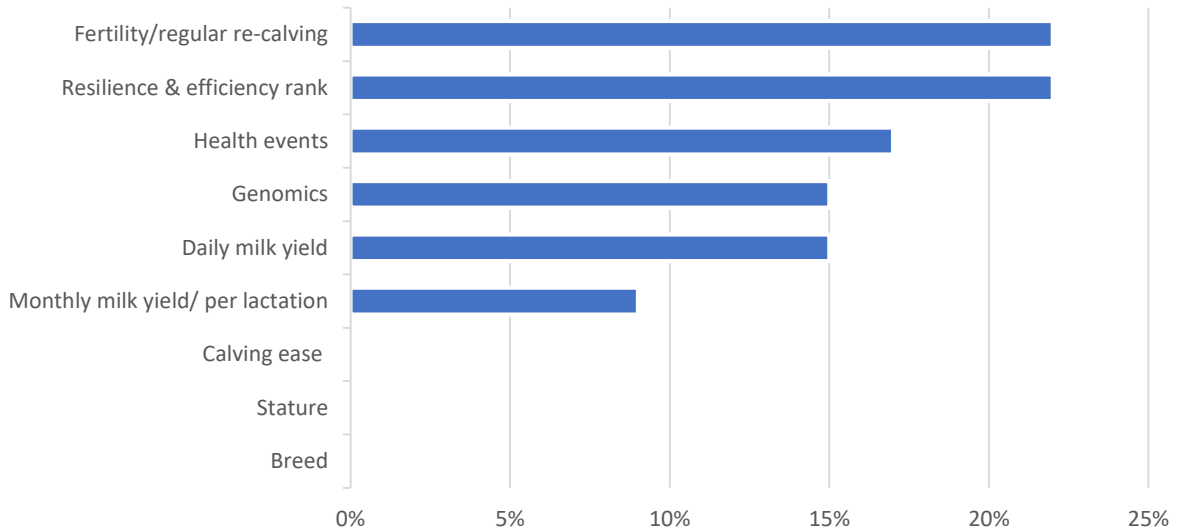
### Q3: What in theory could you do with information regarding predicting ranking of animals in a herd on resilience & efficiency?



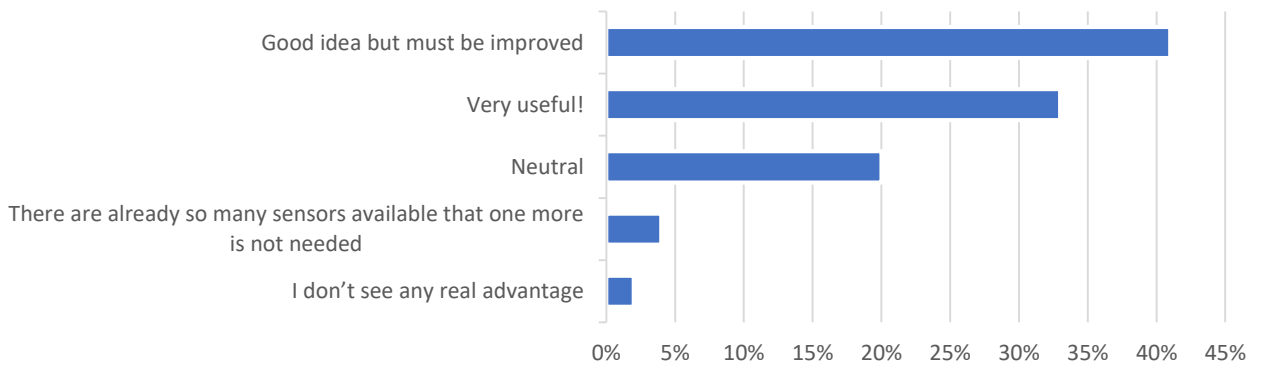
### Q4: What are the most important data parameters for making herd level breeding and culling decisions?



Q5: What parameters would you prioritise at individual animal level?



Q6: What is your opinion about the Resilience & Efficiency dashboard that GenTORE is developing as a decision support tool to be used in addition to the existing sensor systems?





**Annexes**  
**Annex 1 Photos from the 1st Stakeholder Meeting**



**Annex 2 Photos from Fitter livestock farming workshop**



**Annex 3 Presentation of results from Questionnaire “What could a future cow look like?”  
(attached as pdf)**