ATF Scoping paper Precision Livestock Farming

Introduction

This scoping paper presents the ideas of the Animal Task Force (ATF) about the use of Precision Livestock Farming within the domains of the key areas that merit research support defined in the ATF White Paper[1] (2013).

Livestock farming systems generate valuable and desirable products for the human diet including some from resources that cannot otherwise be converted into food. They also support the development of rural communities. Besides, they contribute to management of ecosystems and increase biodiversity and are in growing demand, globally, to meet changing dietary preferences for ever more affluent communities. However, the past also showed drawbacks of continuous growth of the animal sector such as challenges to the environment (through gaseous emissions, water and soil pollution and ecosystem damage), human health (through zoonotic diseases) and for the welfare of animals within the systems. This is part of the continuous societal discussion about the livestock sector. Hence future and present farming systems need to be (re)designed, discussed with society, integrated in a regional and economic context and give social and ethical value to the people working with and in these systems and value to the individual animals living in these systems. This is where the need of development and the application of Precision Livestock Farming (PLF) comes round. PLF is aimed at providing care for individual animals in larger groups, by adapting management of livestock to continuous automated real-time monitoring/controlling of production/reproduction, health and welfare status of livestock. As a result, it can be possible to give individuals animals exactly the amount and composition of feed on the right moment, to detect upcoming diseases in an early stage and provide preventive health care, and to detect the optimal moment for insemination to improve reproductive success.

PLF

Precision Livestock Farming includes the real-time monitoring of animals, the analysis of the gathered information and the transformation of the information to management actions. PLF is a key element for successful implementation of sustainability measures in the livestock sector. When integrated in the sector, PLF is a perfect tool to meet goals for more efficient use of resources combined with emphasis on better animal health and welfare with reduce use of drugs and to improve selection decisions for livestock by exploiting technological gains in these areas. This includes the identification and implementation of welfare indicators that are animal-based and selection for breeds that are well adapted to the specific livestock system. The combined use of genetic, genomic, metabolomic and phenotypic information to manage livestock is innovative, but new techniques for deeper phenotyping, including metabolic profiling, new parameters, sensor technology and remote sensing are required.

Bridging knowledge and relevant actors is crucial for advancing together smarter farming-systems by integrated breeding, feeding, healthcare, and housing. A main goal is to develop and share innovative pathways dedicated to high-throughput delivery of big data generation and analysis. Computer databases and data management and analysis facilities are necessary tools for handling the huge amount of data relevant to livestock production, and for simplifying the localisation, the extraction and the analyses of relevant information. Information gathered trough sensing leads to need of robotics, which is essential to collect data. Such research databases should be shared through common projects and will include data collected by precision livestock farming

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[1] The key areas for research identified in the ATF White Paper are Resource efficiency; Responsible livestock farming systems ; Healthy livestock and people ; Knowledge exchange towards innovation

technologies and classical performance data (dairy production, body weights, health proxies, real health parameters, welfare indicators, etc.). Innovative scalable management tools will facilitate the acquisition, the storage, the access and the links to other public databases such as climate databases. Scalable computer facilities will make available data mining tools capable of integrating and analysing huge amounts of diverse types of data from different sources. In this way, such shared data infrastructures are essential components of systems biology methodologies (heterogeneous data integration and modelling), serving as proof-of-concept projects to explore new polymorphic combinations of genomics, epigenomics and metagenomics and to better predict the adaptation of animals and their production systems. Such novel databases can act as models for shared infrastructures to combine new sources of data as they become available in the future.

How to make PLF work

One of the barriers to make PLF reality is the sharing of data. Farmers are reluctant to give access to their farm management and sensor data, including data on variation within soils, crops and livestock. They want to be in control of who can see and use the big data. Only a few farmers see that this big data can be used as a sign of Good Agricultural Practices and can become a licence to produce. Another challenge is that there is a need for access to good quality public data. New business models for sharing of data and open data sources should be developed to bring PLF to the next level and benefit from the opportunities that Big Data developments have to offer. Recognition of ownership of data is crucial. Also portals to facilitate exchange of data are a prerequisite.

Development of automated data sampling and analysis from the production chain including appropriate indicator traits and sensor data is key requirement for further optimisation of efficiency, health and welfare at animal and herd level. The opportunities to automatically collect data on a large scale have created major challenges for Big Data analysis.

The development of predictive biology approaches in PLF requires the development of mathematical decision support modelling (e.g. data mining and artificial intelligence), (wireless) sensor technology (including remote sensing and telemetrics) for monitoring biological, behavioural and morphologic parameters on animals and physical parameters in the buildings or at grazing, ICT-infrastructure (web based, databases), standardisation (e.g. RFID) and user-centric design methods to evaluate the benefits of combining data from different origins (biological, behavioural) and to improve the quality of the diagnosis and support. Research will focus on biological models and decision support tools. Data from different systems/sensors need to be made available for farmers and third party software developers. This will enable development of decision support software for integrated farm management independent of hardware vendors and allow combining data from multiple single signal systems. The goals are to create systems for the collection, collation and sharing of relevant data and the creation of protocols for the use of such data in software development for smarter farming systems.

By continuously fully automated monitoring, PLF could lead to:

- Increase of efficiency and sustainability of farming and livestock production
- Improvement of the health and welfare of the animals
- Quantitative information and complete traceability of livestock within the food chain.
- Reduce workload through automation and management of the exception (only the animal for which an alert is generated needs attention).

How to implement PLF
The Animal Task Force proposes to create a platform to link Big Data, High-Tech, Farm

Practice Innovations, and T&T Food Chain Quality Management (Figure 1). At the moment PLF is restricted to Engineering. The goal is to connect this part to the other three areas.
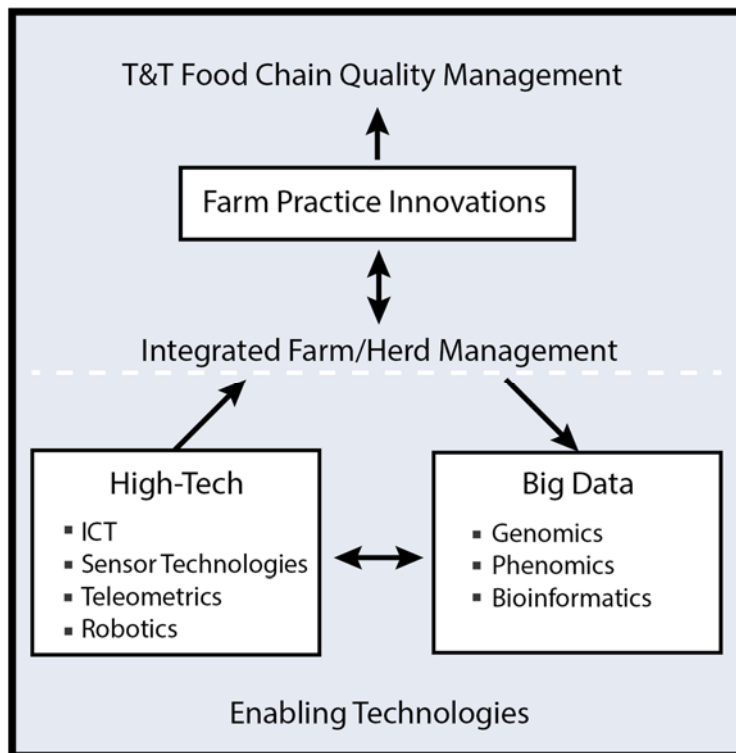

Figure 1. Implementation of PLF.

Our agenda 2015

This scoping paper is based on input from ATF members in a consultation round at the end of 2014. Through organising two sessions on the implementation of PLF, ATF strives to gain insight in the why, where, and how to implement and use PLF in practice in the future.

1. **ATF & EAAP Special Session**
   The EAAP & ATF Special Session will be held on August 31st, 2015 and will provide visions from both research and practice on PLF. The session will especially focus on how to implement PLF in practice. By splitting up the presentations in two sections; demand (farmer, industry, EC) and supply (research, industry, big-data expert), multiple facets of the implementation of PLF will be covered. Afterwards, a discussion will highlight most important topics on which ATF can work further. During the EAAP session stakeholders will be consulted in order to create a basis for the ATF Seminar in November.
2. **ATF Seminar**
   The ATF seminar on November 17th, 2015 (Brussels) will also focus on the implementation of PLF. Stakeholders will be invited to share their vision on how to implement PLF in practice. There will also be a link to the EAAP session. Based on the input of this seminar a position paper of ATF on PLF will be created by the end of 2015.