EIP-AGRI Focus Group

Benchmarking of farm productivity and sustainability performance

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Table of contents

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1. Summary

The Focus Group brought together 20 experts from 14 EU Member States and a diverse range of backgrounds. They explored the potential for farmers and advisers to **use farm benchmarking data and process to improve productivity and sustainability performance in agriculture**.

Where benchmarking was originally introduced by advisory services (and in some countries by accounting offices), in recent decades new players have arrived: specialised ICT-companies that created farm management software and food processors (often cooperatives) that introduced data management services with benchmark options. The need for innovation in this changing landscape of players is to find new business models and governance mechanisms for benchmarking where data from different organisations have to be combined to **create value for farmers**.

Benchmarking is based on data sharing. To facilitate easier benchmarking, increasing the incidence of sharing farm level data between systems and moving as much of this data electronically in a seamless way will encourage greater participation in benchmarking, boosting the dataset and thereby improving the accuracy and applicability of benchmarking.

The group identified five **data sharing models** that hold various degrees of potential to **keep farmers interested in benchmarking by providing distinct advantages**:

Model 1: Single entry of data
Model 2: Open data and the role of government
Model 3: Farmer as data owner and manager with authorisations
Model 4: Integrated at farm level
Model 5: Business models and governance

They also identified a number of promising topics for further innovation, based on the analysis for the new needs, technological and organisational issues. These are:

- **Automatic data sharing based on data-authorisations.** Where data should be available for the farmer in a digital format suited for further processing.
- **Benchmarking with real time operational data.** New technologies create an abundance of operational data which could be better used
- **Benchmarking on sustainability and strategic changes.** Benchmarking sustainability performance can help farmers achieve increased sustainability, higher added value and improved farm management.
- **Business models and governance in benchmark systems.** As the ICT revolution makes agriculture more data-driven, innovations in this aspect of benchmark systems can be realised but have to be managed carefully as risks are also present.
- **Benchmarking for small farms.** Small farms, in general, are less active in benchmarking, although when organised in cooperatives or producer groups, benchmarking activity may be more pronounced especially when assisted by advisory services.

The Focus Group concluded its work with remarks on the **European dimension** of the innovation challenge in particular the **CAP data management** and the **cross-border exchange of data**. A second remark concerns the need for a **multi-actor approach** in the innovation topics proposed as it involves changes in working methods of farmers: how they administrate, use a dashboard for farm management (including operational benchmarking) and how they discuss (often sensitive) results in farm discussion groups. It also involves advisors and changes in administrative procedures with agri-businesses and government agencies. Such innovation is as much a form of social engineering as it is innovative science. The “interactive innovation” approach as promoted in the EIP-AGRI with operational groups, thematic networks and multi-actor projects is therefore well suited to take up the innovation challenges.

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2. Introduction

Benchmarking can support farmers to improve their productivity and sustainability performance. At its simplest, benchmarking is defined as improving the performance, of a farm, for example, by comparing with peers, learning from others and identifying actions. Valuable lessons can be drawn from benchmarking by raising the subsequent questions: why are others better?, how are others better?, what can be learnt?, and how can the farm catch up?

The European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) aims to stimulate innovation and seeks practical solutions to on–farm problems by bridging the gap between practise and science. A Focus Group on Benchmarking of farm productivity and sustainability performance has been established by EIP-AGRI. This Focus Group has to address the question: **How can farmers and advisers use benchmarking data and process to improve productivity and sustainability performance?** In understanding how a benchmarking environment can be facilitated, a distinction should be made between the micro-benchmarking environment (farm level), meso-benchmarking environment (sector/market/business environment level) and macro-benchmarking environment (policy/regulatory level). This clearly set out in Annex 4, **Why do we do benchmarking and what objectives are we aiming to meet?** This Focus Group concentrated on the farmers and advisors, but also dealt with the meso and macro levels in proposing various questions and suggestions on what it would take to make benchmarking for farmers a reality.

The specific objective of this EIP-AGRI Focus Group has been defined as:

- Make an inventory of existing farm assessment tools and benchmarking systems, including private ones and covering different types of farming, to describe and evaluate their characteristics and objectives and to map their use by farmers and others in different member states and organisations.
- Review how farmers and businesses in the food value chain make use of benchmark indicators and assessment tools for decision making, for improving farm productivity and sustainability performance. Identify the usability and accessibility of individual data to the farmer and his advisers (for example on-line via computer or via smartphone). Look into innovative ways that allow farmers to actually use relevant data for “day-to-day” management and more strategic decisions.
- Analyse the use of farm performance benchmarking by advisory systems (including use of ICT, coaching, strategic management) and the evolving best practices in the use of farmers’ own data to improve the effectiveness of advisory services (for example use in one-to-one consultations, use in group meetings, training and education, use of branding and marketing).
- Identify the main problems and issues in farm benchmarking related to collection, processing, access and usability of data on the different levels (farm level, advisory and policy information support) and the operational solutions and innovative actions to tackle these issues, including how the different systems can be integrated with each other at higher levels.

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3. Brief description of the process

The Focus Group on Benchmarking (see Annex 1 for the composition of the Focus Group) addressed its task during two meetings (Madrid, December 2015; Bologna, April 2016). A Background paper (Annex 2) and a survey (Annex 3) among the members of the Focus Group were the basis for discussion in the first meeting, followed by 7 mini papers (Annex 4-10). These were discussed in the second meeting. In the meeting the need for and direction of innovation was discussed. This paper summarises those needs for innovation, its direction and how this innovation could be realised. This relates to the last point of the objectives, mentioned above. The other objectives are dealt with in the Background paper (Annex 2) and mini papers in the annexes as follows. The inventory of farm assessment systems and benchmark tools is taken up in the background paper (Annex 2), the Survey (Annex 3) and the mini paper 1 (Annex 4) on the need for benchmarking. The objective to review how farmers can make use of benchmarks is **especially** discussed in mini papers 3 and 4 (Annex 6 and 7). The role of advisory services, the third objective, is dealt with in the background paper (Annex 2) and the survey (Annex 2). Other mini papers were written to discuss topics that are related to the need and direction for innovation **in more detail**.

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4. Agriculture and benchmarking

4.1. Existing farm assessment tools and benchmarking systems

Benchmarking is the comparison of one´s performance with the performance of others engaged in a similar activity and learning **from this**. The main advantage of benchmarking is that it is an effective and efficient approach to bring about improvements because it involves imitation and adaptation rather than pure research or invention which would then require experimentation and testing. Benchmarking thus requires quantitative measures of selected key performance indicators (KPIs) which describe the competitive performance achieved and a subsequent process of interpretation to formulate actions.

Agricultural extension systems tend to **play** a prominent role in benchmarking diffusion. **EU Member States** (MSs) have established various public databases (e.g., Farm Accountancy Data Network – FADN) on agricultural production and economics to support policy decision making and this information can also be used to support benchmarking. Many farmers pay taxes on a real basis (and not by forfeit), which implies the obligation to keep books, although there are important differences between member states in this respect. In addition to extension services, specialised agricultural management, consulting, and accounting offices are active in offering management accounting, carrying out farm comparisons and creating benchmarks. However, many smaller farms make little use of such services.

Privately developed Management Information Systems (MISs) to support decision making have already existed for over 30 years. More recently, food processors (like slaughterhouses or sugar companies), input suppliers, and testing and certification laboratories, amongst others, provide data exchange services with benchmark options.

4.2. The use of benchmarks

Adoption of benchmarks by farmers in EU member states is heterogeneous, a conclusion based on an online survey among 20 experts (Annex 3) and a literature review. In approximately 50% of the member states the adoption rate is lower than 40% of the professional farmers (i.e. those that are responsible for 90% of production). In approximately 20% of the member states the adoption rate exceeds 60% of the professional farmers. In the dairy sector, granivore (pigs or poultry) sector and arable sector benchmarking is adopted **relatively widely**, while other sectors such as permanent crops, horticulture and mixed farming are lagging **behind**. In the majority of the EU member states benchmarking mainly focusses on farm productivity (i.e., technical and economic indicators) for tactical decision purposes at farm level. Approximately 50% of the EU member states also benchmark sustainability performance (e.g., CO2 emissions, water user, nitrate and phosphate balances, pesticide impact points). Indicators are used in only 30% to 40% of the EU member states to benchmark cash flow statements for tactical decision purposes or to benchmark results of distinct parts of the farm (e.g., individual fields).

In the majority of EU member states the benchmarks are freely provided (78%) by (semi) public organisations (i.e., advisory service providers, research institutes and experimental stations). Provision of benchmarks by other stakeholders in the agricultural value chain is available in 40% to 50% of the EU member states (i.e., accounting offices, farmers' organisations, private advisers and consultants, ICT companies, input industry or food processing industry). However, only approximately half of the EU member states have an overarching coordination on the definition of the key indicators used, while only in approximately 20% EU member states is there coordination on the formats used for electronic data exchange (e.g. EDI, XBRL, Agro-XML). In fact, in more than 40% of the EU member states the information is **not sent digitally** but still exchanged on paper.

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4.3. Role of advisory systems

Benchmarks are discussed on a regular basis between **individual farmers and their advisers**, or discussed in a peer group among farmers (Annex 3) in approximately 80% of the EU member states. Most commonly, farmers compare their performance with the average of other similar farms in the region, while in 20% of the EU member states a more specific derived norm to account for structural characteristics of his farm is applied.

When considering the role of benchmarking in bringing about innovation practices or improvements, it is worth **distinguishing between different kinds of innovation**. Innovation can be “evolutionary”. This means that it involves incremental and often continuous, advances in technology or processes. Innovation can also be “revolutionary”, which means that they are novel and “disruptive”; that is, they are not part of a continuous process. With respect to innovation and benchmarking for agriculture, occasionally interaction within a benchmarking group or process can result in “revolutionary” innovative change. More commonly, benchmarking involves evolutionary innovation, where benchmarking group interactions contribute to small incremental changes on a road contributing to continuous improvement (Annex 4). Experience has shown that farmers benefit greatly from a second opinion from either their peer group or from a knowledge transfer adviser during the decision making process. For peer-to-peer interaction the use of social media channels such as blogs or instant messaging groups could be used more frequently by farmers to assist them in clarifying how to react (Annex 6).

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5. Needs for innovation

In the discussions that resulted from the analysis and fact finding, the Focus Group identified a need for innovation in three areas: new demands, new technology and new organisational options. We discuss these in detail in the next sections.

5.1. New needs

5.1.1. Operational data

Traditionally benchmarking is mainly based on the data of a growing season or yearly data, in the case of livestock for example. Data is analysed by relevant groups in such "down time" in order to make strategic decisions. This can imply a very long feedback cycle from monitoring to decision making, unless management accounts are prepared quickly. **Currently** in many farm systems new Information and Communication Technologies (ICT, see section 3.2) are introduced in the form of sensors, satellite data, robots, RFID-chips, etc. All these devices are in essence data capturing techniques. **This results in much more of the farming process being observable**, as well as in improvements in the management of production processes.

Many experts argue that we are just at the beginning of this trend (EU-SCAR, 2015). However, farmers stress the fact that there is now already an urgent need **to better integrate** the data from all these sources and to build flexible dashboards to control their operations. The ongoing developments in ICT and data analytics should allow greater sense-making of the data by creating connections between for example financial and farm operational data (from different data sources) to allow the farmer to understand **which management practices are most influential**. The Focus Group argues that such data could also provide an excellent source for benchmarking operational management on a monthly, weekly or even real time basis.

Innovation needs in this area relate first of all to making the operational data from different sources on the farm available, developing new (key performance) indicators, developing agronomic and farm management models that interpret the data and generate, if possible, **actionable advice**. While this information and data is already needed for on farm management and does not necessarily involve benchmarking, the pooling of data could be beneficial for innovation and benchmarking, since data often gain value **when they are combined and aggregated**. In such a data exchange, benchmarking systems can be set up, including digital support for discussion groups that help to interpret the data.

5.1.2. Sustainability data

The existing tools for benchmarking productivity have **more recently been widened to capture sustainability performance**. Diffusion of these indicator frameworks is in its early stages. Various frameworks, approaches, methods and indicators have been developed to appraise how much farms and firms in the food production chain contribute to sustainability, mostly based on a Triple P approach of Profit, People and Planet (Elkington 1997). FAO has combined many of those in the SAFA-tool. Industry standards like SAI and TSC are used to develop food safety and tracing- and tracking systems (like GlobalGap and its many **schemes and variations**) towards sustainability frameworks (see Annex 10 for more details).

In practice, **the data collection of sustainability indicators at farm level is steadily growing**. One of the early refinements was the emerging of nutrient accounting systems for livestock and crop farms in some parts of Europe (Breembroek, Koole et al. 1996). Some national FADN systems collect sustainability data; **currently**, the European FP7 project FLINT **is running an experiment** to collect such data on 1.000 farms in Europe.

Innovation needs in this area are based on the trend that in the future the issue of climate change **and** other environmental and biodiversity issues will play an even more prominent role in the Common Agricultural Policy (e.g. cross-compliance, greening measures) as well as in the food chain (e.g. data on similar requirements being asked by various non-harmonised certification systems). As a consequence, farms already are and will further be required to collect data on environmental performance which could be taken into account in benchmarking key performance indicators. Increasingly, sustainability indicators can be benchmarked, as they allow farmers

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to improve their performance, increase added value thanks to better transparency of their efforts and create room for growth. For example, those with the best sustainability results might use the benchmarks to substantiate claims in marketing their product as 'better for nature' or complying with various sustainable certification schemes.

5.1.3. Small farms

Accepting the statistical data that the European Union has nearly 11 million farms, it is important to note that **most of these are small and semi-subsistence farms** (SSFs) that play a number of socio-economic roles. They maintain rural welfare, keep rural areas populated, contribute to the rural non-farm economy, and provide environmental public goods such as biodiversity, erosion control, attractive landscapes (Davidova and Bailey 2014), etc.. However in many member states their contribution to global food production and their integration in the international food chains is limited. Most are in the 'EU 13', that often have a dual production structure.

These farms are hard to reach for advisory services in general and with benchmarking systems in particular. SSF's generally keep limited records and therefore their performance is difficult to benchmark with their peers. Despite such drawbacks, a gradual introduction of benchmarking appears to be needed. Simple benchmark systems should be designed as a first step into more detailed benchmarking, and may be based on new technologies like smart phones and **on data that are already available with government agencies** (e.g. through the Land Parcel Identification System) and food processors of such farms. Local organisations that form part of larger networks, such as producer organisations, farmers´ associations, cooperatives, federations, and even NGOs could play an important role in introducing such early enabling environments and necessary capacities for benchmarking.

5.2. New technologies

5.2.1. Information and Communication Technology

Innovations in information and communication technology (ICT) have opened a window of opportunities for on-line benchmarking via computer or via smartphone (Kaloxylos 2014). The first aspect of these technologies is that much more data is captured by sensors, satellites, cameras (from drones to sorting equipment), pedometers and many other devices. Farms are becoming wired and data-intensive. This Internet of Things is also the Internet of Animals and the Internet of Plants and **it contributes to the era of big data** (see also section 3.2.2). As mentioned above, the sheer volume and diversity of sources of data **can create potential bottlenecks**. **The goal is therefore not necessarily to capture more data** but to make the data from different sources on the farm available in an integrated way (the so-called interoperability problem) and to develop (agronomic and farm management) models that interpret the data and generate actionable advice in decision support by highlighting relations between the results of the farm and the underlying operational practices.

It is expected that the food chain will become much more data-driven. Several actors in the food chain **are already making advanced use of ICT and experimenting with new developments**: pedometers and milking robots give insights in the status of the individual cow, combine harvesters measure the grain yields per square meter, sensors detect irrigation and nutrition/fertilisation needs of individual plants and provide dosages accordingly, etc.. The exchange of data also makes it possible to add more (computer) intelligence to the chain, including monitoring, problem notification, deviation management, planning and optimisation of both production and anticipation of demand. However this is just the start of what could become a revolution in agriculture. Despite these trends, electronic communication in food supply chains is still in its infancy and **it is often restricted to providing online access or to emailing transmission of delivery characteristics** (Theuvsen 2010). Typical examples are cooperative processors of milk or meat in livestock production, processors of potatoes or wheat in arable production industries and in highly perishable fruit and vegetable cooperatives, who are starting to report on-line information of quantity and quality of produce delivered (and offering the service of benchmarking information of cooperative members). Also, pest monitoring and warning systems support farm decision making based on algorithms related to the pest population and on climate data. In addition, new data-driven business models are being set up, such as short supply chains (e.g. the delivery of vegetable boxes directly from the farm to consumers in the city) or on-demand harvesting, where collection is done post-order (EIP, 2016).

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As referred to above, an important issue for electronic data exchange in benchmarking is to improve the interoperability of data by standardisation of definitions of KPI and of the formats used (e.g., EDI, XBRL, Agro-XML). A standardised gateway for data exchange and communication is essential for several reasons; **registration of identical data is avoided, simplicity, and enhanced availability**. Yet, data-secure transfer of privacy-sensitive data has to be guaranteed.

Cloud technology, that gives users access to their data from different devices and places, makes sharing of data easier. Open data (where governments or others share their data free of charge) is an example of sharing data. Block chain technology, that creates undisputed data registers on ownership, holds promises to make food chains more transparent with guarantees of authentic data.

Future internet investments propose new concepts for data exchange (Poppe et al, 2013). An innovative, file-sharing service based on a platform for data-transfer with cloud-technology may be the way forward. In such an architecture, farm records can be matched with administrative and GIS data. Moreover, software and reports can be developed and the indicators can be reported back to farmers and added to their "dashboard" to monitor and benchmark their farm.

5.2.2. Big data

Big data is a term for data sets that are so large or complex that traditional data processing applications are inadequate. The term often refers to the use of predictive analytics or certain other advanced methods to extract value from data, although it is also used to address certain concerns of the digitalisation of the society (privacy issues as in 'big brother'). Mayer-Schönberger and Cukier (2013) identify three lines of thinking that characterise the big data concept: the possibility to combine large amounts of data on a topic (n=all instead of a sample), the preparedness to accept real-world messiness in the data instead of exact and precise measurements, and to base insights on correlation instead of causality. Five techniques from statistics or computer science are favoured in big data analysis: reasoning based on symbols, deep learning with neural networks, genetic algorithms, Bayesian statistics and reasoning based on analogies (Pedro Domingos, 2016). A well-known example of such big data analysis is IBM's Watson.

Big data is characterised by the 4V's: volume, velocity, variety, and veracity of data. As the figure below illustrates, that does not make benchmarking easier. The more aggregated and the more structured the data are (in the centre of the illustration), the easier it is to benchmark. With streaming data (real time continuous data from sensors, gps, scales etc.) it becomes much more difficult. In light of this fact, there may be valid concerns as to who has access to and control of data and when. Access to information often transfers into market or intelligence power. For example, in the finance sector, Bloomberg services are essential for trading, yet are costly. Small, individual traders would not have the same access. Carrying the metaphor over to famers, such streaming data and the lack of resources and/or ability to process and interpret the data would put small farmers at a disadvantage and potentially expose them to more market and process volatility.

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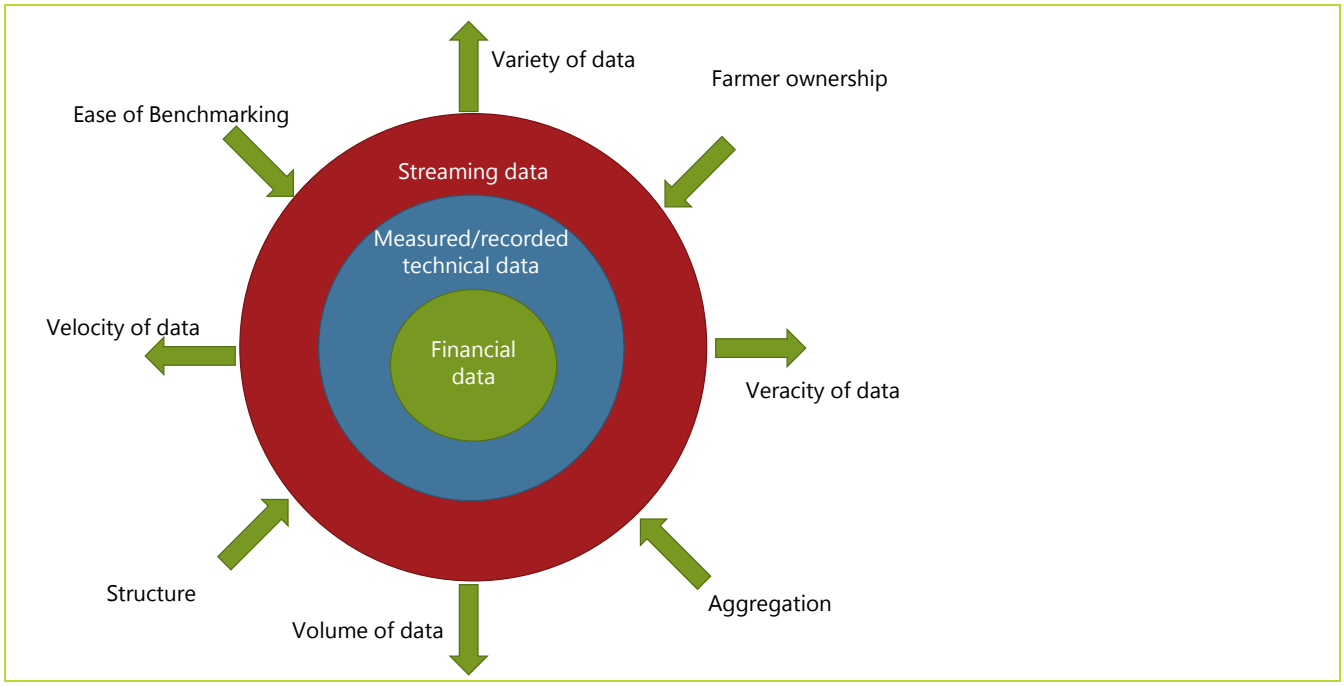

Figure 1: Characteristics of big data

Innovation needs in this area are related to the testing of such technologies on data sets of large groups of farmers (such as the FADN). For the moment this seems to be more a challenge for research, rather than an expectation that such techniques can already be introduced. However some interaction between advisory services, farmers and research in this area is needed. There is already a discrepancy between current benchmarking tools and the available statistical tools. Where researchers make use of techniques such as factor analysis and data envelop analysis (DEA) to draw conclusions on the efficiency of individual farms and the factors that influence relative efficiency, advisors and farmers often see these as black boxes and **they do not have the skills and software to perform these analyses themselves**. Their benchmarking and discussion groups focus on comparing a number of key performance indicators, often presented as a table with data of a group of individual farms with a group or regional average. Introducing big data techniques in agriculture should therefore also have an aspect of social innovation **so that it can successfully be incorporated in current benchmarking processes**. As mentioned above, access and ability to make real use of such data should be equitably treated, so as not to result in discrimination against various groups of farmers, and **enable all farmers to remain owner of the data generated on their farms**.

5.3. New organisational options

Where benchmarking was originally introduced by advisory services (and in some countries by accounting offices), in recent decades new players have arrived: specialised ICT-companies that created farm management software and food processors (often cooperatives) that introduced data management services with benchmark options. The current interest in new ICT-options brings new start-ups in the market, some of them based on a platform-business model that links different (types of) clients. An example is the Amsterdam-based service **Agriplace** that offers a platform for farmers, auditing companies (for food safety standards like GlobalGap, BRC, Fair Trade, Organics, etc.) and food processors to exchange data (that could be the basis for a benchmarking system). The Spanish association of producer organisations, COEXPHAL, also supports various related companies who have sophisticated integrated data services for their associated cooperatives and farmers, such as **AGROCOLOR** with certification and auditing of schemes such as Global Gap, GRASP, LEAF, Integrated production, BRC, Organics, geographical areas/denominations, etc., and LABCOLOR,(testing laboratory), along with a market intelligence unit. With the digitalisation and the focus on interoperability, standardisation organisations like GS1, AgGateway and UN/CEFACT also become important for benchmarking, as do all the companies (especially machine-manufacturers) that collect (and often own) data on the farm with their sensors.

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The need for innovation in this changing landscape of players is to find new business models and governance mechanisms for benchmarking. Data from different organisations have to be combined to create value for farmers, and that brings a cost that has to be paid by the farmers or others like food processors that also use the data and have an interest in a viable and sustainable agriculture. At the same time there are issues on privacy and ownership of data that need to be addressed.

In theory there seem to be five ways to make money from data (Van 't Spijker, 2015): basic data sales, product innovation (e.g., milking robots), commodity swap with data for data (e.g., between farmers and food manufacturers), value chain integration (e.g., Monsanto's Fieldscript for prescriptive farming) and value net creation (platforms to pool data). Benchmarking can take place in several of these categories. Some have set up new business models and governance structures (Ge and Bogaardt, 2015; EIP, 2016). For example, in the USA Farm Mobile is a service for comparing field data and benchmark input products where the farmers own the data and earn some money when the data is sold to the food industry or others. It is an independent company, backed with venture capital. But there are also cooperatives of farmers who do similar things, in reaction to the prescriptive farming systems of multinationals. Agriplace, mentioned above, is a start-up owned by a foundation with a sustainability objective. COEXPHAL, also mentioned above, is an example of a not-for-profit, association of producer organisations (mainly cooperatives) which carries out such function. Finally, also the public authorities could play an incentivising role through support for standardisation and in particular by guaranteeing data ownership.

Finding optimal business models and governance systems to organise benchmarking is therefore an important area for innovation. This includes the issue of public-private collaboration. **In all EU countries, advisory services are developing into a landscape of public and private actors** (EU-SCAR, 2015). The same is true for benchmarking. Where in some countries this is fully a service of public advisory systems, in others it is (also) a private business, either as part of a private advisory service, commercial farm management software or an aspect of the commercial relation between farmers and food processors or other actors in the food chain. **This raises questions on what might be the most efficient organisational form(s) in a given region**.

For public and private advisory services the organisational issue becomes even more complex if the data is **no longer only sourced from the farmer**, but **also from other data-holders** like the machinery industry, input suppliers, food processors or retail. Data sharing as a basis for better management tools and benchmarking holds important promise in the era of ICT and big data, but also raises valid concerns and needs for innovation. Giving holistic advice becomes a challenge because of the fragmentation of the data. As a result, the Focus Group decided to pay extra attention to this issue – which is the topic of next chapter.

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6. Options for data sharing

Benchmarking is based on data sharing. To facilitate easier benchmarking, increasing the incidence of sharing farm level data between systems and moving as much of this data electronically in a seamless way will encourage greater participation in benchmarking, boosting the dataset and thereby improving the accuracy and applicability of benchmarking. Greater participation also makes it more attractive for service providers (like public authorities, public or private advisory services or software suppliers) to invest in benchmarking systems.

Currently, data sharing is based on the sharing of the Key Performance Indicator data, but as pointed out in the previous chapter, data sharing has broader aspects: for benchmarking of operational (and to a lesser extent sustainability) data much more data has to be shared and ownership for farmers is key to enable neutral and holistic advising. **Most of these data come from new data sources**. For some of these data sources, like those of machinery companies (also known as original equipment manufacturers) or a variety of input suppliers, data is an essential part of their business model, and such data are not automatically available free of charge for farmers.

Second, our analysis found that several benchmarking systems are a by-product of other data collecting purposes, like tax accounting or collecting data for food safety tracing- and tracking systems. That is a positive thing, but this also creates bottlenecks for small farmers not involved in such systems.

Thirdly we see several new initiatives for data sharing, especially in the USA around prescriptive farming (like Fieldscripts, Farm Mobile, Farmers Business Network, FarmEdge, FarmForce, FarmLogs and others, see Ge and Bogaardt, 2015) that are based on new business models and governance structures.

Against this background the Focus Group discussed issues of **data sharing and related concerns of farmers and advisers**. The insights from this discussion can be summarised in a number of most promising design principles for future development of benchmark systems and should be further investigated, in particular on possible integration of the different strands described below.

6.1. Single entry

Farmers, like most people, do not like to enter data into devices that are already available somewhere else. Unfortunately, the current situation is **far from an ideal situation of non-repetition of data input**. Agri-businesses, such as sellers of farm inputs and buyers of farm produce send ten thousands of paper invoices and other documents per year to farmers (one of the characteristics of agriculture is that farmers do not send invoices on their sales, but their buyers do, as this is more efficient). Farmers then have to **type such data into their farm management information systems or accounting software** (or have to pay their accountant to do that). This is often restricted to the most needed data (e.g., financial data) where other data on the documents (on volumes of input and output or on quality indicators of the produce) is ignored, although this would be useful for indicators on productivity and especially sustainability.

In the next couple of years, this practice should evolve towards digital exchange with EDI (Electronic Data Interchange) messages. Some agri-businesses provide invoices in pdf or make them available on their own platform or website. Although this helps the development of the paperless food chain, **these formats do not help in reducing administrative burdens** and nudging farmers into benchmarking systems where data is combined, as data still has to be transferred manually into other systems and formats. Agri-businesses have an understandable tendency to allocate their scarce IT sources to company projects and not directly to such digital data exchange projects, as their own benefit is relatively unclear. Support for innovation actions in this area and lobbying of farmers / industry organisations can help.

Novel more pro-active government approaches by public authorities could play a key role to promote EDI approaches and benchmarking sustainability. The Focus group discussions mentioned the blockchain technology as a possible solution, guaranteeing the ownership of data for the farmer and as such creating trust in a common interoperable system which holds data that farmers may not want to share with all actors. Standardisation organisations like AgGateway Europe or national ones could help in providing EDI-standards (many of them already available as UN/CEFACT standards).

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6.2. Open data – the role of the government

European governments currently have an open data policy, meaning that data available within the government should be made public if it does not violate privacy laws. Some of such data, like weather data, soil maps and data on animal movements is useful for farm management and can support benchmarking. Also, the amount of geographical and sustainability data stemming from the CAP policy which are already available in public sources is huge. For instance, the Land Parcel Identification System is applied and harmonised in all EU Member States. Currently it is mainly used for direct payment and rural development funding applications, but it can also register data linked to cross-compliance requirements such as the Nitrates, Habitat and Water Directives, the Pesticides regulation, EU Food Safety legislation, Good Agricultural and Environmental Conditions of land (maintenance of landscape features, soil, buffer strips, ...) etc.

An example **showing how far this principle might be stretched by governments** is the application **BoerEnBunder** in the Netherlands that was created due to the fact that the paying agency RVO made field level data available to the public. Everybody can click on a field in a map anywhere in the country and **see which crops have been grown there since 2009**. It also provides soil data and data on the level (elevation) of the field. In addition, a greening index based on satellite data is provided, essentially an indicator of plant growth. **So far, no experiences have been reported yet on farmers or app builders using this as a benchmarking tool**, but one could easily imagine an app builder using standard FADN-data (or a farm management book with **standard advice** on inputs of fertilizer, seeds and pesticides per crop) to provide a benchmark per field. This or similar systems could prove to be especially beneficial as benchmarking tools for small farmers, but **trust in the system remains essential**.

In a similar way in Lombardia the Sostare project (Paracchini et al., 2015) has developed a diagnostic farm-level model for an integrated assessment of sustainability and efficiency from an **agronomic, economic and ecological point of view**. The tool is structured in such a way that existing data sources, such as the Farm Accountancy Data Network (FADN) and the Integrated and Administration Control System (IACS) data can be automatically integrated in order to diminish the load for data accrual. **A large part of this procedure has been operationalised and made available**, through a web interface on the Region Lombardia's web portal, and **it can be used directly by farmers and advisory systems**. The user will be able to complement the analysis by either relating the performance of the farm to the optimal performance, or by comparing the performance of the farm to a reference situation of his/her choice (i.e. the average of the farm typology, the average of all farms). **Such benchmarking possibilities provide information on strengths and weaknesses of farm management**, in order to identify key actions that could be adopted to improve the farm performance.

Related to open data is the fact that governments could help farmers with the single entry principle mentioned above. Data that farmers upload to a paying agency (including the layout of fields in a GIS system for direct payments) is often also useful in a farm management system and for agri-businesses related to the farmer (as e.g., the sugar company that has to know where to collect the harvest). The Dutch paying agency RVO offers farmers the option to download or forward the data they have entered in the government system **and to upload the data from their own farm management system**, using a UN/CEFACT standard Crop4.0.

Once farmers are reassured that the data exchange system guarantees that they will remain the owner of the data, and that they can decide themselves on the flows of data generated on their farm or even financially benefit from it through selling data, then such a public system could turn into a powerful benchmarking tool which provides a basis for all kinds of farm management systems and for agri-businesses.

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6.3. Farmer as data-owner and manager with authorisations

The ownership of data is legally a difficult concept. As such it does not exist, but privacy laws, intellectual property rights and the recently introduced 'right to be forgotten' and 'commercial secrets exemptions to disclosure' are relevant. Many farmers, not unlike other people, feel that they should own data, or at least have unconditional access to data, **which relate to their farm operations**. **This includes data collected by devices on machinery owned by contractors or that are linked in the cloud to databases of the original equipment manufacturer**s. They also worry that they do not have any control where these data might end up: in the public domain, with advertisers, with public inspection services (e.g., on pesticide use), or with companies that are able to improve their bargaining position in international (futures) markets. As such, the problem is not new (e.g., who owns the data on the laboratory results of a milk analysis carried out by the dairy company?), but with big data it has become a bigger issue and examples from other sectors illustrate the risks.

At present, data ownership is the small print in private contracts between farmers and their business partners that rule such issues, and the impression is that **many farmers do not pay much attention to this**, although **in discussions they voice these worries**. To make operational benchmarking successful, the Focus Group argues that the agricultural sector should create systems in which farmers feel they are the owner of the data and control where the data travels. Authorisations on data use are a way to implement this. Where data collection is facilitated by farmers´ groups or producer organisations, such information could be held "in trust" for farmers or held for their collective benefit.

An example from the Netherlands is a system called Agritrust. A farmer can log in into this register with an **e-recognition tool similar to the ones used in e-banking**. This then shows his/her data flows (invoices, orders, laboratory results, etc.) that are sent by a certain business partner he/she can subsequently change a checkmark to forward (or stop forwarding) a data flow to another business partner or government agency. In this way an invoice (in EDI-format) to the farm from the dairy company can also be sent to the veterinary or the accountant or a farm management information system. **This system works through a hub called EDI-Circle, which was created already in the 1990s by accounting offices to improve efficiency**.

6.4. Integrate at farm-level

Farmers deal with many business partners and government agencies, but they are a weak party when it comes to the information architecture of the sector. Information systems that supply farmers with data are often designed on the basis of the needs of the business partners, and ask farmers to type in data on a website and retrieve a pdf from such a website. This leads to a low level of interoperability of data. Sometimes different definitions are used (e.g., is the size of a field with or without ditches and roads, **when does a cow start counting as a cow, rather than a heifer**, the moment of insemination, or birth of a living calf?). **This complicates benchmarking with data from different software or sources**, and in case of operational benchmarking it could be unreliable. Harmonisation of data definitions, based on data models or ontologies, is therefore important.

From an economic point of view, such conceptual data integration as well as the systems for managing data authorisations and hubs to exchange data are investments that benefit many in the food chain, but **they are also a common pool type of investment that is hard to exploit commercially**. As the Spanish say: a common cow is well milked but poorly fed. Therefore specific public support may be needed to get started.

There are differences in the organisation of food chains that determine how much support from innovation programs is needed for such activities. In some chains there is a major player (like a cooperative slaughterhouse) where farmers are supported like franchisers. Here the leading partner has an incentive to organise the data exchange in the chain in an integrated way and to support farm-level decision making and benchmarking.

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In some regions farmers' organisations, farmers' cooperatives and the advisory have a strong common position to organise the data exchange. Denmark is an excellent example. What makes the Danish data management possible is the long tradition in Danish agriculture of cooperatives unifying farmers in the ownership of the processing industry and a tradition of **farmers' union membership**. The cooperatives are Danish market leaders for dairy processing plants, slaughterhouses, grain elevators, grass seeds, eggs, production of fur, and potato starch. Farmers are also members of farmers' unions which, besides political lobbying, also provide farm management and crop, dairy and pig advisory services on a commercial basis. Local farmers' unions collectively own the Agriculture and Food Council and the subsidiary R&D centre called SEGES. When the **bookkeeping began to be digitalised and businesses needed computer power the farmers' unions and the cooperatives founded the "Agricultural Electronic Data Central"** (AEDC) back in 1962. **The ICT-development part of AEDC was sold off and is now a part of IBM-Denmark**. SEGES took over the farm software development. IBM hosts some of the software owned by SEGES and by the cooperatives (Olsen, 2016).

Probably in most regions and chains the situation is not as favourable as in these examples, and the common pool problem exists, in addition to the heterogeneity of legal treatments of such common pools. There, systems for data exchange and data integration on common definitions have to be created, as in the example of the Netherlands (EDI-circle with authorisations in AgriTrust).

Whatever the system for conceptual data integration and the actual data exchange mechanism, the real challenge for benchmarking is to create trust, interoperability and data-ownership, and to integrate the data into a useful dashboard for farm management, especially for benchmarking of operational data and for sustainability indicators. The Focus Group argues that more efforts should go into such innovation, if we want to harvest the fruits of the data capturing by all devices. Some advisory services are active in providing software and since the 1980s this is also the role of commercial farm management information systems. Agribusinesses tend to focus on their own service and website or platform (MyJohnDeere, My etc.). The commercial farm management information suppliers are however often rather small companies with relatively small innovation budgets, that have to be spent on incorporating new software-techniques like cloud computing. These companies also have small marketing budgets in order to "get the word out" about their latest innovation in using data. Although this might change with some new platforms coming into the market (e.g., **365 Farmnet**), most software finds it difficult to offer benchmarking and to integrate it with activities like farmer discussion groups coached by an adviser. Therefore, the Focus Group suggests **paying more attention to this aspect** of creating integrated farm level dashboards with benchmarking tools and farmer interaction in innovation programs. The whole Agricultural Knowledge and Innovation System (AKIS), including farmers, advisers, enterprises, governments etc should be involved to reach this goal.

Available organisational structures, such as producer organisations and other recognised farmers´ associations and groups could help facilitate the creation of such innovative programs. An example from Ireland is the knowledge transfer agent Teagasc that has worked closely with small ICT-companies to assist them in developing data harvesting and analytical tools which are used primarily by the farmers but can also be accessed by the adviser, the accountant, the vet, all with the **permission from and under the control of the farmer**. The commercial software developers see this as attractive, as these advisers then also promote the benefits of the software to the farmers, **provided they see benefits for their own business in getting access to the data**.

Recently, advances in research on confidential benchmarking have made promising prototypes of exchange of sensitive data. In a prototype setup sensitive data were exchanged encrypted without revelation of the original data. **The relative performance of the farms in the project was assessed using DEA**, where all calculations were done encrypted by secure multiparty computation (Damgaard et al., 2015). In the project the participating banks were granted access to illustrations of the performance of their portfolio of farmers against the performance of the entire sample. Technologies enabling confidential benchmarking could be promising for instance in the case of benchmarking of products that are sold to farmers in oligopolistic or other thin markets, **where revelation of product performance is not appreciated by the sellers**.

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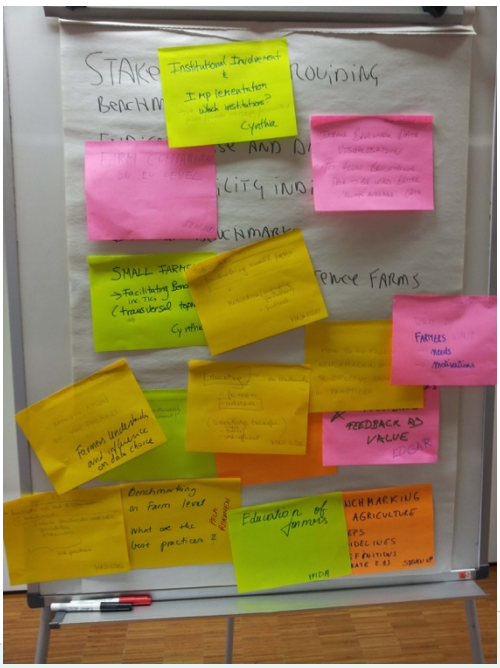
6.5. Business models and governance

A **final design principle in data sharing for benchmarking** is to pay explicit attention to business models and the governance of benchmarking tools that are developed. Innovation actions very often focus on the content and lay out of dashboards that have to be developed, but for the sustainability of the project results **the business model and the governance are equally important**.

A business model describes the rationale of **how an organisation creates, delivers, and captures value in economic, social, cultural or other contexts**. In the end it also determines who **needs to receive an invoice** to cover the yearly costs of the system (EIP, 2016). The governance is related to the decision rights on the system: who decides who can take part, what can be done with the data, **how should the system innovate in the next couple of years**? The North American examples mentioned above in the introduction of this chapter show that there is **a lot of ongoing experimentation in this regard**. If data becomes a valuable aspect of doing business, it is in the interest of farmers to have a stake in the decision rights.



7. Agenda for innovations in benchmarking

In this final chapter the EIP-AGRI focus group on benchmarking of farm productivity and sustainability performance presents its conclusions in the form of an agenda for innovation. We first list the main topics for innovation, and then make some remarks on how to organise this innovation.

7.1. Topics for innovation

The most promising topics for further innovation, based on the analysis for the new needs, technological and organisational issues are:

- **Automatic data sharing based on data-authorisations.** To promote benchmarking and more and better use of data in farm management, data should be available for the farmer in a digital format suited for further processing. This should be based on a dashboard to manage permissions (authorisations) and could take into account best practices in the EU and abroad (e.g., **the Data Linker project in New Zealand**). The design principles in previous chapters should be taken into account. It may not be necessary to build one register of authorisations for the EU, such dashboards could be a competitive market, but authorisation-messages should be standardised so that cross-border activities in the single market (also of the multinational cooperatives) are possible. A farmer should be able to permit other key advisers (**management adviser, accountant, vet, animal nutritionists**) to also access the data in a controlled way to assist the farmer in understanding the data and in **helping to take decisions using the data**.

- **Benchmarking on sustainability and strategic changes.** In several food chains as well as in the Common Agricultural Policy, issues like climate change, environmental practices, water management, soil fertility and biodiversity **are becoming more important**. Farmers **apply for funding** and have **reporting obligations** but **they may also strategically benefit** from the demand for more sustainable farm practices and products. Benchmarking sustainability performance can indicate potential weaknesses that can lower farm productivity on the short or longer term. On the other hand, it can move farmers towards sustainability and higher added value. Data gathering on sustainability can be used and developed much further, as in many sectors sustainability certifications are taking off. There is **a significant role that sustainability certification can play in data gathering to improve farm management and to back up sustainability claims towards retailers and consumers**. Such data gathering must be done **anyway** for the auditing of the compliance of farmers with their certification schemes. Also some FADN-units have positive experiences that could be a basis for developing benchmarking, also in industry programs. Improving data gathering could also incorporate farm reality in the wide range of indicator tools proposed in research projects. Current benchmarking systems are based on a set of homogeneous, comparable farms. It could be interesting to bring together (data from) **farmers that have made a similar change in their farm system** (e.g., from conventional to organic) at an earlier stage.

- **Business models and governance in benchmark systems.** Benchmarking is offered by different organisations: advisory services, farmers´ associations, accounting offices, farm management information systems and agri-businesses (food processors and input suppliers). Outside agriculture we can see the risks: for instance in retail or advertising, some commercial vendors of benchmark systems have grown to a unique selling position in the market and **are presently impossible to circumvent** (e.g., the Nielsen panel). In the USA we currently see a lot of activity to set up new benchmark systems, partly based on venture capital. Also in Europe we see new platforms (e.g., 365FarmNet, Agriplace for compliance data) and more commercial consultancy to farmers in competition with the public advisory system, fragmenting the Agricultural Knowledge and Innovation System and hampering knowledge flows which are key to innovation. As the ICT revolution makes agriculture more data-driven, innovations in this aspect of benchmark systems can be realised but have to be managed carefully.

- **Benchmarking for small farms.** Small farmers, in general, are less active in benchmarking, although when organised in cooperatives or producer groups, benchmarking activity may be more pronounced. Now that farmers are obliged to provide a lot of data to paying agencies, the government could make that data available to the farmer enriched with benchmarks (see the Lombardia example in chapter 4) and could make such data available for app developers while respecting data-ownership. Advisory services could use

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automatic data sharing methods (see above) with agri-businesses to make such benchmarks even better and more farm-specific.

Several other suggestions for innovation were considered in the Focus Group. As most can be linked to the five options for data sharing and innovation topics listed above, we feel that these are, at a European scale, the state of the art in thinking where innovation in benchmarking is most promising.

7.2. Organisation of the innovation

Many stakeholders have an interest to work on the innovations needed in benchmarking. Nevertheless the Focus Group wants to conclude its work with some remarks on an efficient organisation of the innovation process.

First of all, it is suggested that there are several **European dimensions** of the innovation challenge. Concerning governmental data, the data for the CAP (as managed by the European Commission and by the paying agencies) play a key role. Paying Agencies should be one of the types of organisations to be involved, also because this links to discussions on reducing the administrative burden of the CAP. This burden can be limited by reducing data requirements, but the balance can also be improved by making the data more useful for broader purposes, which are of interest for the farmer in his daily management (e.g. technical management of fields or animals, certification systems etc) including benchmarking. Another issue is cross-border data-exchange. Many agri-businesses, including cooperatives, are multi-national, so arrangements for automatic digital data sharing (authorisations, EDI-standards, etc.) should be defined at a European level. Many member states would benefit from a template of standard definitions of farm level input data and KPIs. Benchmarking itself is often a regional activity, especially when it is embedded in farmers' study groups. However some farmers´ organisations (and others) benchmark their regional competitive position with other European regions. Farmers with very special farm systems (who have few peers in their own region) or commercial secrets (but want to benchmark with similar farms elsewhere in Europe) might benefit from benchmarking systems at a European level, as well as the small group of farmers with operations in different member states. This could ask for better statistical measures for the size of the farm (Annex 9).

A second remark concerns the need for a **multi-actor approach** in the innovation topics proposed. In the last decades, productivity benchmarking was not a hot topic in academic research, but data science now is. Social innovation however is an important aspect of the approach as it involves changes in working methods of farmers: how they administrate, use a dashboard for farm management (including operational benchmarking) and how they discuss (often sensitive) results in farm discussion groups. In underdeveloped rural areas, it may also involve an analysis of the technical infrastructure available and even the most basic concepts of data management and collection and benchmarking. It also involves advisers and changes in administrative procedures with agri-businesses and government agencies. Such innovation is as much a form of social engineering as it is innovative science. The "interactive innovation" approach as promoted in the EIP-Agri with operational groups, thematic networks and multi-actor projects is therefore well suited to take up the innovation challenges. It will make the link to the Agricultural Knowledge and Innovation Systems to spread the experience gained from projects to a broad audience of end-users.

The Focus Group would welcome Operational Groups who take up the innovation challenges. Some of them would probably be linked to experiences in farm study groups with benchmarking, others to interests in sustainability management, precision farming or harmonisation of data. Thematic Networks could work on similar challenges or be formed to seek synergies between some of these Operational groups, possibly with other actors like advisory services, farmers associations, ICT-companies, agri-businesses, standard organisations and paying agencies. Multi-actor Horizon 2020 projects could be another option for such challenges, perhaps linked to data science and ICT-aspects.

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Annex 1: List of members of the Focus Group

Name of the expert	Profession	Country
McCabe Lorcan	Farmer	Ireland
Bodini Antonella	Scientist	Italy
Keszthelyi Szilárd	Expert from agriculture organization, industry or manufacturing	Hungary
Mckay Bernard	Farmer	United Kingdom (Northern Ireland)
Connolly Kevin	Expert from agriculture organization, industry or manufacturing; other	Ireland
Riikonen Aila	Farmer	Finland
Olsen Jakob Vesterlund	Other	Denmark
Dieulot Romain	Expert from NGO	France
Kožar Maja	Other	Slovenia
Gomoliauskienė Vaida	Farm advisor	Lithuania
Garcia Manzanilla Edgar	Scientist	Ireland
Van Passel Steven	Scientist	Belgium (Flanders)
Marchand Fleur	Scientist	Belgium (Flanders)
Morrison Steven	Scientist	United Kingdom
Blatchford Giles	Expert from agriculture organization, industry or manufacturing	United Kingdom
Ahlgren Serina	Scientist	Sweden
Pedroni Paola	Farmer	Italy
Giagnocavo Cynthia	Scientist	Spain
Ferenczi Nicolas	Expert from agriculture organization, industry or manufacturing	France
Schader Christian	Scientist	Switzerland
Facilation team		
Poppe Krijn	Coordinating expert	Netherlands
Didicescu Sergiu	Task manager	Romania
Schreuder Remco	Civil servant	Netherlands
Van Asseldonk Marcel		Netherlands
European Commission		
Van Oost Inge		
Mahy Louis		

You can contact Focus Group members through the online EIP-AGRI Network.
Only registered users can access this area. If you already have an account, you can log in here
If you want to become part of the EIP-AGRI Network, please register to the website through this link

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Annex 2: Background paper: Benchmarking of farm productivity and sustainability performance

Krijn Poppe, Marcel van Asseldonk[1]

1. Introduction

Benchmarking can support farmers to improve their productivity and sustainability performance. At its simplest, benchmarking is defined as improving the performance, of for example a farm, by learning from others. From benchmarking valuable lessons can be drawn by raising the subsequent questions: why are others better?, how are others better?, what can be learnt?, and how can the farm catch up? It is believed that, although benchmarking has been established in agriculture, the full potential has not been exploited yet by the farming community.

The European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) aims to stimulate innovation and seek practical solutions to on–farm problems by bridging the gap between practise and science. A Focus Group on Benchmarking of farm productivity and sustainability performance has been established by EIP-AGRI. This Focus Group has to address the question: *How can farmers and advisers use benchmarking data and process to improve productivity and sustainability performance?* The specific objective of this EIP-AGRI Focus Group are:

- Make an inventory of existing farm assessment tools and benchmarking systems, including private ones and covering different types of farming, to describe and evaluate their characteristics and objectives and to map their use by farmers and others in different member states and organisations.
- Review how farmers and businesses in the food value chain make use of benchmark indicators and assessment tools for decision making, for improving farm productivity and sustainability performance. In particular the usability and accessibility of individual data to the farmer and his advisers (for example on-line via computer or via smartphone). Looking into innovative ways that allow farmers to actually use relevant data for “day-to-day” management and more strategic decisions.
- Analyse the use of farm performance benchmarking by advisory systems (including use of ICT, coaching, strategic management) and the evolving best practices in the use of farmers’ own data to improve the effectiveness of advisory services (for example use in one-to-one consultations, use in group meetings, training and education, use of branding and marketing).
- Identify the main problems and issues in farm benchmarking related to collection, processing, access and usability of data on the different levels (farm level, advisory and policy information support) and the operational solutions and innovative actions to tackle these issues, including how the different systems can be integrated with each other at higher levels.

1 Wageningen Economic Research, Wageningen UR, The Netherlands

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The Focus Group on Benchmarking will address the aforementioned tasks during its first meeting in Spain 9-10 December 2015. This current starting paper (also known as discussion paper) for the first Focus Group meeting identifies points of discussion. The objective of this paper is to:

- Establish a common understanding about the purpose of the Focus Group on Benchmarking;
- Provide information on benchmarking of farm productivity and sustainability performance;
- Provide an overview of current and potential benchmark future strategies at farm level for improving the use of benchmarking;
- Identify key questions to be discussed at the first Focus Group meeting.

In addition, a survey is conducted among panel members to map the current state of affairs in their country or region. The results of the survey are reported in Annex 3. The topics in this paper are to be further elaborated in mini-papers by the participants of the Focus Group and formalised by the coordinating expert in the final discussion paper.

2. Agriculture and benchmarking

2.1. Benchmarking

Benchmarking is not particularly radical for a farm manager to improve farm performance (Franks 2003). Alternative and complementing definitions are used in the literature to describe the objectives of benchmarking. For example, Spendolini (1992) defines benchmarking as the comparison of performance with the performance of others engaged in a similar activity and learning from the lessons that these comparisons throw up. Slavin (1994) complements it by stating that it involves the action of continuously measuring and assessing products and services and practices against those of world-class businesses or top competitors. In summary, it involves borrowing good ideas from others about how to improve (Brown, 1995).

Although the number of steps in the process may vary from organization to organisation, and from definition to definition, three subsequent steps contain the core features (Figure 1). Firstly, actual performance is measured and compared against others. Secondly, performance gaps are identified and understood. Thirdly, outstanding practices found are incorporated to fill the gaps to improve performance.

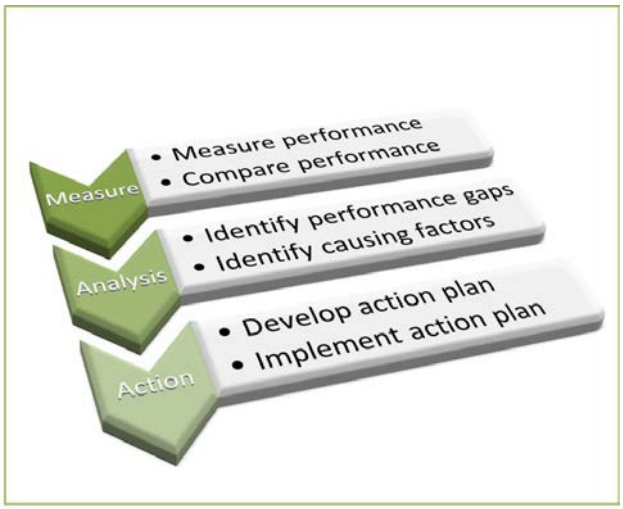

Figure 1: Benchmarking process.

The main advantage of benchmarking is that it is an effective and efficient approach to make improvements because it involves imitation and adaptation rather than pure invention, and thus eliminating to a certain extend the adverse effects of trials and errors. Yet, the impact hinges on the availability of farm-specific benchmarks to guide to meaningful use and targets, since farm and site-specific characteristics, outside the control of the farmer, influence economic, environmental and societal performance.

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Farmers need to identify which benchmark to take as being representative of their industry performance (Franks, 2003). Benchmarking can be conducted on the basis of internal or external farm data (Figure 2). Internal benchmarks can be derived from historical performance or similar on-farm activities. External empirical benchmarks can range from a generic approach (e.g. average performance of all other farms in the country or county, or individual data of other farms in the county), up to best in class (e.g. average performance of the best 25% of other farms), or even best of the best. Alternatively, a more normative approach can be followed whereby the target is derived from best practices issued by for example the competent advisory service or relevant research station performances. Moreover, a tailor-made benchmark can be estimated to account for the structural characteristics of the farm (e.g. parametric and stochastic frontier analysis SFA or the non-parametric data envelopment analysis DEA). Essential for all approaches is that farm-specific benchmarks are used which account for factors that are beyond the farmer's control.

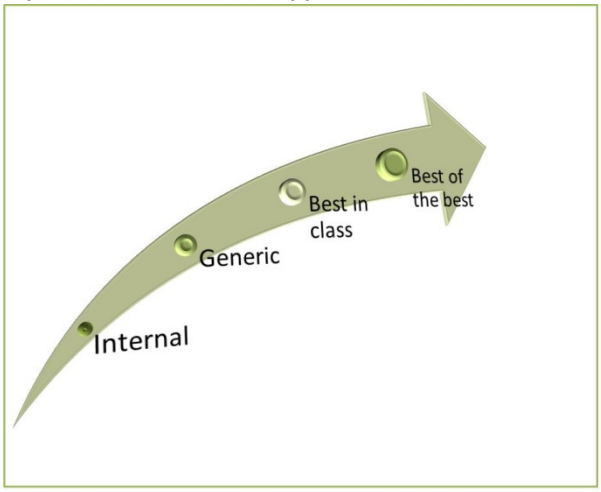

Figure 2: Categories of "who" is being compared.

Timeliness of the analysis and reporting is typically done with annual data, or moving averages of annual data, since most agricultural activities depend on the growing season. For specific agricultural activities a more frequent approach can be followed (e.g. 6 weeks for broilers).

2.2. Key Performance Indicators

Benchmarking is used to measure performance using specific indicators resulting in a metric of performance that is then compared to others. Benchmarking thus requires quantitative measures of selected key performance indicators (KPIs) which describe the competitive performance achieved. Note that benchmarks are goals to aim for, while KPIs are specific measurements used to gauge performance. KPIs represent a set of measures focusing on those aspects of organizational performance that are the most critical for the current and future success of the organization (e.g., productivity per unit of measure and cost per unit of measure).

In farming, KPIs per agricultural activity in general focus on quantities like yields (e.g., kg wheat/ha or piglets/sow), process or production practices (e.g. use of pesticides or fertilizer per crop), and economic performance (e.g., gross margin per crop and type of animals). At farm level, more aggregated KPIs are used (e.g., profit and loss accounts of farms, balance sheets of farms, and cash flow statements of farms. More recently, sustainability KPIs are gaining interests too (Iribarren, 2011).

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3. Bottlenecks and future strategies in benchmarking

We propose to identify five key issues in farm benchmarking (i.e., stakeholders, dissemination KPIs, ICT, small and semi-subsistence farms). These issues, where we see the main bottlenecks, are related to collection, processing, access and usability. Operational solutions and innovative actions to tackle them are discussed for each key issue.

3.1. Stakeholders providing benchmarks

National agricultural extension systems tend to have an eminent role in the early phase of benchmarking diffusion. Extension services are usually organized predominantly either by central or regional governments, or by agricultural colleges, mostly in close association with experimental stations, or by farmers' organizations (agricultural societies, cooperatives, farmers' unions, or chambers of agriculture), or combinations of these parent bodies (Jones and Garforth, 1997). Public extension managers at various levels require relevant information accessibility in order to support decision making at farm level. The starting point is thus public data gathering, for instance via the FADN (Farm Accountancy Data Network). The public implemented databases offer the possibility to overview farm production and economics based on diverse indicators to identify areas for improvement or action. In the absence of such information, extension officers act only on the basis of their intuition and past experience (Ramesh Babu, 1997).

In varies ways MSs have established public databases on agricultural production and economics to support policy decision making and this information can also be used to support stakeholders (be they professional organisations or individual farmers) in comparing their situation with that of others. The Farm Accountancy Data Network (FADN) was created in 1965 to support the Common Agricultural Policy (CAP). To measure European farm incomes and to conduct farm business analyses, FADN collects and analyses annual data from around 80,000 farms. In many MSs, the data are also used to create detailed benchmarks for this purpose. For example, farmers can benchmark how their farm structure and performance compare with others in the sector or region, or whether their input costs are competitive (FADN, 2015).

In many member states farmers, or at least the larger ones, pay taxes on a real basis (and not on a forfeit), which implies the obligation to keep books. In addition to extension services, specialised agricultural accounting offices are active in offering farm comparisons and create benchmarks. Such financial service providers have valuable benchmarking information. However, in many MSs (smaller) farms make little use of accounting or use a minimal system driven by taxation rules (e.g. in depreciation) and until now have been largely excluded from the scope of accounting standards and benchmarking.

Since approximately the eighties privately developed Management Information Systems (MISs) have emerged to support decision making. Specialised record-keeping software has become available for all main sectors in agriculture provided by mainly private and specialised software companies. The MISs are enabling benchmarking with other adopters. Although numerous reporting on insufficient adoption rate of MISs by farmers, its diffusion has grown steadily in the past decades (Kuhlmann, 2001). By now, the industry is still growing in some EU regions, while it is has grown into a mature market in other EU regions.

More recent benchmarking developments result from innovation in information exchange, and use of information and knowledge, between diverse private actors in the agricultural value chain. Food processors (like slaughterhouses or sugar companies), and to a lesser extend suppliers, provide data exchange services to benchmark against other farmers.

In general, the use of supplier and processor-based as well as accounting-based information can significantly improve benchmarking activities.

In general, research on mapping of existing farm benchmarking systems, either public or private ones, is fragmented. Level of adoption varies between MSs and farming systems. Traditionally, benchmarks are more used in homogeneous sectors (i.e., livestock production and arable production) where farmers are not direct competitors and mutually benefit from cooperation. Current available benchmarking systems are provided by numerous stakeholders, ranging from public advisory services, research institutes and experimental stations,

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farmers' organisations, accounting offices, private consultants, input industries and food processors (including cooperatives), as well as ICT companies providing farm management software systems.

3.2. Indicator use and dissemination of benchmarks

The set of representative KPIs should capture those aspects of operational as well as strategic performance that are the most critical for the current as well as future success of the farm. Benchmarking therefore focuses on the key variables influencing productivity, profitability, liquidity and solvency (Wilson, Charry et al., 2005). Sustainability (in the profit-people-planet meaning of the word) should be added to that list. Common complementary productivity indicators tend to focus on measures associated with input use and yield per unit of measurement, but may not reveal much information on the longer-term farm sustainability. While profitability measures (e.g., gross margin, net income per labour unit, and return to capital) often seem to proliferate without any clear guidelines as to which parameters are more critical for farm performance (Wilson, Charry et al., 2005). Solvency related KPIs, to capture the degree to which the current farm assets exceed the current liabilities, are often represented by the total farm assets and equity as a % of total assets. Interestingly, according to Wilson et al. (2005), provision of any significant focus on the farm's ability to meet its short term financial commitments (i.e., liquidity) is generally limited in benchmarking. That suggests that risk management is not a main topic of benchmarking.

KPIs presented properly will aid stakeholders in analysing situations and to make more informed decisions (Ramesh Babu, 1997). Thus dissemination of relevant KPIs together with advice to farmers is crucial. In practice, different types of extension programmes are developed to pursue such knowledge transfer and human resource development. The most effective allocation of resources for dissemination is context-specific (Nagel, 1997). In the past most large-scale agricultural programmes were ministry-based general extension work for reaching large numbers of farmers. However, government extension services have been forced to rethink their top-down approach as the private sector is more and more complementing and substituting formerly public tasks. So next to public-based extension, private-based extension is more frequently used for dissemination purposes. Mainly extension officers of input suppliers and processors provide benchmarks to farmers of their own clientele in one-to-one consultations. Moreover, there is an considerable interest in participatory Farmer-led Extension (FLE) approaches in the recent decades (Scarborough, Killough et al., 1997) as shown in European projects like FarmPaths, Solinsa, Pro-AKIS and Impresa. Farmers are encouraged via FLEs in sharing their experiences and creating an opportunity for learning on the part of those during group meetings. Preferable in all dissemination approaches MIS plays an eminent role in providing KPIs and benchmarks that serve as a basis for coaching by farm advisors or peers.

3.3. Benchmarking sustainability indicators

The existing tools for benchmarking productivity are more recently widened to capture also sustainability performance. Despite enthusiastic support in general, diffusion of these indicator frameworks is in its early stages. To date, various frameworks, approaches, methods and indicators have been developed to appraise how much corporations (farms and firms in the food production chain) contribute to sustainability. These attempts monitor (partially) sustainability in agriculture with a Triple P approach of Profit, People and Planet (Elkington, 1997). The European project FLINT has made an inventory of such indicator systems, that include industry standards like SAI and TSC.

One of the early refinements was the emerging of nutrient accounting systems for livestock and crop farms in parts of Europe. These KPI's are analogous to financial accounting KPI's in the sense that they can be audited to insure that nutrient losses to water and air, fall within legal bounds. Bookkeeping of inputs and outputs at the level of individual farms control nutrient use and formed the basis for taxing nutrient surpluses in agriculture. At the same time, nutrient accounting presents important management information. The relationship of the nutrient accounting system with the obligatory financial accounting is discussed and evaluated in literature as crucial, for auditing purposes and for advice. The establishment of conformity of financial and nutrient accounts is considered as an important audit instrument of the nutrient system as a policy instrument (Breembroek, Koole et al., 1996).

More recently, other sustainability KPIs are gaining interests too (Iribarren, 2011). Environmental indicators can be derived from a cradle-to-farm-gate life cycle assessment, such as land occupation, non-renewable energy

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use, global warming potential, acidification potential, eutrophication potential and soil quality. Societal indicators are for example payments for agri-environmental measures and grazing hours in case of dairy farming.

The long list of potential farm-level indicators with at the same time a limited availability of data underscores the problems to establish a data-infrastructure of on farm-level indicators (FLINT, 2015). This will hamper sustainability-specific benchmarking (e.g., segments of producers which are aiming to reduce their environmental impact). Furthermore, there is a need for a sound benchmark assessing the effect of claims on economic, environmental and societal performance of adopters of innovative 'green' farm systems compared with those applying conventional practices (Dolman, 2014). Statistical matching methodologies for determination of net impacts and establishment of counterfactuals are required for measuring the impact of adoption (i.e., truly resulted from aiming at improving sustainability, and not from differences in farm structure).

3.4. ICT and benchmarks

Innovations in information and communication technology (ICT) have opened a window of opportunities for on-line benchmarking via computer or via smartphone (Kaloxylos et al., 2014). The sector will move away from a situation characterised by a low level of integration of data. Attempts are made at different speeds in MSs to develop and adopt information exchange in the agricultural sector.

Specific key elements for electronic data exchange in benchmarking are coordination and standardisation with respect to the formats used (e.g. EDI, XBRL, Agro-XML) of KPI's. Those information systems implemented or being developed should be aligned to meet the standard exchange formats. A standardised gateway for data exchange and communication is essential for several reasons; registration of identical data is avoided, simplified, and availability is enhanced. Yet, data security transfer of privacy-sensitive data has to be guaranteed. It should be noted that data analysis and exchange is not restricted to benchmarking purposes only, the main driver of this innovation is enhanced traceability to secure food quality.

Future internet investments propose new concepts for data exchange (Poppe et al, 2013). An innovative, cloud-based, file-sharing service based on a platform for data-transfer with cloud-technology may be the way forward. Cloud technology (that gives persons access to their data from different devices and places) makes sharing of data easier. Open data (in which governments or others share their data free of charge) is an example of sharing data. Together with the Internet of Things (using data from sensors, machines and other devices) this contributes to the era of big data. In such an architecture farm records can be matched with administrative and GIS data. Moreover, software and reports can be developed with which the indicators are reported back to farmers and added to their "dashboard" for monitoring their farm compared to others (Poppe, 2013).

It is expected that the food chain will become much more data-driven. Several actors in the food chain make already advanced use of ICT and experiment with new developments. The exchange of data will also make it possible to add more (computer) intelligence to the chain, including monitoring, problem notification, deviation management, planning and optimisation. However this is just the start of what could become a revolution in agriculture. Despite these development trends, electronic communication in food supply chains is currently still in its infancy and mainly restricted to providing online access or to email transmission of delivery characteristics (Theuvsen, 2010). Typical examples are cooperative processors of milk or meat and in livestock production, and processors of potatoes or wheat in arable production industries, who are starting to report on-line information of quantity and quality of produce delivered (and offering the service of benchmarking information of cooperative members).

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3.5. Benchmarking small and semi-subsistence farms (SSFs)

A one size fits all approach in benchmarking is not foreseen because of the heterogeneity of the existing farming systems. Specialised producers are because of economies of scale more likely to be targeted for benchmarking purposes by private stakeholders. Especially small and semi-subsistence farms (SSFs) have to be outreached differently for benchmarking purposes. SSFs account for almost half of all agricultural holdings in the EU (i.e., 5.8 million in 2010) of which 86% are in the NMSs (Davidova, 2013). These SSFs play a number of socio-economic roles. They maintain rural welfare, keep rural areas populated, contribute to the rural non-farm economy, and provide environmental public goods such as attractive landscapes (Davidova and Bailey, 2014).

Implementing and upscaling of benchmarking is faced with challenges in MSs in which there are a large number of SSFs. For example, SSF's generally keep limited records and therefore their performance is difficult to be benchmarked with their non-organised peers. Furthermore, it is questionable whether it is worth the effort to include SSFs in benchmarking systems, based on economic arguments only, since incentives to motivate adoption are limited. Moreover, the extension programme to reach these hard to reach farmers is confronted with inherent challenges. Rather than trying to reach all farmers directly, and thus pre-programming constant failure, the extension service in providing benchmarks should concentrate on contacting farmers expected to pass information on to fellow farmers with similar problems (Nagel, 1997). Alternative, media as TV or radio with large outreach can provide basic extension of benchmarks.

Despite drawbacks, a gradual introduction of benchmarking with numerous modalities of such system appears to be sound. It offers the prospect of improvement in the use of benchmarking over time. Therefore, a tailor-made and flexible system adapted to SSF's needs should be established without increasing the administrative burden. A first step could be that processors report their performance relative to other SSF's each time a delivery is made (e.g., milk content and somatic cell count in dairy farming, average slaughter weight and lean meat percentage in fattening pig farming). However, those SSFs only side-selling directly to the market are inherently hard to be reached.

4. Concluding remarks and discussion

The diffusion of benchmark adoption differs in pace between MS's and farming systems. Research on mapping of existing farm benchmarking systems, either public or private ones, is currently fragmented. This holds for relevant benchmark data for "day-to-day" management and more strategic decisions. A more in-depth mapping of benchmarking adoption was outside the scope of the current research. Moreover, the impact of benchmarking is inherently difficult to measure from observational data because of self-selection.

However, the current high-level analysis reveals that farmers are becoming more aware of the benefits that benchmarking can generate in order to improve productivity and sustainability performance. Also suppliers and food processors are becoming more interested to share information bringing advantages to all participating.

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Annex 3: Adoption survey of benchmarks in EU agriculture

Marcel van Asseldonk, Krijn Poppe[2]

1. Introduction

Adoption of benchmarks by farmers in EU member states is elicited among 20 experts which were also selected as member of the Focus Group (Annex 1). The experts consulted were selected such that it would represent the majority of the EU member states (and Switzerland). Elicited information was based on the expert judgement. The online survey was carried out in close co-operation, and coordinated with the EIP-AGRI Service Point and DG Agri.

2. Results

The descriptive statistics of the survey are provided in Figure 1. In approximately 50% of the member states the adoption rate is lower than 40% of the professional farmers (i.e. those that are responsible for 90% of production). While in approximately 20% of the member states adoption rate exceeds 60% of the professional farmers. In the dairy sector, granivore (pigs and poultry) sector and arable sector benchmarking is relatively well adopted, while other sectors such as permanent crops, horticulture and mixed farming are lagging. In the majority of the EU member states benchmarking mainly focusses on farm productivity (i.e., technical and economic indicators) for tactical decisions purposes at farm level. Approximately 50% of the EU member states benchmarks also sustainability performance (e.g., CO2 emissions, water user, nitrate and phosphor balances, pesticide impact points). In only 30% up to 40% of the EU member states indicators are used to benchmark cash flow statements for tactical decisions purposes or to benchmark results of parts of the farm (e.g., individual fields).

In the majority of EU member states with benchmark tools the benchmarks are freely provided (78%) by (semi) public organisations (i.e., advisory service providers, research institutes and experimental stations). Provision of benchmarks by other stakeholders in the agricultural value chain is available in 40% up to 50% of the EU member states (i.e., accounting offices, farmers' organisations, private advisors and consultants, ICT companies, input industry or food processing industry). Yet in approximately half of the EU member states there is an overarching coordination on the definition of the key indicators used, while only in approximately 20% EU member states there is coordination on the formats for electronic data exchange (e.g. EDI, XBRL, Agro-XML). In fact, in more than 40% of the EU member states the information is not digitally send but still exchanged on paper.

In approximately 80% of the EU member states benchmarks are discussed on a regular basis individually between a farmer and his advisor, or discussed in a peer group among farmers. Most commonly, a farmer compares his performance with the average of other similar farms in the region, while in 20% of the EU member states a more specific derived norm to account for structural characteristics of his farm is applied.

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Figure 1: Adoption of benchmarks by farmers in EU member states

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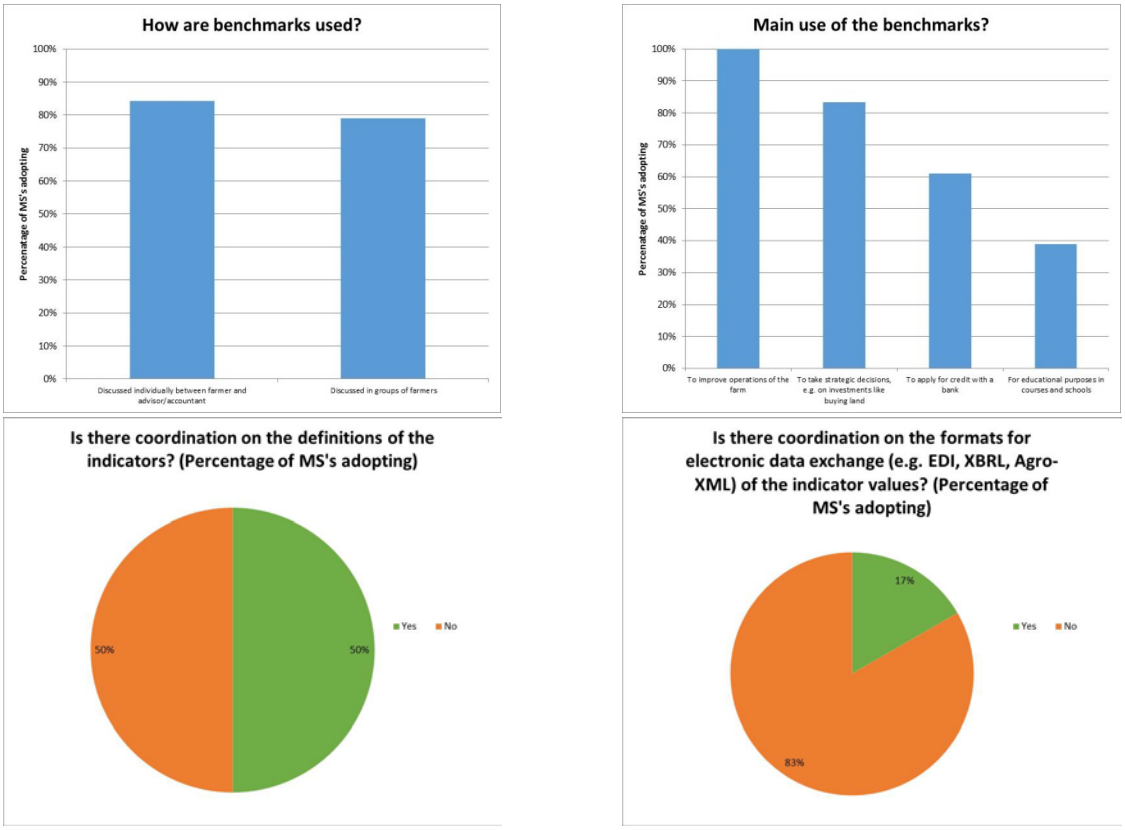

Figure 1: Adoption of benchmarks by farmers in EU member states - continued

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Annex 4: Mini paper 1: Why do we do benchmarking and what objectives are we aiming to meet?

Giles Blatchford[3], Raimond Dieulot[4], Cynthia Giagnocavo[5], Paola Pedroni[6], Jakob Vesterlund Olsen[7]

1. Introduction

Several definitions are useful to understand the objectives we are aiming to meet by using benchmarking. Mainly benchmarking is a process by which farmers and growers can innovate and develop their business by comparison to identify "best practice" or high performance being achieved by neighbours, competitors or by an entirely different industry. Moreover, benchmarking is a process for obtaining a measure – a benchmark, around which relative performance can be compared. The contrasts generated can be used to identify operational gaps and to develop competitive advantage. It is important for business managers to:

- Understand fully the objectives and strategic scope of benchmarking;
- To ensure that the data being compared is suitable to address the company's management objectives;
- Use benchmarking as a primary management tool;
- Understand that successful benchmarking is dependent on having homogenous, reliable and comparable data.

Benchmarking is important to aid and reassure farmers in strategic decisions making, understanding where markets and competitors are headed, and enabling innovative change, even though it is rarely the driving force of change. A study conducted in France considering the trajectories and motivations of farmers who have made change shows that change is a response to a level of dissatisfaction. Change arises from frustration or a perceived threat. The motivations to change are often linked to the farmer values: nature, environment, production intensification, reputation, as well as market conditions or consumer demands. For example, factors which can initiate a change are:

- To access to the unthinkable: a response to the unexpected, "the black swan event", such as not fertilizing pasture and have an increasing yields thanks to leguminous plants.
- Practical difficulties which pose a threat; can be financial, technical etc.
- External demands or obligations such as policies: environmental laws, subsidies.
- Inconsistency between what the farmer thinks and what he does.

2. Micro-benchmarking environment

2.1. Beneficiaries and contributors

The initiative in developing a farm level benchmarking tool is most likely involving the data-collectors. In some countries this might be the institution that collects data to FADN and in other countries farmers unions or supplies to the agricultural sector might have technical farm level data suitable to apply for benchmarking. I.e. organization of farmers varies from MS to MS and hence also the contributors vary from MS to MS.

The farmers are active contributors at this micro level. Farmers are naturally considered beneficiaries of this process but it should be remembered that they are also the primary contributors of data. Farmers supply extra information to make benchmarking more valid and reliable e.g. farm location, soil quality or type and climate. This is supplementary data necessary for benchmarking comparisons purposes, but which is not a natural part of on-farm record keeping. Often, farmers' groups can work better and obtain better results if they are linked

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to an applied research centre that offer experimental data and is more involved in the practical problems of agriculture.

2.2. What are the objectives and motivation to participate?

The motivation to participate in farm level benchmarking is intrinsic as farmers can assess their relative performance compared to other farmers with similar opportunities and production systems.

Most farm output can be described as commodity or sufficiently generic to be undifferentiated, although this depends greatly on the subsector. As such farmers, are price-takers with no direct influence on the "market" price, hence profitability is achievable by Cost Leadership as described by Porter's generic strategies for competitive advantage (Porter, 1980; Porter, 1985). This would include greater unit productivity or lower cost of production than their competitors. However, a significant number of farm production systems can also be identified that pursue Differentiated or Focused strategies, particularly those achieving quality standards and certification schemes, integrated or organic production, and foods which are either part of short supply chains or closely linked with consumer demand.

In all cases, benchmarking may help define and develop the strategic competitive advantage derived from following any combination of i) production cost management, ii) product differentiation or iii) marketing segmentation focus. Benchmarking is the most efficient way to disseminate innovation widely to achieve these ends.

When participating in benchmarking farm performance can be assessed though either i) an economic lens: for understanding costs and financial resilience ii) or through a technical lens: for the operational development and identifying best practices. What this narrow view of data fails to examine is the cause-effect relationship between the technical and economic indicators. This approach depends on farmer /advisor to choose which KPI will influence profitability most. Both lenses focus on making better operational and strategic decisions and in adopting new practices to improve productivity and profitability.

Using more comprehensive data including financial and physical data in the same survey not only give a richer 3 dimensional portrayal of production practices but also allows a clearer understanding of the opportunities for innovation.

2.3. Opportunity to motivate changes in farmer groups?

There is not a culture in farming of making change and adoption of new practice.. By benchmarking in farmer groups some impetus might be given to encouraging farmers into making change and adoption new practices. When benchmarking farm data in a peer group, farmers are more motivated to change their decision process and adopt innovative practices or change routines. The direct exchange of farm practice between farmers within same industry has a proven fruitful track record.

Farmers generally participate in benchmarking with an expectation that they will learn how to change daily routines to increase performance.

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Purposes of benchmarking for micro-environment analysis:

- Adopting new practice: In an industry that is very traditional and where processors can work in isolation for long periods, the adoption of new practice can meet with a majority of resistors. By bring people into peer groups and introducing those same ideas in a safe non-competitive environment this barrier to change can be softened.

- KPI focused benchmarking: KPIs can be used to help highlight specific areas of performance to enable farmers to transfer their learning to their daily operation. KPIs specifically selected for a particular operational type or with in a peer group is essential. More on this in Minipaper 5.

- Sharing established best practice: Benchmarking in groups allows best practice to be shared and leaders within a peer group might be a positive force in encouraging producers otherwise resistant to change.

- Identifying performance gaps: Benchmarking can both support decision-making (strategic and operational) by identifying gaps between own performance compared to a peer group. Farmers participate in benchmarking with an expectation to identify a potential performance gap.

- Social consistency: Benchmarking in groups is more likely to bring about changes in practice or decision making as the data reviewed in peer groups identifies producers at variance from the group norm, this results in a significant social encouragement to be consistent to a norm when that norm is out performing existing farm practice.

- Opportunity for innovation: Occasionally when reviewing data with in a groups there can be a moment of realisation that brings about a fundamental innovative change. This is only one form of innovative change. Group discussions might also contribute to small incremental changes on a road contributing to continuous improvement.

- Special cases: Occasionally a farmer might introduce a new production or a new process that allows a competitive advantage within the relevant market, maybe a niche market; in that case the farmer would not be inclined to share knowledge, so as to maintain advantage for as long as possible. Moreover, when the innovation is radical, with elements of novelty compared to the previous scenario, the innovator does not carry out benchmarking but instead sets new competitive standards and benchmarks for the sector. This sort of innovation might also be subject to protection from patent registration.

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2.4. Link between the Micro and Mesa Environments: Organisational objectives

Organisational objectives are different and dependent on which kind of organisation is offering the service. The following are the more common drivers:

- Farmer unions: Servicing the members
- Industry levy organisations: value for money, supporting the decision to pay levy. For example, in New Zealand the levy is paid only if a majority of producers vote for paying a levy. In Denmark the obligation to pay is decided by law. Funds are channelled to farmer unions and/or industry organisations.
- Processing firms / Cooperatives: Demonstrate that there is potential to have high yields and make a profit within this line of business. Aim of increasing the number of farmers interested in producing the product to the firm.
- Public organisation: The motivation is likely economic growth and development of the agricultural sector. Sometimes the public authorities are the only ones with the relevant data.

If benchmarking is a by-product of other processes it is very relevant for the farmer to interpret the benchmarking results from that context. If a processing plant (or any other supplier of benchmarking tool) is only showing the total yield per unit e.g. kg of sugar per hectare or milk per cow, then the farmer might use the maximum attainable yield as a goal. This is very likely not to be the optimal production intensity and it might from a sustainability perspective be overexploiting the resources used.

Benchmarking with the aim of pursuing excellence comparing one´s own performance with others might have a myopic effect because the focus is on improving current process/production instead of innovative processes.

3. Meso-benchmarking environment

For our purposes the “meso” level of analysis deals with the markets and the transactional environment of farm-business. A meso level analysis includes supply and demand, distribution, competition and how markets are designed and organised. In turn, the actors involved at the meso level include suppliers, wholesalers and intermediaries, distributors and retailers, competitors, strategic alliance partners and other entities that might drive product substitution.

The market can be divided into various areas of focus, such as regions or geographic areas; subsectors such as F&V, animal husbandry, arable crops, wine, oil, etc.; or supply or value chains of specialist production (i.e. organic). Relevant benchmarking data is dependent on the definition of the market place or level of meso analysis. Meso level benchmarking data includes an analysis of supply chain processes and transactions (including marine freight and transport costs); market share and marketing information; international competition and regional, national and international rankings. Benchmarking data on the meso scale is not only concerned with profit. It is also geared towards viability, which is a measure of performance efficiency that shows how well a wide range of resources available to farmers and related entities are used to sustain livelihoods. Finally, it considers overall industry or sector efficiency, which is the wise and sustainable use of the resources available, whether technical (producing the highest possible output from a given set of inputs) or economic (the financial returns from resources used).

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Purposes of benchmarking for meso-environment analysis:

Considering some of the meso level objectives helps to tie meso benchmarking back to the central question of this EIP group of improving farmer´s productivity and sustainability performance:

- Adaptation and Change.
  Create a framework which helps farmers to adapt farm activity to specific market and climate fluctuations in order to safeguard profitability of the sector in the medium and long term; Provide a vision for what farming can look like after change, as well as data, evidence and success cases to support change.

- Best Practices and Knowledge sharing.
  Provide a method to identify and create a community of best practice and knowledge sharing amongst vertical and horizontal supply chain participants with respect to creating value, spurring innovation and increasing efficiencies, profitability and sustainability; Inform replication of successful organisational design; Allow farmers to understand impact of introducing or adopting new enterprise forms or supply chain arrangements into the farming system; Increase transparency regarding farm results, value chains and their management.

- Solidarity and Social Capital.
  To build solidarity amongst national and international farm groups and their representatives in order to highlight or developing competitive advantage (whether based on subsectors, geographical region, specialised markets, etc.)

- Policy making and lobbying.
  Allow a better understanding of particular farming conditions and issues thus allowing the sector/industry to more clearly represent articulate and lobby using focused KPIs and benchmarking outcomes. This will add value for farmers who benchmark by generating the momentum and motivation for change.

- Food Safety and Security.
  Better ensure food safety and security on a systems level.

It is important to keep in mind the limits of benchmarking data for use at a Meso level. First of all, is the issue of who collects and owns the data, and how and with what resources. In addition, meso benchmarking may be a long term investment, not to mention a complex process if it is meant to include international benchmarking practices. Global markets are extremely volatile and benchmarking processes should be agile enough to respond. In addition, communication with farmers and other actors of the supply chain and market actors is difficult to coordinate.

4. Macro-benchmarking environment

The macro benchmarking analysis involves a more generic framework or context where farm conditions, and thus productivity and sustainability, are shaped by policy (international, national and regional), law and regulation, and import-export trade. In addition, macro conditions are influenced by economic and social developments and demographics, technical advances and environmental conditions.

The use of benchmarking data in the aggregate form may benefit the agricultural industry, and indirectly or directly the farmer, in achieving greater productivity and sustainability. Benchmarking may inform policy development, guide industry regulators and trade organisations, inform industry R&D+i, and provide a wealth of information for advisors and educational institutions. In general, an ideal macro benchmarking system would give clear indicators on where the greatest impact of policies for encouraging competitiveness, productivity and sustainability could be found.

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Purposes of benchmarking for macro-environment analysis include:

- Food Safety.
  Safeguard food security and safety and contribute to quality production by crafting quality regulation and requirements, through monitoring and evaluation which can give the end-consumer confidence in the provenance of their food.

- Rural Areas.
  Create sound social rural development policy and stimulate local economic growth through knowledge sharing and benchmarking territorial competitiveness which could allow increased productivity, profitability and efficiency in use of capital, labour, land and natural and geographical resources. By supporting competitive agricultural practices, which are contextual specific, the abandonment and isolation of rural areas may be reduced and employment and land ownership maintained.

- Economic.
  Allows identification of problems and correction of policy as economic issues emerge and aids in the identification of unintended policy outcomes; provides a “bottom up” method to assess impacts of policy, regulatory and institutional change. Overall provides a more conducive and enabling environment for farmers, with context specific solutions, so that they can achieve productivity and sustainability in a less volatile macro environment.

- Environmental.
  Inform policy on the protection, improvement and regeneration of farming environments, biodiversity and wise resource use. Focus on reduction of pollution and use of pesticides and overall protection of plants, water and air quality. Encourage reduction of energy use and support of renewable energy in agriculture.

- Governance.
  Increased transparency in formation of policy and management of economic and social development regulation and actions.

- Innovation and R&D.
  Allows prioritizing of which issues to investigate in greater depth and ensure that famers have adequate institutional measures and resources to become more productive and sustainable.

Limitations of macro benchmarking relates to time lag of aggregating benchmarking data, determining whether such benchmarking data is reliable enough and relevant so that policy should be based on it; problems of communication between farmers and policy makers. Trade policy and agreements are not based upon productivity and sustainability but rather on global politics, such that benchmarking on a macro scale may prove less effective. However, benchmarking may provide a basis to assess the likely impacts of change processes.

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5. Conclusions

The primary beneficiary must be the benchmarkee or people actively engaged in the process, for the purposes of this paper, farmer and grower decision makers (including farm advisors). Their motivation in this process will generally also be to increase productivity and profitability or to improve the strategic competitive advantage of the business.

The data considered in the process can include a range of comparable financial or physical performance benchmarks. This provides a tool-box for the farmer decision maker and potentially increases the usefulness of advisors. We consider this direct beneficiary in the Micro-benchmarking environment level.

An analysis of benchmarking at only a farm level (micro-benchmarking environment level) disregards the wider advantages that benchmarking activity may realise. Equally, limiting benchmarking comparisons to the micro-economic level fails to maximise the development of competitive advantages in a globalised market and may not successfully link with industry strategic objectives.

By having access to benchmark data, businesses both upstream and downstream in the farm food supply chain can also benefit. This both helps plan resources and allows other business to adjust to seasonal fluctuations and variations. This group of beneficiaries are in the Meso-benchmarking environment.

Society as a whole benefit from increased and sustainable farm productivity via better resource use efficiency impacting on social and natural environments. Increased competitiveness from the land based production contributes to local and regional economies and human wellbeing in the long run. This is described as the Macro-benchmarking environment.

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Annex 5: Mini paper 2: Management of data collection and processing

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1. Introduction

Lack of understanding of the importance of benchmarking at producer level, perceived increased bureaucracy and concern over potential surveillance opportunity created by collecting and sharing data in addition to small scale production are barriers to farmers embracing benchmarking. An increased focus on farm performance analysis and how best to use data in daily life would enhance the quality, robustness and appetite for collecting, storing and providing data for the purposes of benchmark analysis. Within this mini paper crucial elements of successful data management and processing for successful and effective benchmarking will be discussed.

2. Supportive data collection and sharing environment

Fundamental to the success of any data management system which involves the collection of data from different aspects of the supply chain is a cooperative culture and sharing environment. This positive culture can be encouraged when strategies such as 'once only' are implemented to help reduce administrative burdens and cut red tape whilst being embedded throughout the supply chain to enhance the efficiency and effectiveness of political, commercial and legislative decisions. 'Once only' strategies are built on trust with robust data sharing agreements being critical so that information provided once can be shared for multiple purposes.

Recently positive developments have occurred in this area in many European countries[13], as well as at the European level through a host of plans and actions. At the European level these concerted efforts are part of the Digital Agenda for Europe (Digital Agenda in the Europe 2020 strategy, 2015), government Action Plans (e.g., The European eGovernment, 2010), Interoperability Solutions for European Public Administration – ISA (About ISA, 2015; ISA², 2015) or legislation on reuse of public sector information (European legislation on reuse of public sector information, 2015).

The key strategies used to achieve the 'Efficient and Effective Government', distinct - yet also overlapping, interdependent and highly synergistic, are listed below (Study on eGovernment and the reduction of administrative burden , 2014). These could be applied also with respect to benchmarking data in agriculture:

'Once only' strategies; The objective is on one hand to collect the same data 'once only' to reduce respondent burden on farmers and on the other hand to make the most out of this data for producers and advisers as the key users of this data. The key building blocks are high level of interoperability and data exchange (common architecture, data collection and processing automation), 'base' or central registries (centralization optional), high level of data quality management, and data protection by default.

'Simplification and personalization' strategies; The objective is to make collection and use of the data and information for key users as easy and quick as possible. The key building blocks are simplification and reduction of processes (i.e., forms) as well as of reporting, user-centered design of data collection and services (to increase user friendliness and experience) and personalization of information and services. Quick win strategies could be for example 'point of single contact', 'single entry point' (such as Dutch www.agrofoodportal.com), standardized semantics at a European level, personalized feedback (reporting) and advisory services (such as Irish eProfit Monitor by Teagasc[14]).

'Digital-by-default' strategies. The objective is to promote the use of electronic/online procedures as primary in data collection and processing, and thus massively reduce costs and time, as well as increase the convenience

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[12] Agri-Food and Biosciences Institute, United Kingdom
[13] Scandinavian countries are widely regarded as the frontrunners (see in e.g., World Bank, 2007; Study on eGovernment and the reduction of administrative burden, 2014).
[14] http://www.teagasc.ie/advisory/farm_management/epm/index.asp (Retrieved January 26th 2016)

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for data providers and users in the long-term. The key building blocks are the appropriate ICT infrastructures and systems (widespread, high capacity, affordable), appropriate ICT skills and internet use, appropriate selection of which services are to be digital by default (direct contact with farmers remains very important, especially in advisory!), and good support to those who are not or cannot use digital by default channels. Quick win strategies include focusing on most widely used or large benchmarking systems and databases (e.g., FADN, animal traceability databases), having an efficient and timely exchange of best practices in building appropriate ICT capacities at a European level, developing digital skills of the users and supporting the ones with incapacities.

3. Data ownership, confidentiality and privacy

Benchmarking is reliant on the provision and sharing of data, often from multiple sources therefore a prerequisite to success is clear, robust and binding data sharing / confidentiality agreements. Common questions of who owns the data, who has access to the data and who can share the data have become all the more critical in recent times with confusion possible and grey areas in data generated by third parties, software providers, 'cloud' based management systems and the Internet of things technologies.

Data owners are usually easily identified as: physical or business entities. In each country data security is ensured by law. Personal data in Member states is protected by the Personal Data Protection Law and at EU level these data are protected by Directive 95/46/EC.

Data managers must ensure that personal data will be (minimum requirements):

- Collected for defined and legitimate purposes;
- Processed accurately, fairly and lawfully;
- Accurate and, if necessary, constantly updated;
- Kept in such a form that the identity of data entities could be identified for no longer than necessary to achieve the objectives for which the data have been collected and processed;
- With appropriate technical and organizational measures to protect personal data against accidental or unlawful destruction, change, disclosure as well as against any other unlawful processing, will be implemented.

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Data protection is named differently in various information or data protection manuals and guides, however, the three main levels of data protection regulations are highlighted:

- Administrative – technical security;
  Defined as an organization of technical measures ensuring the information security (paper and electronic). Security policy regulations, which clearly define which information is protected and which is not, can be attributed to this level. Protection organization using technical means can be attributed to this level as well (e.g., installing firewalls, anti-virus software installation). Equally important is determination of users' rights in computerized systems.

- Physical security;
  Comprises methods designed to protect computer hardware and technical means of communication from the physical effects of outside forces. Natural disasters and technical faults, which may lead to significant damage or destruction of important data, can be attributed to such forces.

- Legal regulation; Introduction of regulatory package, which regulates employee behavior with relevant data and information of commercial secrets of companies, are attributed to this level.

4. Types of data used for benchmarking, common language and definitions

Important sources of data which are currently or of potential use for benchmarking in agriculture include:

- Accountancy data (e.g. FADN[15] or other accountancy data); together with the analysis provide significant business economic information. For example, in Lithuania proposals are in place to ensure that bookkeeping is a main source for analysis, since every business must pay taxes therefore retain financial information.

- Official statistics data (e.g. Farm Structure Surveys, Economic accounts for agriculture);

- Specific administrative registers (e.g. animal traceability databases, land use and ownership databases, producer and subsidies registers, animal veterinary drug use registers);

- Industry supply/processor databases; For example in Northern Ireland cattle abattoirs share data enabling the development of online benchmarking systems at a producer level (BovIS, 2015);

- Technical data inputted by primary producers directly or collected by specialist bodies e.g. feed use, fertilizer use, purchases and sales etc;

- Machine/sensor derived data; (e.g. yield and quality data direct from harvesting equipment, animal performance data direct from monitoring equipment).

[15] European Union countries have been collecting, processing and transferring structural/technical and economic information on agricultural holdings through the Farm Accountancy Data Network (FADN) survey since 1965. The European Commission publish standard results according to shared definitions on the website at an aggregate level. FADN data is used to analyse the overall agricultural sector of the country and it is less suited to evaluate farm operational efficiency and competitiveness because data is not published at farm level. However within a country, single farm benchmarking can be accomplished by comparing own results to a reference group, however due to privacy issues such performance results are limited to single farms participating to the survey (i.e. Italian farm dashboard- Cruscotto aziendale http://www.cruscottoaziendale.inea.it/Login.aspx).

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With such a wide range of benchmarking metrics used within the agri-food industry it is important to have a common language relating to types of data and definitions. This is critical within the regions to enable effective benchmarking, but also to promote producer and adviser understanding. Further, it is also becoming increasingly important at a cross-country level to enable robust comparisons in production systems with different environmental, political and socio demographic conditions but it must be noted that country specific legislation, regulatory requirements, pricing structures for example may make cross country comparisons difficult and not that useful to a primary producer.

Currently there are many unresolved issues related to common terminology, language, data and method of analysis with unified fully integrated database and collection systems limited in numbers internationally (e.g. Irish Cattle Breeders Federation - ICBF). This is mainly due to the fact, that data is generated and collected by many different stakeholder organisations (commercial, private, government) within the agri-food supply chain, but held and processed separately with no common system to collate and process. In addition, different data managers might use different methods to calculate the same indicators. Therefore, the value of the same indicator from different sources can differ (e.g., average productivity of wheat), which means that the data can be difficult to interpret and use for comparison purposes.

In solving issues linked to different methods of data collection and processing, it should be ensured that the data used in the analysis are:

- Collected, stored and processed by a common methodology (e.g., of calculating specific indicators), irrespective of their managers. Organisations such as the International Committee for Animal Recording (ICAR), International Dairy Federation (IDF) and the Sustainable Agriculture Initiate (SAI) endeavour to standardise methodologies, definitions and data languages;
- Accompanied by Metadata;
- Of various types covering economic, financial, environmental and social aspects in order to be able to carry out a comprehensive and detailed analysis for different users and purposes;
- Obtained from sufficiently large and representative numbers of respondents in order to have reliable and meaningful results. Representative sampling techniques and analysis must be standardised to ensure robust like for like comparisons are performed when necessary.

5. Database structure and platform for sharing data

The database structure and platform for sharing of data is dependent on the data driven culture and environment for sharing of data and the participation in the ‘Once only’ and ‘Digital-by-default’ strategies. Traditionally, data was manually entered and held in separate databases with limited cross database analysis/sharing. Information technology developments now enable automatic sharing of data and real time analytics effectively meaning that if the environment, security and legal aspects are in place multiple databases can be treated as a single connected database with customised dashboards allowing for endless data extraction and analytic opportunities. Critical for effective and efficient database interrogation and management is both solid and robust metadata and index keys enabling the linkages across databases.

The database structure and platform for sharing of data is dependent on the data driven culture and environment for sharing of data and the participation in the ‘Once only’ and ‘Digital-by-default’ strategies. Traditionally, data was manually entered and held in separate databases with limited cross database analysis/sharing. Information technology developments now enable automatic sharing of data and real time analytics effectively meaning that if the environment, security and legal aspects are in place multiple databases can be treated as a single connected database with customised dashboards allowing for endless data extraction and analytic opportunities. Critical for effective and efficient database interrogation and management is both solid and robust metadata and index keys enabling the linkages across databases.

With the appropriate infrastructure and sharing agreements in place the data can be assessable by multiple users such as discussion groups, veterinaries, advisors, researchers and quality assurance inspectors in a quick

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and efficient manner with the same data used for all analytics therefore standardising results/methodologies and reducing the risk for error or mixed messages. Who houses and controls the database is often debated with independent industry bodies or organisations at arm's length from government often seen as the best solution to help build trust and confidence to share data.

6. Data collection

Historically different approaches have been adopted for the data collection process and it can depend on the intended level of resolution, e.g. general level of production or exact financial performance by enterprise within a complete business. FADN draws on different methods of data collection such as British Farm Business Survey, the French CER survey and the Danish farm survey system. The benchmarking data collection processes often fall under government control; below are the common collection options:

Producer collection: Templates are developed and provided to farmers for self-populating and return. One such example is the Agriculture and Horticulture Development Board (AHDB), a producer levy board which has recently embarked upon a scheme, 'Stocktake', (http://stocktake.ahdb.org.uk/) involving farmers completing a simple forms with basic production information. Advantages and disadvantages of this type of collection system:

- Advantages
  - Simple guided electronic data collection;
  - Self-management system reducing data collection cost.

- Disadvantages
  - Relies on self-motivation to participate and skills to enter data which is timely and accurate;
  - Careful design required to ensure correct language and data asked for and entry method often has to be simplified to help ensure accuracy;
  - Validation processes can be complicated or lack robustness.

Government collection: Benchmarking information can be collected by government agencies which appoint staff to visit farms and record data. This approach has been modified by the Department of Agriculture and Rural Development in Northern Ireland (DARD) which has appointed an independent agent to collect farm benchmark data, cleanse it and enter the information into the DARD IT System. This system has been very successful, increasing farmer participation threefold during the lifespan of the contract (CAFRE Beef and Sheep Benchmarking Report 2014). Advantages and disadvantages of this type of collection system:

- Advantages
  - Agent training produces collection of timely, standardized, accurate data;
  - Data collection can be refined and improved in an integrated manner;
  - Rapport with farmers overcomes issues of confidentiality and access to sensitive information.

- Disadvantages
  - The process does not train the client to collect data independently;
  - Data collection can be costlier as a result.

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Automated supply chain provision of data: Data collection via developments in information technology has become more common with potential for physical, financial and environmental benchmarking. Examples include systems developed by ICBF and Teagasc in Ireland (see also paragraph 7.1 in Annex 6) and the BovIS and PiGIS systems developed by the Agri-Food and Biosciences Institute in Northern Ireland whereby data is collated automatically from each link in the supply chain including government databases to create online and paper based benchmarking services and livestock genetic improvement programmes. Advantages and disadvantages of this type of collection system:

- Advantages
  - Cost effective;
  - Provides quality data relevant to each link in the supply chain.

- Disadvantages
  - Accuracy of entered data can be variable;
  - Lack of available internet/broadband and IT knowledge;
  - Confidentiality issues and reluctance to send sensitive financial information over the internet.

7. Quality control and data validation

Quality control and validation of the benchmarking data is a vital part of the benchmarking process. In 1991 the network of the European Dairy Farmers (EDF) was founded to explore the feasibility of on-going farm benchmarking. They identified that one major problem with existing systems was that data collection was not validated by experts (EDF Report 1991).

An efficient system of data quality checks and validation involves dedicated data collectors who collect the data directly from the farmers. They then present the data to experts who validate the data to ensure accuracy and consistency between the benchmarks. Any inaccuracies can be referred back to the data collector to either check presentation of the data or to request further information from the farmer. Unless data can be supported by a robust validation process it can result in the eventual database being corrupted by unreliable data. In Northern Ireland the validators are allocated to a specific enterprise type and this has reduced greatly the tendency of some farmers to miss important enterprise specific data.

In 2003 a dairy industry group in New Zealand (KPI Working Group) set out to design a bespoke benchmarking system. It produced a process similar to the one described above whereby the farm business owner is able to authorize any one or more rural professionals to enter data into the system. The initial data is entered over the internet to a validation or scratchpad area. Once the data has been validated or passed through a series of checks it is transferred into the actual database.

8. Key questions for innovative action

What progress has been achieved towards sharing of agri-food related benchmarking data within and across Member states? What are the barriers to progress? It is important that the following issues are addressed in future work:

Development of an inventory of farm assessment tools and benchmarking systems across the EU. This would include a best practice library, evaluation of bottleneck issues and proposals for operational solutions and innovative actions.

Detailed case studies required of best practice in data collection and management use for livestock, crop and horticulture benchmarking activities. These could be used as templates to build upon across the EU and form the basis of operational groups. Case studies would also be used to highlight how to use data on a day to day basis to realise benefits for each stakeholder in the industry.

The operational groups through a coordinating (accreditation) body at an EU level would, firstly, identify the key needs of all stakeholders regarding the benchmarking data. Secondly this body would propose specific targets and approach to reduce the administrative burden (standardisation of common language and

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methodology, etc.) and increase the reuse of benchmarking data in agriculture. This approach should be modeled by the 'best in class' and harmonized at an EU level, yet be flexible enough for the Member States to reflect specific needs of their farmers, regions and countries.

9. Conclusions

Efficient, effective and secure data management systems which incorporate the collection, validation, storage and analytical aspects of data handling are fundamental requirements of any benchmarking system. Failure or sub optimal performance any of these aspects will reduce the quality of the benchmarking outputs, confidence in the findings, willingness to share data and eventual uptake of any recommendations. An inventory of 'best practice' systems currently used in the EU, how they were developed, obstacles overcome during the process and how uptake was encouraged is urgently required. This will provide a pathway which can be built upon to promote the potential of benchmarking, create enhanced benchmarking capabilities and develop a common data language aiding comparison across enterprises, regions or countries.

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Annex 6: Mini paper 3: Role of the farmer in benchmarking and data management

Antonella Bodini[16], Kevin Connolly[17], Edgar Garcia Manzanilla[18], Fleur Marchand[19]

1. Introduction

Building a benchmarking system is an interactive long term process that has to be done with and for the farmers. Systems that are developed by "experts" for farmers but without significant farmer input will most probably fail. There has to be value for the farmer in the process from the beginning to engage them and make the most out of it. Benchmarking should **not** be used **only** as a comparative tool but it should also facilitate farmer's individual and peer to peer learning in relation to the operational processes impacting on profitability. In order to establish the benchmarking process we need to discuss with the farmer what data we have, what data would be useful to collect and how are we going to share it and use it. Some agricultural practices and some countries have already benchmarking and advisory systems that involve the farmers in an efficient way. There is a value on describing and discussing examples of success.

Key to the success of benchmarking system is to answer the main questions of farmers and advisers as part of their management of the farming business. These *Key Performance Questions* will determine what data is required and how it is presented back to the user with the ultimate aim of assisting them in managing their business better by making better decisions. Early-stage users of benchmarking may well be happy with answering the question "How am I doing versus the average or best in class?" but as the users mature and become comfortable with the process then they often want to use the benchmarking process to answer the more stubborn question of "how can I improve?".

The main farmer's roles in the benchmarking process are: 1) Provide the data in the correct format and quality; 2) Interpret the benchmarking analysis when it is produced; 3) Create an action list / decision list for change based on the analysis.

2. Providing the data

The benchmarking input data harvesting step is key for the farmer to take an active role in. With the advancement in cloud technology and data transfer systems farm level data can often be sourced electronically, thus removing the hard work in the data collection process. There are also a number of benchmarking systems that utilise a bureau or recorder service to assist in data gathering.

The question remains that if the farmer does not develop a "feel" for the raw input data by either collecting it and organising it themselves or by utilising a regular monitoring system (electronic or otherwise), which they themselves regularly interact with, then will they be proficient at linking back the final analysis to the day-to-day data and management tasks that drive performance on the farm? If they are not proficient in this step will the impact of the benchmarking process be lessened?

The concept of a farmer controlled virtual repository for all farm data has the potential to greatly streamline the process of data collation for benchmarking. Key transaction data from business activity could potentially be collected over the course of the business year and combined with physical metrics associated with these transactions which could later form part of the "drill down" process when benchmarking is carried out so as to help the farmer understand the reasons for the gap.

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[17] TEAGASC, Rural Economy and Development Programme – Financial Management Department, Ireland
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3. Interpreting the analysis

Providing the analysis in a format that is understandable by the farmer is a key function of any benchmarking system. There is often a balancing act between providing enough detail in the analysis to give the farmer the information they need and not suffocating them with unwanted details which clouds their understanding of the key issues.

The ICT capability is surely available to allow benchmarking systems to be dynamic in the way the analysis is presented – allowing reports to be tailored based on the end-users experience in consuming analysis data or their thirst for detail. Some benchmarking systems rely on a knowledge transfer adviser or agent to distil the analysis to suit the end user. In the absence of such a service the farmer must be capable of understanding the analysis reports produced from the benchmarking system.

Key question Should every benchmarking system provide a graded structure for its reports – initially providing high level summary information yet also giving the option to drill down into increasing levels of detail as required by the farmer? This could be easily available as part of online viewing of the data but must also be replicated in any hardcopy presentation of the results which is how most farmers will consume the analysis.

4. Using the benchmarking analysis to support decision making

For the process to have a measurable impact then the analysis should prompt and support changes in the management of the business to increase productivity, efficiency and ultimately profitability.

Experience has shown that farmers benefit greatly from a second opinion from either their peer group or from a knowledge transfer adviser during the decision making process. For peer-to-peer interaction the use of social media channels such as blogs or instant messaging groups could be used by farmers to assist them in clarifying how to react to what.

In Knowledge Transfer (KT) activities in Ireland Teagasc KT advisers utilise the forum provided in farmer discussion groups to tease out the main trends in farm performance revealed by the group benchmarking analysis. Mature groups (in terms of time spent meeting as a group) then often move on to target setting and actions identification to set out the main operational decisions that need to be taken to improve farm performance.

This may then be often followed by an individual one-to-one consultation with the adviser to fine –tune the action plan for the year ahead.

Key question Can the data from one benchmarking system be easily combined with data from other systems (interoperability of the data is key here) to make understanding what areas to focus on to implement change? Can the system handle scenario (What-if?) analysis so that the end user can test potential production system changes using the data?

Agencies that hold farm data that would be useful in a farm benchmarking analysis, either stand alone or combined with other data, would likely have to see some incentive for them in putting the systems in place to collate and transfer the data either directly to a benchmarking service or to individual farmers' data repositories. This incentive could well be just that they are better able to utilise aggregated data to inform their marketing decisions or for other reasons.

Key to the benchmarking process having an eventual impact in influencing farm financial performance is the ability to utilise the resulting analysis in financial projections or budgeting as part of the strategic planning process for the farm.

An integrated short term projection "tool" as well as a long term forward planner should be part of the suite of programmes "feeding" off the benchmarking analysis. Farmers are more likely to value benchmarking as a process and continue to participate in it for the long term if they see added value in what the benchmarking analysis can give them to help in improving farm business financial performance.

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5. Identifying the data required for the process

Farmers are obliged to collect data in a book for agrochemicals/agricultural inputs and in the book for livestock management, therefore farmers hold useful information on environmental and technical issues. Besides keeping records of the amount of inputs used, farmers have receipts of inputs bought and products sold, so they hold economic information as well. However accounting books are not always kept regularly and in the same way around member states. The quality and completeness of the baseline data for benchmarking is of obvious importance for the success of any system. Farmers usually need a few key information metrics to assess their own performance. Information should be presented in an understandable and concise manner, better if accompanied by a definition of terms.

Key question: There is an increasing demand for "real time" benchmarking based on what is happening on the farm business now rather than benchmarking based on historic data. Can robust benchmarking systems be developed using the latest cloud technology for data storage, transfer and analysis as well as mobile technology to and to meet this demand?

If the benchmarking process is taking place through the medium of monetary financial measures then it is vital that there is enough supplementary information (physical, technical or other financial measures) to allow the benchmarking process to point the way towards changes to improve performance. Typical physical measures would include hectares, kilograms of saleable products produced (milk, meat, crops), effective grazable area (dairy milking platform), economic breeding index (EBI) of herd etc.

6. How to compare data

Farm benchmarking should follow a bottom-up approach (micro level). Farmers need to know their performance in comparison to peers in order to understand weaknesses and strengths given a shared starting point/common ground. Benchmarking should not be used only as a comparative tool but it should also facilitate farmer's individual and peer to peer learning in relation to the operational processes impacting on profitability. Comparisons should be done only within homogeneous groups of farms according to farm type and economic size (i.e. crops cultivated, animal bred, farm assets in terms of Utilized agricultural area, machinery and equipment, geographical area). However it is not necessary to aim for complete homogeneity in the groupings of farms prior to carrying out the benchmarking process as farming businesses by their nature are going to be different. The key criteria to make benchmarking "work" at farm level is whether the farmer (in conjunction with his knowledge transfer adviser) can identify where the performance differences are occurring and can get behind the headline data to see the main management, efficiency or market factors that are influencing the differences.

7. Presentation and visualization of data

The less the contact between researcher/advisers and farmers the less they will speak the same language. In many cases it is said that the farmers need to be taught how to understand and use the data but it works the other way around for the advisers and researchers. In many cases farmers have very little time to spare and the effort should be done by advisers and researchers to understand the way they see the world and what kind of data they really need. The data should be presented and discussed with the farmer in different ways until an optimal format is found. There is a huge variation in the ability of farmers to interact with advisers depending on factors like age or education. Thus, as previously outlined it may be needed to have the data available in different ways to different people. There is also the need for data to be discussed at individual and group level and to have the data available in a repository in a simple comprehensive format.

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8. Description of best practices in benchmarking from selected member states

In this section two examples of benchmarking tools are described.

8.1. eProfit Monitor as an example of livestock farms in Ireland

The Teagasc eProfit Monitor (http://www.teagasc.ie/advisory/farm_management/epm/_index.asp) is an online tool to facilitate annual financial benchmarking on Irish farms. It allows farms operating dairy, cattle, sheep, tillage and pig enterprises to analyse key financial and physical data for the last completed production year (usually standardised at the calendar year) to be entered by the farmer and/or his adviser into the ePM system. Typically the farmers that use the system interact with the Teagasc advisory knowledge transfer service and participate in discussion groups allowing peer-to-peer sharing of data to assist in the benchmarking process.

Strengths

- Electronic webservice linkages have been put in place to facilitate the gathering of input data from already available electronic sources, thereby freeing up both the farmer and the adviser's time to concentrate on fully digesting the analysis.

- Key to the interpretation of the analysis is the usage of the data by the Teagasc Knowledge Transfer advisory service as part of its discussion group KT mechanism. Individual benchmarking analysis is both discussed with the farmer individually and also discussed during discussion group meetings with the farmer present where other discussion group members are encouraged to comment of the strengths/ weaknesses revealed in the analysis as well as suggesting action plans to improve future performance.

Weaknesses

- Links to underlying data which points to the reason for farm strengths and weaknesses often relies on linking ePM data to other data sets/ sources (such as grass utilisation data or breeding data). This takes time and can often be hindered by lack of data interoperability between data sets.

- Collecting a similar level of non-financial data within the eProfit Monitor system would not be feasible so efforts are continuing to make the data easily collatable from multiple systems.

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8.2. The Italian farm dashboard as an example of FADN farm benchmarking

In Italy the liaison agency for FADN (Regulation (EU) No 385/2012 on farm return) has developed a tool for farmers participating to the survey (Cruscotto aziendale – Farm dashboard http://www.cruscottoaziendale.inea.it/Login.aspx). At the end of each survey farmers can access to a website where they can consult their own results and also see how their performance is ranked compared to a reference group and on a time series (according to the years when farms have participated to the survey).

Strengths

- Richness of information. Farmers can compare own holding to peers according to structural, economic, financial and environmental indicators.
- Individual benchmarking analysis is discussed between FADN data collector and the farmer.
- Use of time series to describe individual farm trends.

Weaknesses

- Timeliness. The availability of data to the farmers is at least a year after the end of the accounting year analysed by the FADN.
- Use of indicators that are not easily used by farmers if not explained.

9. Conclusions

Given the analysis above, some recommendations were identified:

- Farmers should be involved in data collection and management useful to benchmarking. This involvement should be at a minimum reviewing the background transaction data that feeds through to the benchmarking system. An authentication/ authorisation step initiated by the farmer to allow the data from multiple sources to be combined would be a useful way too.
- Farmers could be involved in benchmarking through training in order to comprehend why it is important to develop and use benchmarking.
- Farmers should be involved in identification of key performance indicators.
- General definitions of key indicators should accompany dissemination tools.
- Key indicators should be simple, few and shared among Member states and/or within the same type of agricultural holdings.
- A list of key performance indicators should be identified and calculated with the same methodology in all member states to make cross country comparisons.
- Performance indicators should stem from data easily available from the farmers themselves.

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Annex 7: Mini paper 4: A farmer's perspective to data management for benchmarking

Aila Riikonen[20], Lorcan McCabe[21], Krijn Poppe[22]

1. Introduction

We now live in the digital age. The explosive growth in digital technology has fundamentally changed the way we now communicate and share information Technology has become an indispensable part of our lives. Agriculture needs to collect and process data to make strategies and daily decisions is one area that digital technology has a lot of benefits to give. There is possibility to gather information from farm processes more than ever before by using modern technologies. We need to get a better benefit of these technologies in farming also.

In this mini paper we discuss how information and communication technology (ICT) might benefit benchmarking for farmers. We stress the view of the farmer. This is important as a lot of benchmarking data is related to farm performance and income, and therefore at least commercially sensitive and often also associated with privacy issues (even if that is not the case in a legal sense). We think that the following design principles should be applied in developing digital benchmarking systems:

- Data gathering should be as simple as possible. Farmers should not be asked to enter data that is already available in a system, on the farm or with a supplier, buyer, advisor or government agency (see section 2).
- Farmers should be able to build their own dashboard with indicators, based on their interest e.g. the bottlenecks they want to manage or their management style (see section 3).
- Farmers should be able manage the data that they "own", that is the data that is related to their farm (see section 4).
- Farmers should receive feedback on their management as soon as possible after their decisions have taken effect, in a digital age benchmarking only on a yearly basis is not the most effective solution (see section 5).

[20] Farmer, Finland

[21] Farmer, Ireland

[22] Wageningen Economic Research, Wageningen UR, The Netherlands

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2. Simplification farmers data management

To be simple, data collection needs to be to done automatically. The biggest problem at this moment is that typically farm-data collecting systems are stand-alone that cannot take advantage of the data provided by other systems without user involvement. In Finland at the Natural Resources Institute (LUKE) there is a research going on in which there is a target to collect all farm related data to one data base and process farm indicators from that data base. The idea of central benchmarking is shown the diagram below:

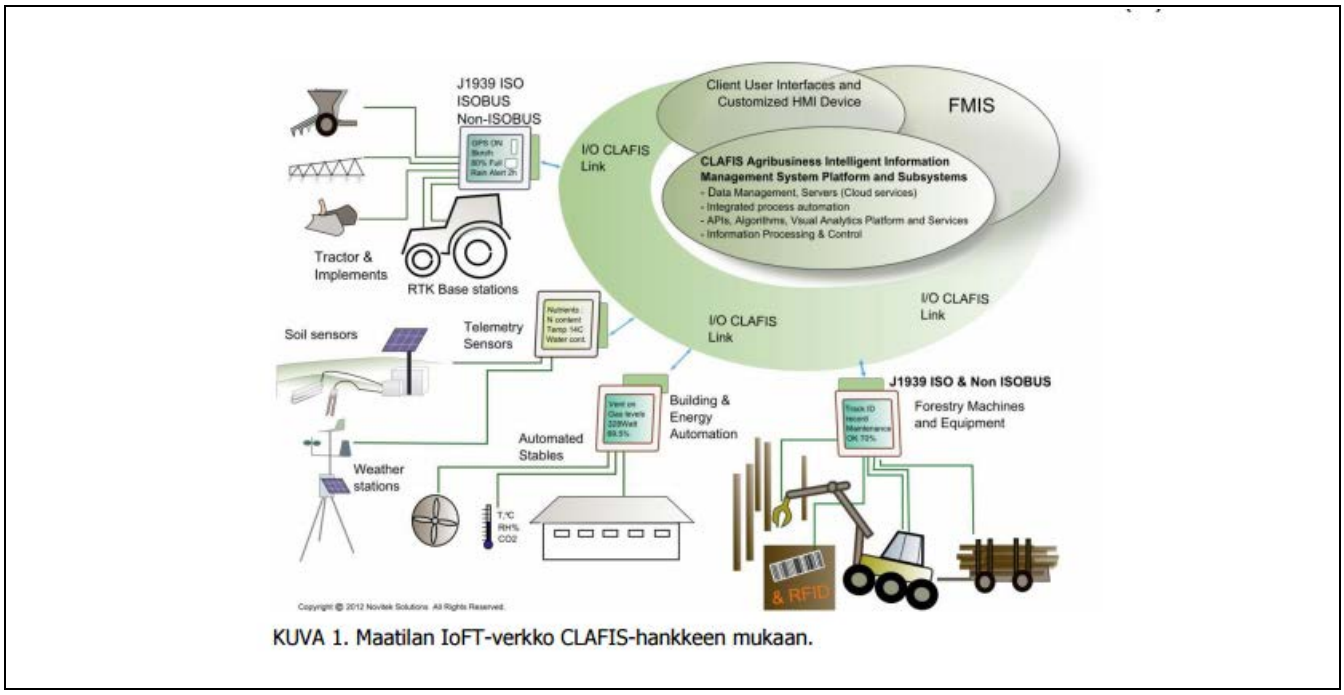

Figure 1: According to CLAFIS-project model of farm based IoFT-net (Luke Finland)

Anyway this is not possible yet on big scale. In the future, companies might not be interested in developing such a complex system as a commercial version, so the development of such a central data-base on farm level will face insurmountable barriers.

The other approach to simplify data management on farms is the situation that occurs now – separated data-bases. We need to accept that the information is not in one place. But we put effort on agreements of common standards and the exchange of data between different operators that manage the farm related data.

There might be new openings for new business models in this kind of action. New indicators combining data from different farming processes could be created to be used in decision making. The most valuable effect of common standard is that farmers do not need any more to move manually data from one system to another. Simplification in the collection of data will be crucial.

One benefit of a common standard is that the farming data would be comparable cross the whole Europe. Most of software solutions and ICT innovations concerning farming are national. Because of declining amount of farmers across Europe the price of ICT solutions is rising too high to be acceptable. This is slowing down the development. By common standard ICT users group would be wider and innovation among ICT solutions could be done in faster rate.

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3. Easy access and additional data, farmer's possibility to select indicator on

Effective management of the collection of the data to ensure its quality and reliability is one key issue. In collecting data from farms we need to get away from collecting data that is needed only for official purposes. We need to head towards collecting data for single farm purpose to support the decision making on farm based on its own strengths and resources.

If collected data and indicators are not used on farms there is no use of this action involved technology. First of all there is a question of how decisions are made on the farm, what are the values of the farmer and also what are the demands of surrounding society. If there is farmer based demand to improve the farming process and also the surrounding society reward the better results, it is natural to use benchmarking data to make decisions on the farm. In this case it is needed also to think about how the data is used systemically in decision making, see chart:

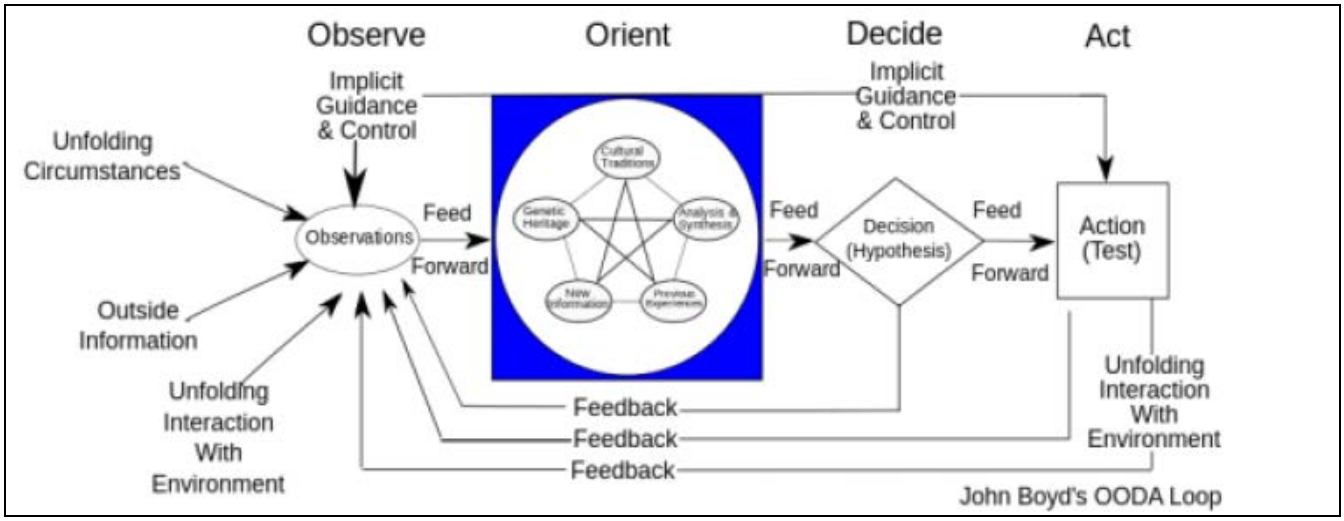

Figure 2: OODA-loop

After a farmer has decided the indicators to be followed during a certain year there need to be easy access to the data. New mobile technology applications are an interesting way to use the indicators and farm data on daily basis. This technology is also worldwide and cheap to use. One is most of the time carrying a device along and by it is easy to connect farm advisor on urgent subjects by e-mail, text message or by even sending a photo of special case. Mobile technology doesn't limit your connections to the nearest ones by distance, it will give you a possibility to select the best knowledge that is served anywhere on earth.

The use of mobile applications in farming decision making demands ICT solution providers to break their solutions to mobile apps.

4. Data ownership and authorisation

Ownership of the data is a key issue and also how it will be disseminated. If a farm had a central data collection system, like in large firms, it would be clear that a single farm owns its own data. In agriculture that is hardly the case. Farmers are one of the few business men who do not issue an invoice after sales. Not because they could not write, but because it always has been more efficient that the cooperative or investor-owned food processor made the invoices for all its suppliers, than that each individual farmer invoiced the cooperative. Which shows the traditionally high trust factor in farming.

To this day this means that the data collected from farms is at least also owned by separated farming organisations and other operators that serve farms. And that ownership of data is sometimes unclear[23].

[23] Legally the Ownership of data is a very confusing concept. Often it does not exist: if you provide a copy of your data to somebody else, both own a similar dataset. Some data is protected by Intellectual Property Rights (IPR). And some data is linked to (personal) privacy issues, which prohibits exchanging data. The ownership of data is especially becoming an issue in case of Internet of Things data created by sensors and machines on farms.

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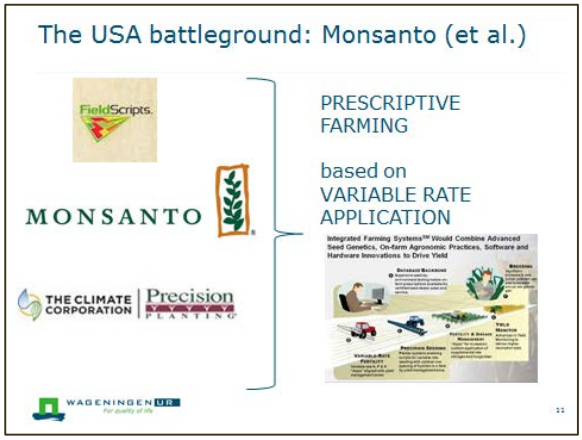
When the client relation of a farmer to these operators is finished, the data that farm has processed will remain within the operator and the farmer has not any more access to this data.

This is one reason why data on a farm is so separated and that we argued in section 2 that farmers should have access to all data on his/her farm that is stored in computers of suppliers, buyers, advisors, government agencies, banks and others. As there are costs involved in making the data available in a digital format, and as some of these firms have a big data strategy in which they want to earn money with the data collected from and on the farm, this is quickly becoming a battlefield.

Some examples from the US illustrate this. The first example is a commercial solution by Monsanto, a chemical and seed company. They bought the company Climate Corporation (and a machinery company) that exploits a huge database with weather and soil data. Based on this information and a technique called Variable Rate Application (in which seeding distances and hence spraying are based on very local soil and weather characteristics) they created a service called Fieldscripts. Farmers who join the service get detailed machine instructions on how to seed, fertilize and spray. As such this is not a direct benchmarking service, but indirectly it is as it uses the data of all the farms to improve its algorithms.

The second example is Farm Business Network, that partly has been created as a reaction. This is farmers' owned, but with a large investment ($ 15 mln.) from Google Ventures. It has collected data from 7 million acres of farm land, and benchmarks 500 types of seeds in 16 crops. Farmers pay 500 dollar a year to join the service.



The third example from the US is Farm Mobile. Interestingly this service has been set up based on the idea that farmers believe that their trust has been violated as their data are used by multinationals that announce big future income from big data, while they (that is, the farmers) have to pay for everything. In this service farmers keep the ownership of the data and decide case by case where the data is going to, and farmers hope to be

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rewarded with some (micro-)payment when making the data available. End of 2015 it received $5.5 mln. venture capital.

These examples show that there is serious money involved in the US in building digital benchmarking services and that the governance of such platforms and the ownership of data are serious aspects.

An interesting service developed in the Netherlands to support farmers in exercising the ownership of data related to their farm and manage the data flows around their farm is AgriTrust (formerly called EDI-Circle). AgriTrust provides farmers with a dashboard where they can manage their authorisations of their data. With such an authorisation they instruct e.g. the dairy cooperative to send their invoices (or other digital information) to their accountant or advisor or veterinary – whatever their choice. And they can instruct the company that receives the data what it is allowed and not allowed to do with it. Of course they can also change and end such data-authorisations.

Dutch agricultural companies have created this system (an earlier version already in the 1990s when data exchange increased for the mineral bookkeeping in the Nitrate directive) to increase the trust in the sector for data sharing. With AgriTrust farmers always can check who has access to their farm data, even if the authorisation registers are with third parties (that is: not AgriTrust itself). The system is owned by a cooperative of the companies that want to build trust with the farmers and use their data. It is operated by an ICT company.

The system is linked to eHerkenning ("e-Recognition"), the digital identification system backed by the government. eHerkenning is a standardised login system which enables organisations to make their services accessible online and securely to companies, civil servants and consumers. Users log in to a web service using their eHerkenning token, which allows them to manage their affairs online. eHerkenning will check whether the person who is utilising a service is actually who he says he is, but also whether this person is authorised to act. This means that organisations always know who they are dealing with and whether that person is authorised to act. The certified suppliers of eHerkenning provide this security at different levels of assurance.

These examples show that ICT makes it possible, and in the US situation even commercially attractive, to build systems for digital benchmarking, They also show that the governance of such a system and the ownership of the data is an important issue. And that solutions exist to involve farmers in the management of their data, to reduce the costs of data entry.

5. Timeliness

Most valuable for farms is data that is needed to make daily decisions. Data need to be fresh and as reliable as possible. Much of the data and analysis will be time sensitive therefore necessary to get information disseminated as quickly as possible – it must be made available in a timely manner to discussion groups and advisors. Many data collection manners on farms are based on official demands – like taxing. There is time to find solutions that benefit the production and create officially needed information on the side of this data collection.

One demand is creating data solutions that take better account the specific situation that farms have. For example right after investment the economical and production characteristic numbers differ a lot from farms that are more on stable balance.

Also the comparison of farms, where farms are divided to four quarters should be rethought. It is very hard to stay in the best quarter year after year, if you improve or change your production on farm. There are some research studies done on this, what is more truthful way to compare farm figures between each other.

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6. Conclusions

The whole Europe has a lack of education and specialists that would deal with modern data transfer solutions of farming. The development work is done by separated companies and organisations and they don't share their knowledge with each other.

Farms are paying indirectly the cost of above mentioned development and always the farm aspect is not the main aim of developing the new technology. Farms need to benefit the new technology. One evident way to benefit from new technologies is the ability to prove the production manner through data collection. This is a very interesting area and new business models based on this operation model need support to arise.

We need to rethink the data collection on farms and after that battle through the barriers that are on the way to get more farm related useful solutions to data management.

Development money is needed to find out better ways to collect data on farms and to process this data immediately for daily decision making. There is also need to create better dashboards and comparing models between farms. In comparing farms it is necessary to be pay attention to different development stages of farms.

Ideal situation is that the farm can get benefit from collected data by different ways, by making better decisions, by earning income of data owner-ship and by getting better product price according to ability to prove certain production way.

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Annex 8: Mini paper 5: Reflections on issues in financial / technical farm level benchmarking

Jakob Vesterlund Olsen[24]

1. Introduction

This mini paper provides some reflections on issues in financial / technical farm level benchmarking. The reflections are not concerning the collection of data and motivation of farmers etc. not because it is not important but it is addressed elsewhere. Hence, this brief concern ways and means available: how do we benchmark at this level. It is assumed that the objective of the farm level benchmarking is targeted farmers with the aim of improving financial performance without sacrificing the long-term sustainability (economic, environmental and social). It is assumed that data for use at a micro level is present. A large number of farmers participate and data from farmers are collected.

2. Purpose of benchmarking

Farmers and advisors are assumed to be the beneficiaries and the utilizer of the benchmarking application. When benchmarking is used strategically to support decision making, the farmer has chosen the line of business in which to apply his/her resources. Benchmarking then can be used to investigate which scope of production gives the best utilization of resources in the long run by choosing a peer group with same long-term commitments. Benchmarking could inspire to answer questions like:

- Should I use a high-cost intensive production scheme or low cost extensive production scheme?
- Should I choose to produce niche products (crops) or bulk products?

By choosing different peer groups (production systems) the financial and sustainability realisable best practices is exposed. This spurs to investigate more qualitative input by sharing information etc. If the criteria for choosing peer group are too narrow the full range of strategic alternatives are not exposed and benchmarking can lead to myopic decision making.

3. Objectives

Using benchmarking as input to tactical level decision making result in other peer groups being relevant to answer the questions at this level. The overall production technology is in place and is fixed in the intermediate time horizon. Hence the peer group is chosen to reflect the obligations given by the production technology. Questions at this level and within this time horizon could be:

- Which mix of input and output should I choose?
- Is one sub-product/variety performing better than the other?
- Is organic farming more financial and environmental sustainable and relevant to me?

Operational level benchmarking is very often used in agriculture when technical indicators are compared. This is also known as partial productivity assessment where yields per hectare or kg of milk per cow etc. are compared. There is an implicit assumption that higher yields are always better and it is prestigious to have the highest yield. The highest yield is, though, not (necessarily) the optimal yield, as there is not accounted for the input use and the costs hereof. Operational level benchmarking is often performed on financial indicators e.g. feed costs per kg of milk. Sometimes it is even compared per kg of dry matter in milk which levels the playing field with respect to milk content. Partial sustainability measures could be used in operational level benchmarking but it is unknown how widely they are used as data shortages could come into play.

When benchmarking at this level it is relevant to choose a peer group very similar to own production technology. How much wheat can other farmers produce sustainable with similar soil quality and climatic conditions?

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4. Context specific

Doing financial and/or technical benchmarking is all about choosing the optimal resource allocation given the specific circumstances on the farm. There are conditions which are unchangeable on the farm level e.g. climatic conditions or the soil quality. The strategic level benchmarking could indicate that the better alternative is to sell the farm and reallocate the farm production to other climatic conditions. Most farmers are not willing to do this; hence the benchmarking should take the climatic conditions as given. The goals of the farmer and the specific conditions for the farmer should be taken into account when benchmarking at this level.

5. Time horizon and asset fixity/specificity

One of these circumstances could be the asset specificity of some valuable assets on the farm. If you have livestock buildings build specifically to house milking cows with milking parlour then this is given on the farm for a certain time horizon. With a lot of givens the benchmarking level is more often operational to reveal operational excellence both financially, sustainably and social. There is an indicator and objective level relationship where indicators used when benchmarking on operational level should be “within” the production technology. Consequently often technical indicators are measuring (partial) productivity and are hence assessing best practice given that production technology.

6. Ensuring sustainable production in peer group

Financial and technological benchmarking is offset in the data availability which is often driven by the desire to measure and evaluate the production performance. These measurements do rarely include sustainability measures unless they are internalized in the farm economy. Some sustainability measures relate to animal health and others to input factor quantities but others are integrated into the farm economy due to tax on externalities. Many dimensions in sustainability are not measured in agriculture and hence it is impossible/difficult to measure whether the peer group is producing sustainable.

7. Limits to benchmarking

Even though benchmarking is widely used there are some limitations to the use of benchmarking which is highlighted in this section.

Group similarity and possible conflict from competition

For niche products with a limited number of producers within a country these are often competitors also and it can become difficult to gain access to data. Each producer does not want to share the data out of competitive reasons. This could be true even if the product is a major commodity in the world market or even within EU because consumers often have a home bias sharpening the competition between domestic producers. The home bias is a bias to prefer products which are produced domestically over products produced abroad. If data are accessible there could be validity issues because the producers are not reporting the correct numbers.

Average data versus marginal data

When you are to choose the optimal resource allocation this optimality is reached by producing the quantity equating the marginal cost of production to the marginal revenue from an extra unit. Most often the data are on average data. Your own data is averaged over the year and the peer group is averaged over the selected group. As a benchmarking analyst it is relevant to consider the differences between the average and marginal cost of production.

A potential income gap between own data and the peer group might not be relevant to aspire to, if this is associated with sunk costs on current assets. This problem is associated with the choice of peer group and the choice of objective level.

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Information on gaps not practical guidelines (quantitative benchmarking not sufficient)

When a relevant peer group is identified based on the objectives with benchmarking and a performance gap is identified then the benchmark-ee would like to know which routines to change to increase performance or catch up on the peer group. Analytical and farm management knowledge is supposed to come into play to transform knowledge on the performance gap into remedies for improving farm performance. It can be resembled with a medical doctor who identifies a symptom and has to diagnose the cause. A combination of financial and physical indicators can reveal some parts of the cause-effect relationship. This part of farm-level benchmarking has proven to be difficult and could call upon certification schemes for farm advisors.

International benchmarking

International farm level benchmarking can reveal productivity differences between farmers in different MS but these productivity differences are expected due to different institutional and legal conditions for farming. Furthermore the price of inputs is different hence the production technology has responded to the relevant price relation in a given MS. Hence, if international benchmarking is done on farm level this calls for a very cautious interpretation of the performance gaps as this is likely to be something different from farm management and farm productivity which is often intended measured.

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Annex 9: Mini paper 6: Problems of using Standard Output for farm benchmarking among the European Union Member States

Szilárd Keszthelyi[25]

1. Introduction

Many economic analyses are based on a comparison according to the farm size. The farm size can be expressed in physical units such as hectare, number of livestock or work unit. These bases sometimes do not reflect the real economic size, since they are not directly correlated with the performance of the farm. Therefore the real economic size could be better described with the earning capacity. In the past this requirement was solved by the Standard Gross Margin (SGM). This indicator was very strongly correlated with the gross value added, therefore it expressed the earning capacity. For technical reasons this system had to be abandoned. However replacing the methodology with Standard Output (SO) widened the gap between the real farm size and the calculated economic size.

2. Standard Gross Margin and Standard Output

In the opinion of Everdingen (2014), compared to SGM the SO is less related to farm value added, farm result and labour input. This implies that farm size based on SO is less comparable to SGM methodology. Overall, many policy questions cannot be answered based on SO. For example, what is the sufficient farm size to provide a living for a farmer?

Moreover this problem also causes a challenge for farm benchmarking among the European Union (EU) Member States. Based on the economic size six size classes have been specified in both methodologies. Calculations show (Annexes I and II) that average and standard deviation substantially increase in the case of SO methodology.

In the middle size class field crop farms (EUR 50,000 – 10,000 SO) the average size varies between 30 (Netherlands) and 211 hectares (Estonia). For the same stratum (single farm type and size class) the average deviation is 40 hectares. These extreme differences could be explained by many factors such as different market prices, quality, yields, production structure, but not by the profitability. Even within one type, farms are so heterogeneous that no-one can draw any conclusion in any kind of analysis.

The quality of the SO values could also pose a further considerable problem. These values have to be defined on the basis of a handbook. However the Member States are using different references and databases that also may have negative effects on the quality of the values.

3. Developing new perspectives

Whereas it has become apparent that the current size categories cannot be used for benchmarking farms at the EU level: a solution should be drawn up. The suggested solution could be to calculate an EU-level SO value set. This does not require any significant effort, since it could be prepared from the available national SO value sets. For instance, the EU-level SO values could be calculated from weighted averages of national SO values taking into consideration the national agricultural GDPs. These values could be published and applied to the Eurofarm database[26]. This means that the Community typology[27] would have to be used for all farms with these new SO values. The database created using the above-mentioned methodology could be used for farm benchmarking with the benefits that farms can be compared on the same physical basis and it is easier to show the differences.

[25] Research Institute of Agricultural Economics, Budapest, Hungary
[26] Structure of Agriculture Holdings: this summarises the main data in the Eurofarm database and contains the results of Community surveys on the structure of agricultural holdings, i.e. labour force, size of holdings, land use, livestock, subsistence farming. This domain also contains the main indicators on the structure of agricultural holdings by region. http://ec.europa.eu/eurostat/web/agriculture/data
[27] Commission Regulation (EC) No 1242/2008 of December 2008 establishing a Community typology for agricultural holdings

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The disadvantage is that this new grouping does not take into consideration the earning capacity. However by applying the same methodology for the FADN farms, this topic can still be analysed. For example, what are the most important factors of profitability in the different farm groups and Member States?

References

Walter van Everdingen (2014): New indicator: Standard Earning Capacity, Pacioli Workshop, Dublin, http://www.pacioli.org/WorkShopDetails.aspx?WS=27

Annex I: Total Utilised Agricultural Area in 2009, TF8 group: Field crop farms

Country	Economic Size Class (in EUR)					
	2000-<8000	8000-<25000	25000-<50000	50000-<100000	100000-<500000	>=500000
Belgium	-	-	-	43,88	88,36	-
Bulgaria	6.95	39.45	88.52	181.86	641.16	1816.3
Cyprus	11.59	15.61	32.44	23.45	-	-
Czech Republic	-	25.51	44.54	95.25	272.93	1214.77
Denmark	-	21.49	38.03	73	180	565.16
Germany	-	-	39.8	65.1	145.38	647.92
Greece	7.26	12.6	22.88	32.81	47.01	-
Spain	23.58	38.95	67.89	109.34	165.26	-
Estonia	-	61.45	107.98	211.71	529.17	-
France	-	-	46.13	79.92	167.12	305.84
Hungary	9.3	26.12	60.56	114.09	292.88	1432.28
Ireland	-	-	-	69.22	-	-
Italy	7.2	13.45	24.14	38.32	75.61	201.8
Lithuania	27.69	46.93	95.39	178.94	412.99	-
Luxembourg	-	-	-	-	-	-
Latvia	27.43	47.89	85.57	176.44	545.9	-
Malta	-	3.89	5.71	-	-	-
Netherlands	-	-	-	30.28	72.43	184.67
Austria	-	23.19	44.45	67.2	90.96	-
Poland	10.08	17.3	43.89	86.39	239.09	1201.57
Portugal	7.45	17.27	47.1	44.65	76.37	-
Romania	8.48	23.47	82.19	184.71	566.68	2372.98
Finland	-	36.5	77.92	110.42	135.38	-
Sweden	-	43.59	64.17	110.1	238.68	-

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Slovakia	-	-	51.34	120.06	338.99	1527.1
Slovenia	-	12.24	-	-	-	-
United Kingdom	-	-	50.38	88.02	208.37	618.58
Total (Country)	9.87	21.84	45.64	80.96	182.27	740.77

Source: EUFADN Database

Annex II: Difference between SO and SGM methodology

	Size class1	Size class2	Size class3	Size class4	Size class5	Size class6
SO methodology						
Average deviations	6.58	12.27	20.39	42.50	140.31	560.55
Standard deviations	8.11	14.92	25.31	53.77	177.08	671.45
SGM methodology						
Average deviations	0.00	9.67	20.55	36.18	96.49	423.39
Standard deviations	6.88	12.49	27.21	46.84	119.03	479.33
Difference (SO-SGM methodology)						
Average deviations	6.58	2.60	-0.16	6.32	43.82	137.16
Standard deviations	1.23	2.43	-1.90	6.93	58.06	192.11

Source: own calculation based on EUFADN Database

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Annex 10: Mini paper 7: Bridging the gap between sustainability assessment and benchmarking tools

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1. Introduction

Increasing attention toward sustaining the environment in the early '90s has led to the development of tools and metrics to assess sustainable development (Riley, 2001). These tools and metrics ranged from indicator lists, assessment models and indexes (Binder et al., 2010). They were developed for one or more specific themes or issues, had different aims and were related to different systems (Bockstaller & Guichard, 2009; Riley, 2001). At first, the focus laid on environmental aspects (Rigby and Caceres, 1997 in Binder et al., 2010; Poppe et al., 2004), but over time these tools were used in more holistic and integrated sustainability frameworks (Binder et al., 2010). Sustainability assessment has become an important aid in the process toward sustainability (Pope et al., 2004).

When we want to compare the performance of a system, assessed with an assessment tool, we can use benchmarks. Benchmarking means comparing your own performance against a standard or with the performance of others. It involves continuous measuring, analysing and taking action to improve our performance (Poppe & van Asseldonk, 2015). There are different ways of setting a benchmark such as a predefined value from literature, models, regulatory standards or a benchmark based on the performance of other systems (Binder et al., 2010; Poppe and van Asseldonk, 2015, Merante et al., 2015). Farm benchmarking tools have been historically introduced in the areas of economy and farm productivity. More recently there has been a wide interest in developing sustainability, and more specifically in environmental and social indicators as benchmarking tools for farmer use.

Unfortunately, we experience a gap between the rationale of sustainability assessment tools originally focussing on environmental aspects and the rationale of benchmarking tools originally focussing on economic aspects, for example, farm productivity. In addition, we experience that a lot of sustainability assessment tools and benchmarking systems are developed by researchers but hamper implementation and lack adoption in practice. As such, we have a case for addressing their weaknesses and proposing solutions to allow a real development and implementation of these promising methods. Questions arise on what are the key-issues for sustainability assessment tools to include benchmarking methods, on what are the characteristics of such tools and on how one can select the most appropriate tool for one's purpose. The objective of this mini-paper is to contribute to this gap by providing starting points to answer these questions and include the state of the art on sustainability assessment tools. Therefore, the paper first describes key issues regarding sustainability assessment, it continues by describing the characteristics of assessment tools and metrics and ends with a discussion on existing assessment tools and metrics analysed.

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2. Key issues regarding sustainability assessment

Many authors have already discussed key-issues regarding the design and use of a sustainability assessment (e.g. Binder et al., 2010; Gasparatos & Scolobig, 2012; Gibson, 2006; Ness et al., 2007; Pope et al., 2004; Weaver & Rotmans, 2006). We specifically will highlight key-issues of sustainability assessment in relation to benchmarking and focussing on the farmers' perspectives, but we would like to stress that this list is not all-inclusive.

Contested meaning of sustainability and sustainable development

A first key-issue is the contested meaning of sustainability and sustainable development (Bond et al., 2013; Hopwood et al., 2005; Pope et al., 2004; Waas et al, 2011). Sustainability can include different aspects such as economic, social, cultural, environmental or governance aspects which have a different meaning or content within different sectors or regions. Actors can interpret sustainability in the weak or strong sense.

As a result, for benchmarking sustainability and farm productivity, there is a need for a well-defined normative dimension of sustainability assessments, including the concept of sustainability (Binder et al. 2010). As many other authors, Bond and Morrison-Saunders (2013) state that the meaning of sustainability should be formulated for every assessment, taking into account the context in which it occurs. However, pluralism, a wide variety of views, should be seen as an opportunity and is an essential aspect of sustainability assessment (Pope and Morrison-Saunders, 2013) which can enrich the discussions among users.

Different purposes of tools versus incentives of end-users

Assessment tools can have different purposes such as *certification, communication (non-committal), reporting to policy makers (obligatory), firm development or research*. Many assessment tools are designed to assess at a specific level of scale. Some will assess the farm level or field level, others the sector level, production system level, regional level or the land unit scale. Literature shows that these different purposes and levels also suggest different end-users (Van Passel & Meul, 2010). Tools assessing the farm level will be mostly used by farmers as results can be used to improve the sustainable performance of the individual farm. On the other hand, tools assessing sector and regional level are most interesting for policy makers as policy measures are drawn up at these levels. Other end-users of tools can be extension workers, researchers, NGOs or actors of the supply chain.

Purpose of tool	Incentive for the farmer as end-user
Certification (and communication)	Market access for niche product with added value
Reporting to policy makers	For farmers? *growing reluctance from farmers and a lack of trust against any collection of data for this purpose!*
Research	Only the most innovative farmers
Firm development	Improve sustainable performance of the farm, link with management decisions and strategic decisions making is needed

Table 1: Link between the incentives of a farmer and the purpose of a tool

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Practical experience shows that there is no one-fits-all tool. Each group, process, farmer group has to choose a tool according to goal. The purpose of the tool should be related to the incentives of end-users. In Table 1, a quick exercise where we link the incentives of farmer to the different purposes of assessment tools shows that we need to develop benchmarking tools that are clearly distinct from compliance schemes and policy goals, but instead focus on the relevance for the farmer involving data controlled by farmers and full confidentiality, in order to (re-)build confidence.

A variety of metrics and indicators within assessment tools

Not only the vision on sustainability or the purpose can differ strongly, also frameworks, tools and metrics used to facilitate sustainability assessments are subject to variety. Indicators and benchmarks are used to describe and determine the state or presence of a complex system (Steunpunt Duurzame Landbouw, 2006; UNAIDS, 2010). They measure farm performance or reflect changes related to farming practices, without necessarily measuring the state of the farming- or eco-system itself (Steunpunt Duurzame Landbouw, 2006). A system can be represented in a holistic way by using many divers indicators or in a reductionist way by using just a few indicators to assess a whole system. The indicator selection (holism versus reductionism) is thus strongly related to the normative concept of sustainability and the question arise when such a set of indicators is able to cover sustainability fully.

Example on the choice of indicators and the link with the normative concept of sustainability: One can discuss to integrate productivity and food production as a sustainability indicator. In the context of growing global food demand from limited land resources, it can make sense for both farmers and citizens to consider indicators such as "environmental impact/kg of food produced" rather than "environmental impact/ha of land farmed".

Sustainability indicators can be of very diverse nature. First of all, data gathering is often an issue, as most data related to environmental or social aspects are not easily available, because these are not included in traditional, finance/business bookkeeping. Second, one can choose to measure the practices farmers apply (practice-based indicators), the resources they use (consumption or target-based indicators) or one can focus on the real impact on the environment (performance-based indicators).

Example of the environmental impact of nitrogen fertilization, by order of increasing relevance: Nitrogen consumption << nitrogen balance << use of decision support tool + impact measurement

In addition, some aspects of sustainability (e.g. biodiversity and soil quality) are difficult to grasp. Although recently there has been research on these aspects, implementation at farm level of these indicators is still lacking. Related to that and the possibilities to measure sustainability, indicators can be quantitative or qualitative making it difficult to benchmark and to integrate them within one index, tool or assessment.

Example of the environmental impact of plant protection products, by order of increasing relevance: Pesticide consumption << consumption weighted by pest/weed pressure << adoption of devices against point pollution + anti-drifting spraying equipment + decision support tools.

The way of benchmarking, the weighing of the indicators and other factors are important aspects of integration and transparency is needed (Van Passel et al., 2007). Results can be visually or numerically integrated. Visual integration means that the indicator results are presented together within a table or diagram. Numerical integration combines the indicator results to present it as a single index or composite indicator (Gómez-Limón & Riesgo, 2009; Van Passel et al., 2007). Benchmarking occurs to comparison with a reference group – a sample of farmers for benchmarking. How to define this group is of major importance as this group needs to represent and serve as a guide for farmers.

To deal with the issues related to metrics and indicators of sustainability assessment tools, we propose following suggestions. End-users and stakeholders of the assessment need to be involved in a process of selection of indicators to embed the context. They need to select the relevant indicators, even though these may not be the easiest to collect or to process, for example if they ask for discrete or qualitative data. The selection should be driven by a path-way towards evidence-based indicators. Furthermore, the process, the data collection and

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analysis needs to be transparent on the used benchmarking, weighing and integration mechanisms. Reference groups need to include farms with similar structures and conditions.

Costs for data gathering and analysis

For many sustainability indicators, the cost of data gathering is an issue, since this type of data is often not very well integrated with normal data flows of invoices and payments or farm management records. These management systems and (fiscal) accounts are often a source for benchmarking profitability but lack data for sustainability indicators. Certainly some aspects of sustainability (e.g., biodiversity and soil quality) are difficult to grasp and costs for measuring these aspects can be very high.

Benchmarking systems should search for multiple use of single data (collect once, use multiple times) in order to share costs between farmers and end-users of the data. For example, policy can provide support for data they need and farmers can complement this.

Link with management decisions and strategic choices

Furthermore, we experience that the uncertainties about possible management decisions and strategic choices that can be made based on the results of sustainability assessment play a dominant role. First, on the level of indicators, we have the issue of translating the results of benchmarking sustainability indicators to management actions. This seems to be more difficult for some indicators (for example, CO_2 and nitrate emission, biodiversity and soil quality) compared to the more traditional profitability benchmarks. Second, on the level of the assessment, there is a need for more guidance and harmonisation of strategic decision making and the choice of currently available tools (Russillo and Pintér, 2009).

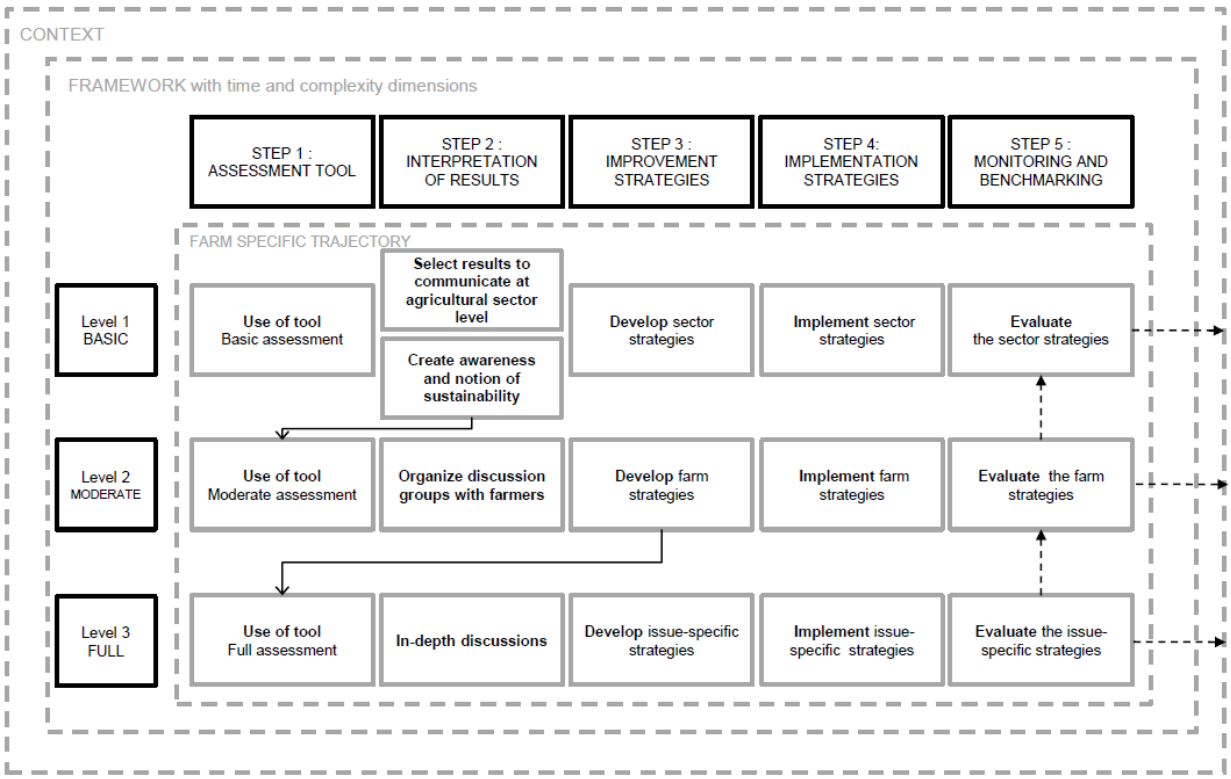

Figure 1: A procedural instrument to guide the use of sustainability assessment tools within strategic decision making at farm or sector level (Coteur et al., 2016)

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To manage decisions and strategic choices, assessments should use time series and sound statistical methods on the level of indicators in order to capture the results of farmer decisions. Furthermore, bias due to initial farm conditions (climate, soils, structure, business environment) or aspects that are beyond farmers' control has to be avoided. On the level of the assessment, a farmer needs his own farm-specific trajectory connecting the right tool to the time frame of strategic process on the farm. Coteur et al. (2016) developed a procedural instrument to guide the use of sustainability assessment tools within strategic decision making (Figure 1). The framework allows a farm-specific and flexible approach leading to harmonised actions towards sustainable farming.

3. Characteristics for assessment system description

As the previous section shows, the variety among tools is immense and there are numerous ways to categorize frameworks, metrics and tools for agricultural sustainability assessment. However, the question remains how to navigate and choose between these tools (de Ridder et al., 2007; Gasparatos and Scolobig, 2012). What are the key characteristics that may facilitate the choice between these tools?

In the context of the TempAg research collaboration (Wustenberghs et al. 2016) on sustainable temperate agriculture and in-depth literature review was performed regarding the characteristics to discern metrics and tools. (Wustenberghs et al. 2016) defined 25 relevant characteristics, presented in Annex (Table 1). These characteristics were grouped according to general assessment related information, information related to stakeholder participation and indicators related information (Coteur et al., 2016). Characteristics of major influence on the way of benchmarking are indicated in Table 2.

indicator type	Quantitative and/or qualitative, practices level or/and impact level
method of data collection	interview (individual farmer + extension worker); audit (control system); self-assessment (tools that can be used and interpreted individually); other
level of data input	at field level, farm level, product level, region level or other?
data source	type of data used: accountancy, farmers' knowledge, expert information, field practices, site practices, other
aggregation & weighting	Occurrence, level and method of aggregation and weighing of indicators
number of topics	number of dimensions, themes and indicators
reliability of data input	accuracy of data
validation of method calculation	occurrence and method of validation with other data or through stakeholder interactions
scoring system	type of scoring system: expert based scoring; scoring from literature; other

Table 2: Tool characteristics of major influence on benchmarking

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A list of initiatives divided by primary purpose, end-user and level of assessment

The preliminary results of the TempAg inventory show a large variation in development and content of the tools. Table 2 in the Annex shows the state of the art of the tools, a large variety of initiatives are divided by the primary purpose of the tool (reporting, firm development, communication, research and certification), the end-user (farmer and policy) and the level of assessment (firm, sector and regional level). Farmer and policy were chosen as the key end-users, because their aims (developing a farm or building/redirecting legislation) might be furthest apart.

As our original selection of initiatives focused somewhat on the farm level assessments, we see a larger amount of tools for the farmer as end-user. We said before that a specific level of scale suggests a different end-user. Results from Van Passel and Meul (2011) show significant differences between these levels as tools which assess at sector and regional level are only used by policy makers. This does however not show from our preliminary data results and many tools have multiple assessment levels, serving both the policy maker as well as the farmer (e.g. COSA indicators, NZSD, FAO-SAFA, SMART). These tools also have different purposes, ranging from firm development to research. These observations should be further investigated. Why do so many tools claim at serving both end-users and are these tools really used by both end-users? What does assessing at firm, sector or regional level mean for these tools and their benchmarking methods?

In any way, we need to gain more insight in the differences between these tools and in the benchmarking methods they use. If we do need different tools or benchmarking methods for farmers and policy makers, it is necessary to align data collection and therefore make the assessment more efficient and affordable. If there are tools of which the results can be used by both the farmer and policy maker, we need to solve following questions: which benchmarks are used, what is the reference group and how are these results presented and used?

4. Conclusion

This mini-paper started with the observation that sustainability assessment and benchmarking tools have both a different history. Sustainability tools are mostly embedded within environmental domains, while benchmarking tools are mostly grounded within economic disciplines. We addressed major issues and characteristics of sustainability assessment tools and related these to benchmarking and proposed some major guidelines on these aspects: i) the importance of context specificity and participatory approaches to deal with the normative concept of sustainability, ii) the purpose of the tool should be related to the incentives of end-users, iii) the selection of relevant indicators, even though these may not be the easiest to collect or to process, for example, assessments should use time series and sound statistical methods on the level of indicators in order to capture the results of farmer decisions and avoid bias due to initial farm conditions or aspects that are beyond farmers' control, iv) transparency on the process is vital, the data collection and analysis including benchmarking, weighing and integration mechanisms, v) reference groups need to include farms with similar structures and conditions, vi) search for multiple use of single data in order to share costs between farmers and end-users of the data, vii) a farmer needs his own farm-specific trajectory connecting the right tool to the time frame of strategic process on the farm.

Furthermore, first starting point to guide tool selection were addressed. Characteristics of tools were listed and, we divided a number of tools and metrics based on the purpose of the assessment, its level and the end-user. This preliminary result showed that a number of tools can be used by farmers and policy makers, used at different levels and for different purposes. However, these results pose new questions for future research. What is the difference between tools designed for a farmer or a policy maker? Do they use the same data source and how does data collection work? Are results presented in a different way and how do these end-users use the results in decision making?

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Annex 1: Characteristics for description of assessment systems (Coteur et al. 2016)

ASSESSMENT RELATED CHARACTERISTICS	
Characteristic	**Definition**
Origin	Country of origin
Initiative	Developed on the initiative of ?
Date	Year of development
Scope of assessment	Dimensions of sustainability: economic, environmental, social, governance, cultural
perspective on sustainability	Definition of sustainability used
primary purpose (intended function) of the assessment	reporting (obligatory), communication (non-committal), firm development, research, certification,...
level of assessment	Spatial scale of the assessment: field, farm, industry, chain, national/regional, landscape, global, product,...
sector scope	The assessed farm type or production type: general (applicable to all agricultural/food products or farm types; applicable to specific products or farm types (+ define which one)
system representation	reductionist (few indicators are used to assess the sustainability of a whole system) or holistic (reflects the complexity of a system by using many divers indicators)
applying user	The one applying the assessment: individual farmers, extension workers, policy makers, researchers,... or a combination: farmer and extension (Schindler *et al.*, 2015)

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end-user of results	individual farmer, farmers in discussion groups, extension workers, policy makers, researchers,... or a combination: farmer + extension/farmers in discussion groups (Bockstaller *et al.*, 2015; Schindler *et al.*, 2015)
method of data collection	method of data collection: interview (individual farmer + extension worker); audit (control system); self-assessment (tools that can be used and interpreted individually); other
aggregation & weighting	Are the indicator scores aggregated? Yes, No; If yes, is it a weighted aggregation? To which level?; If yes to weighing, method of weighing?
Transparency	Are there reports/documents available for users regarding: content, purpose, method of assessment, indicator scores, interpretation of results, other?
level of implementation	Is the assessment being used, implemented? If yes; specify: only on a project basis, commercially used, used by farmers, used for certification, other
STAKEHOLDER RELATED CHARACTERISTICS	
stakeholder participation when?	Following the 6 stages defined by Binder *et al.* (2010): *(1) Preparatory phase:* defining context, goal and challenges; *(2)* Indicator *selection:* choosing the appropriate sustainability indicators, taking decisions on including interactions between indicators and how to weight indicators; *(3) Indicator measurement*: quantification of indicators and processes (use of statistical data, surveys or categorized qualitative data); *(4) Aggregation of indicators:* taking decisions on whether or not to aggregate indicators, to which extent and how; *(5) Applicability* of the assessment results: the process of getting the generated knowledge ready for utilization in practice; *(6) Follow-up:* reporting results, developing management advice, monitoring of indicators over time.
stakeholder participation who?	Who was involved? (farmers, extension workers (advisors), researchers, policy makers, civil society,...)
stakeholder participation how?	What type of stakeholder participation? (interviews, focus groups, workshops, other)
time for data collection	Time requirement for data collection (categories: < 2 h; 2-4 h; 1 day; 2 days; > 2 days)
INDICATOR RELATED CHARACTERISTICS	
indicator type	Primarily quantitative; primarily qualitative; equally quantitative and qualitative indicators
level of data input	Are the data needed to complete the assessment at field level, farm level, product level, region level or other?
data source	type of data used: accountancy, farmers' knowledge, expert information, field practices, site practices, other

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number of topics	What is the number of topics for this dimension? Number of themes Number of indicators
reliability of data input	Are the data used for assessing correct and reliable? Yes, for all indicators within this dimension; yes, for most indicators of this dimension; no, data input for many indicators is doubtful
validation of method calculation	Are the calculation methods validated? If yes, what type of validation was used?
scoring system	What kind of scoring system was used for scoring the indicators of this dimension? benchmarks: which method is used?; expert based scoring: which method is used?; scoring from literature; other

Annex 2: List of initiatives of... divided according to primary purpose, end-user and level of assessment

PRIMARY PURPOSE	ASSESSMENT LEVEL	**END USERS**	
		FARMER	**POLICY**
REPORTING	**firm level**	COSA Indicators FAO-SAFA FLINT FtoM GRI INSPIA LEAF-SFR NZSD SAI-FSA2.0 SMART SPA	COSA Indicators FAO-SAFA FLINT GRI NZSD SMART
	sector level	COSA Indicators FAO-SAFA NZSD SMART	COSA Indicators FAO-SAFA FLINT NZSD SMART
	regional level	NZSD	FLINT NZSD

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FIRM DEVELOPMENT	**firm level**	BJCD BRP COSA Indicators DEXiFruits DEXiPM EISA FAO-SAFA INSPIA KSNL LEAF-SFR MESMIS MOTIFS NZSD ORC-FAS RISE SAI-FSA2.0 SAN-SAS ScalA SMART Veldleeuwerik	BJCD COSA Indicators DEXiPM FAO-SAFA NZSD ScalA SMART
	sector level	COSA Indicators FAO-SAFA NZSD SMART	COSA Indicators FAO-SAFA NZSD SMART
	regional level	MESMIS NZSD	NZSD
COMMUNICATION	**firm level**	FAO-SAFA INSPIA KSNL LEAF-SFR MOTIFS RISE SAI-FSA2.0 SMART	FAO-SAFA FLINT SMART
	sector level	FAO-SAFA SMART	FAO-SAFA SMART

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	regional level	FoPIA	FoPIA
RESEARCH	**firm level**	COSA Indicators DEXiPM MESMIS SMART	COSA Indicators DEXiPM FLINT SEAMLESS SMART SVA
	sector level	COSA Indicators SMART	COSA Indicators FLINT SMART
	regional level	FoPIA MESMIS	FLINT FoPIA SEAMLESS TOA-MD 5.0 model
CERTIFICATION	**farm level**	GlobalGAP KSNL LEAF-Marque SAN-SAS	
	sector level		
	regional level		

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eip-agri
AGRICULTURE & INNOVATION

The European Innovation Partnership 'Agricultural Productivity and Sustainability' (EIP-AGRI) is one of five EIPs launched by the European Commission in a bid to promote rapid modernisation by stepping up innovation efforts.

The **EIP-AGRI** aims to catalyse the innovation process in the **agricultural and forestry sectors** by bringing **research and practice closer together** – in research and innovation projects as well as *through* the EIP-AGRI network.

EIPs aim to streamline, simplify and better coordinate existing instruments and initiatives and complement them with actions where necessary. Two specific funding sources are particularly important for the EIP-AGRI:

- ✓ the EU Research and Innovation framework, Horizon 2020,
- ✓ the EU Rural Development Policy.

An EIP AGRI Focus Group* is one of several different building blocks of the EIP-AGRI network, which is funded under the EU Rural Development policy. Working on a narrowly defined issue, Focus Groups temporarily bring together around 20 experts (such as farmers, advisers, researchers, up- and downstream businesses and NGOs) to map and develop solutions within their field.

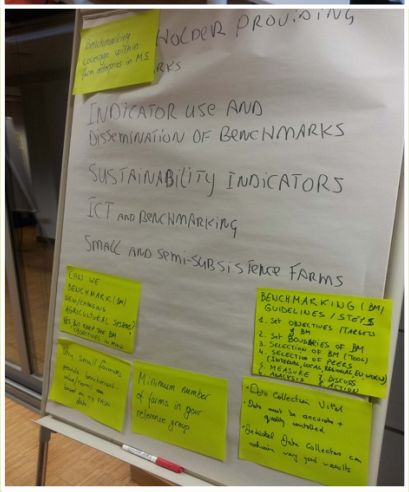
The concrete objectives of a Focus Group are:

- ✓ to take stock of the state of art of practice and research in its field, listing problems and opportunities;
- ✓ to identify needs from practice and propose directions for further research;
- ✓ to propose priorities for innovative actions by suggesting potential projects for Operational Groups working under Rural Development or other project formats to test solutions and opportunities, including ways to disseminate the practical knowledge gathered.

Results are normally published in a report within 12-18 months of the launch of a given Focus Group.

Experts are selected based on an open call for interest. Each expert is appointed based on his or her personal knowledge and experience in the particular field and therefore does not represent an organisation or a Member State.

*More details on EIP-AGRI Focus Group aims and process are given in its charter on:
http://ec.europa.eu/agriculture/eip/focus-groups/charter_en.pdf



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