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agriXchange – an analysis of the data exchange in agriculture in Europe

In this paper the results of the investigation of the present state and issues related to agricultural data exchange and data integration, made in the EU research project agriXchange, are reported. The investigation employed experts in EU member states and Switzerland to inquire quantitatively and qualitatively about agricultural data exchange in the EU. For each country, separate reports were prepared and analysed. Special attention was given to different integration levels, within as well as between enterprises. The results based on the analysis of country reports showed big differences between different countries in EU in terms of level of data integration and standardization. The findings establish the importance, highlight the shortfalls and opens up discussions on frameworks for establishing a system for common data exchange in the agricultural sector.

Keywords
Data exchange, standardisation, information systems, communication technology, ICT

Abstract
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Information systems in agriculture frequently lack standardisation, which makes efficient data exchange and the establishment of innovations into practice difficult to achieve. Especially the data exchange between stakeholders in the value chain and within networks is currently not efficiently organised. Within the European research agenda, the ICT (information and communication technology) will play a key role. The provision of new information management systems and improved communication facilities between various stakeholders (farmers, agricultural suppliers and customers, associations, public authorities, etc.) are of special importance. The exchange of information between trading partners will result in a refined flow of information and thus improve the cooperation. Both aspects are indirectly also useful for the consumer [1], because an exchange of information on product properties is expected to optimise the production and processing. As a result, the quality can rise and waste can be reduced by bringing the relevant charges to the necessary subsequent processing steps. Additionally, the transfer of information can result in transparency and traceability starting from primary production up to the consumer. Faster response times in an emergency can be achieved. To guarantee an integrated, consistent and barrier-free system, it would be useful if the various stakeholders exchange standardised data and information free of charge.

Study within the framework of the EU project agriXchange

To achieve harmonisation and standardisation of information and communication technology within the European agricultural business, the research project "agriXchange" (www.agrixchange.eu) has been initialized in 2010 funded by the EU's Seventh Framework Programme. The overall objective of this project was to coordinate and support a sustainable network to develop a system for common data exchange in agriculture. As a first step in this project, the state-of-the-art of ICT in agriculture, and the level of automation, data integration and data exchange in Europe were examined. This article summarises the current state of knowledge in selected EU member states and analyses in more detail the situation in the German speaking countries.

Detailed statistics on the level of automation and ICT use in agricultural holdings are currently hardly available. Until now, no consistent surveys on this topic in the EU member states have been performed. To obtain an overview of the situation, a) several aspects of information management and b) several processes on the agricultural holding with relevance to data exchange were identified and c) information exchange processes with external stakeholders were investigated. The aspects identified follow the methodological framework by Giachetti [5]. Ac-

cording to this framework, integration as an abstract concept has the following levels:

- Connectivity: characteristics of the basic infrastructure such as internet connections, local networks etc.
- Data exchange: consistent definitions of data content
- Applications: use of relevant communication protocols and interfaces etc.
- Processes: level of coordination between sub-processes

The following use cases of data exchange were selected as a framework to investigate processes:

- Land use information systems as specified by IACS (Integrated Administrative and Control System)
- Geo-fertilisation, especially methods to integrate external data, e.g. soil properties
- Animal registration and animal identification as regulated by law for several animal species in the EU, but also other, not binding practices in this environment.

Based on these topics, the project team developed a semi-structured questionnaire to analyse the information flow between stakeholders and the integration of data, applications and processes between various businesses. The questions were answered by experts located in each country and results were summarised in a consolidated report.

Level of automation and use of information and communication technology

Table 1 shows the level of automation and ICT use. The experts estimated that up to 95 % (lowest estimate 20 %) of farmers use an internet connection. A more generic investigation confirmed this number and showed that 93 % of all enterprises had internet connection in 2009 [4]. The average for whole Europe is estimated to be lower, about 60-65 % when only regarding agricultural holdings. Mobile phones and Smartphones are regularly used by farmers. Until now the main use however is restricted to telephone calls and short messages. The mobile data exchange between equipment on the farm and other facilities is less common. Precision farming (PF) is in most EU countries only implemented by a small number of agricultural holdings. Frequently, PF is initiated by experimental research projects. However, it is then boosted by the integration of PF into agricultural machinery. The use of both personal computers and of farm management information systems is higher for specialised businesses then for mixed production systems.

The experts consider the level of adoption of process automation as generally low. For certain types of enterprises automation can be of high relevance, e. g. dairy farms for feeding and recording milk production data in free-stall barns.

In terms of the number of farms, the application of information and communication technology might be low in some countries. This is frequently attributed to the large number of small farms who do not use any ICT at all. As the major part of farming area and of livestock is concentrated in larger holdings, it can be assumed that a relevant share of agricultural production is generated using ICT. The low uptake of ICT in agricultural holdings is frequently also attributed to the increasing number of farms without a successor. Older farmers and those with small farms are reluctant to invest into the automation of their enterprises.

A badly organised data integration and data exchange both on process and on farm level are in many EU countries explained by the insufficient infrastructure (broadband internet) in rural areas. The new Member States furthermore lack

- Cooperation of private and governmental institutions to improve the infrastructure and
- Institutions which are responsible for the organisation and standardisation of data flows.

In Germany, France, Belgium and the Netherlands, these infrastructures and networks are comparatively well developed.

Challenges for the future use of information and communication technologies

In summary, general challenges for the future use of ICT are the aging population and lacking infrastructure in rural areas, but also the reluctant investment behaviour in small enterprises. These challenges are met in Switzerland, but also in Germany, by the following drivers:

- Compulsory animal registration
- Broad use of ICT for accounting and taxation
- Integration of ICT in agricultural machinery
- Use of electronic data transmission to distributors and public institutions, mainly for agricultural direct payments [3].

Especially the use of ICT in accounting and the application in agricultural machinery resulted in a wider acceptance and utilisation.

Within the EU, mainly the Baltic States have the potential to adopt new ICT quickly, because these countries demonstrate a remarkable initiative to build up a new infrastructure both in the agricultural sector and in the ICT sector.

In order to be able to compete successfully, it is important to keep processes flexible and not to stick too tightly to formal standards. Therefore the experts recommend standardising the data flow on a business level and not on a process level, to allow for a later linking of information from different processes.

Conclusions

In summary, the technical basis for an intensive information exchange in agriculture exists. However, the development of broadband internet infrastructure in rural areas is still needed in some European countries.

Data integration can be enhanced by open networks with a flexible intensity of relationships between the partners. Education and training opportunities for new technologies can improve both the data integration and the data exchange in the long run. In some countries, several initiatives involved in the standardisation of data content exist. The agriXchange project contributed to a better networking of the stakeholders and to trigger a continuous harmonisation process at the EU level in the framework of future projects.

Table 1

Level of ICT and technology adaptation in the (most) EU countries and Switzerland on agriculture holdings

Land ***Country***	**Betriebs-PC** ***Farm Personal Computer***	**Internet-Zugang** ***Internet***	**Betriebs-informations-system** ***Farm Management Information System***	**Mobiltelefon** ***Handheld***	**Relevanz der Landparzellen Registrierung** ***Relevance of LPIS Land parcel identification systems***	**Geo Düngung** ***Geo Fertilisation (Precision Farming)***	**Tier-registrierung** ***Animal registration***
Belgien *Belgium*	●	●	◐	●	●	◐	●
Bulgarien *Bulgaria*	○	○	○	–	◐	–	–
Tschechische Republik *Czech Republic*	●	●	●	○	◐	◐	◐
Dänemark *Denmark*	●	●	◐	●	●	◐	●
Estland *Estonia*	●	●	◐	–	◐	○	◐
Finnland *Finland*	●	●	●	●	●	◐	●
Frankreich *France*	●	◐	◐	●	●	◐	●
Deutschland *Germany*	●	●	◐	●	●	◐	●
Griechenland *Greece*	○	○	○	◐	◐	○	◐
Ungarn *Hungary*	◐	◐	○	○	◐	○	◐
Irland *Ireland*	◐	◐	◐	◐	◐	◐	●
Italien *Italy*	◐	◐	◐	●	◐	◐	●
Lettland *Latvia*	○	●	○	–	◐	○	●
Niederlande *Netherlands*	●	●	●	●	●	◐	●
Polen *Poland*	◐	◐	◐	–	◐	○	◐
Portugal *Portugal*	○	◐	○	◐	◐	○	○
Rumänien *Rumania*	○	○	○	○	◐	–	◐
Slowakische Republik *Slovakia*	●	◐	○	○	◐	○	◐
Slowenien *Slovenia*	○	○	○	○	◐	–	◐
Spanien *Spain*	●	◐	◐	●	●	◐	●
Schweden *Sweden*	●	●	◐	●	●	○	●
Großbritannien *United Kingdom*	●	◐	◐	○	◐	○	●
Schweiz *Switzerland*	●	◐	◐	○	◐	◐	●

Symbole: gering=○ < 30 % der Betriebe, mittel=◐ > 30 % und < 70 % der Betriebe, hoch=● > 70 % der Betriebe:, – keine Daten
Symbols: low=○ < 30 % of the farms, average=◐ > 30 % and < 70 % of the farms, high=● > 70 % of the farms: , – no data
Quelle: Eigene Darstellung basierend auf/*based on* [3].

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