agroXML – a standardized language for data exchange in agriculture

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Abstract

Farmers are subject to a multitude of obligations concerning documentation of agricultural practices. agroXML is the result of a tight cooperation with producers of agricultural software and online service providers, which integrate agroXML into their software. agroXML introduces a standard, which facilitates data storage and exchange. agroXML is based on the international standard XML and consists of the agroXML-Schema and several contentlists. agroXML is available in an extended version 1.2. Several applications even in commercial software are existing since a couple of weeks. Some of them are described in the presented paper.

Key words: XML, agroXML, standard, data exchange, schema, contentlist

1 Introduction

Farmers are subject to a multitude of obligations concerning documentation and verification of agricultural practices. Farmers' sensitivity concerning data exchange processes has increased due to publication of EU regulation 178 in 2002 and the consecutive Cross Compliance measures. The demand for appropriate technical solutions has become obvious. For data exchange processes in agriculture only individual interfaces between different communication partners were available. Often the required data had to be transferred by hand from one software to the other or from screen into paper forms. Using agroXML as a data exchange language, these procedures and the individual interfaces between communication partners are substituted by universally usable data exchange processes. Application- and documentation processes for agricultural subsidies, traceability and quality assurance can be simplified and automated step by step. First concepts concerning agroXML have been presented by DOLUSCHITZ et al. (2005) and JUNGBLUTH et al. (2005). A summary can be found in KUNISCH et al. (2007a and b).

2 Cooperating Partners

To develop and introduce agroXML as a standard, tight cooperation with partners from the branch of industry is necessary. The implementation of agroXML takes place at the producers of agricultural software and online service providers, which integrate agroXML into their software and service products. Currently, the following partners are contributing to the development:

agrocom GmbH & Co. Agrarsystem KG, Bielefeld; agroproject Technologie und Informationssysteme GmbH & Co. KG, Greven; agroSat Consulting GmbH, Baasdorf; BASF AG, Ludwigshafen, Claas Selbstfahrende Erntemaschinen GmbH, Harsewinkel; Helm Software, Ladenburg; ISIP (Informationssystem Integrierte Pflanzenproduktion e. V.), Bad Kreuznach, John Deere, Agricultural Management Solutions, Zweibrücken, Land-Data-Eurosoft GmbH Co. KG, Pfarrkirchen, Progis Software AG, Villach, Austria.

3 Basics and state of development

3.1 Schema

An XML Schema defines electronic documents for data exchange. The agroXML schema is based on a model of the real-world processes in agricultural production. They are represented in a tree-like hierarchy. At the moment, agroXML can describe data for plant production. Fig. 1 shows a graphical representation of an excerpt from the agroXML schema which describes a plant protection measure. The measure plant protection is anchored in the schema on the left besides other measures like soil tillage, seeding or fertilization, on the right the branches split to characterize the measure plant protection more in detail. The branches describe e. g. fields, machinery and persons executing the pesticide treatment and the deployed supply items. The elements carry additional information, e. g. date, time and the duration of the measure.

Profiles define the obligatory elements for a specific data exchange case. To create a profile, elements are copied from the agroXML schema to a separate file and the necessary restrictions applied to the data types in there. Data are transported in an XML instance, a file built according to the rules of the schema and the profile. Using profiles, lean, clear and easily transferable instances can be generated.

The current release of agroXML, Version 1.2, was published in March 2007 on www.agroxml.de and replaces Version 1.0 from May 2006. Schema development will be carried on in the English language in the future. Currently contained terms have already been translated but the translations have not yet been incorporated into Version 1.2. Other topics to be worked on will be further upgrading of geo-data functionality as well as addition of elements for livestock farming and cultivation of vegetables and fruit.

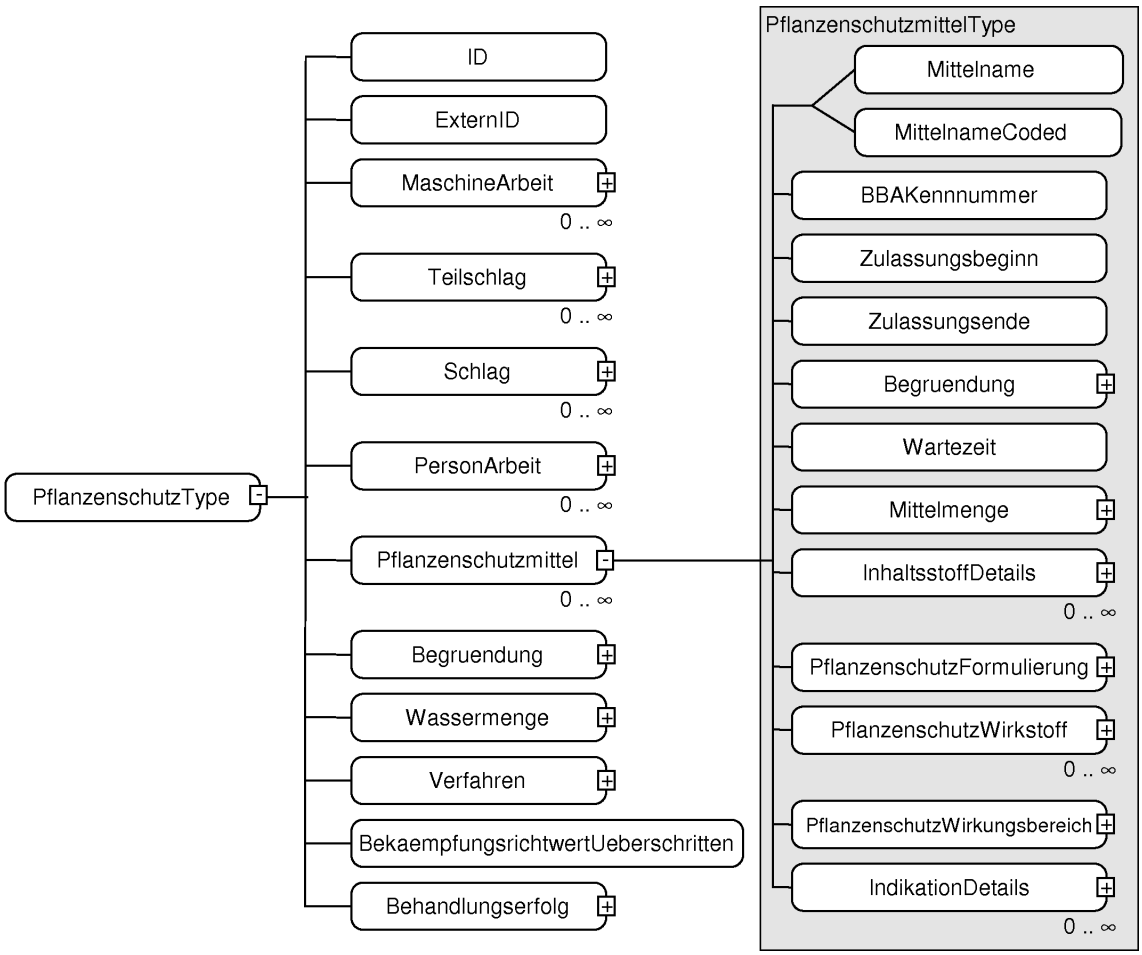

Fig.1 Graphical representation of an excerpt from the agroXML schema.

3.2 Content lists

Content lists are provided as described in detail in MARTINI et al. (2007) using a unified XML dictionary structure. Currently, several lists exist containing e. g. soil types, machine types, fertilizer types, pesticides and plant variety names. The lists can be downloaded at http://www.agroxml.de/content. They ensure the uniqueness and automatic evaluability of information.

The list of pesticides contains the licence numbers of the respective agent as identifiers. It is edited by the Bundesamt für Verbraucherschutz und Lebensmittelsicherheit. Content for the list of varieties is obtained from the Bundessortenamt. Provision of the european and international list of varieties is in preparation.

Software systems implementing agroXML keep a local copy of the content lists for filling instances. Different caching strategies are possible to ensure a recent data pool. agroXML does not provide any guidelines for this. A Web Service is provided for checking up-to-dateness of lists. If the local copy is older than the one available on the server, the new list is provided.

4 Functionality

The sphere of action of agroXML as a data exchange language is schematically represented in Fig. 2. The ISOBUS specifications for machinery and farm equipment cover data exchange inside of the farm. Data exchange with external partners and between farm management information systems is conducted using agroXML.

Fig. 3 shows the realization of data exchange schematically. An interface which can write (at the sender) or read (at the receiver) agroXML is the prerequisite. This interface is based on the agroXML schema. XML development tools are available, which allow a fast implementation of routines for parsing XML instances. One can e. g. use the standardized SAX (Simple API for XML) or DOM (Document Object Model) APIs in a variety of programming environments and languages. During reading, an instance is decomposed and data offered in an efficiently manageable manner to further program routines. SAX is event-oriented, while DOM builds a tree of the data in computer RAM. In DOM, not only the necessary

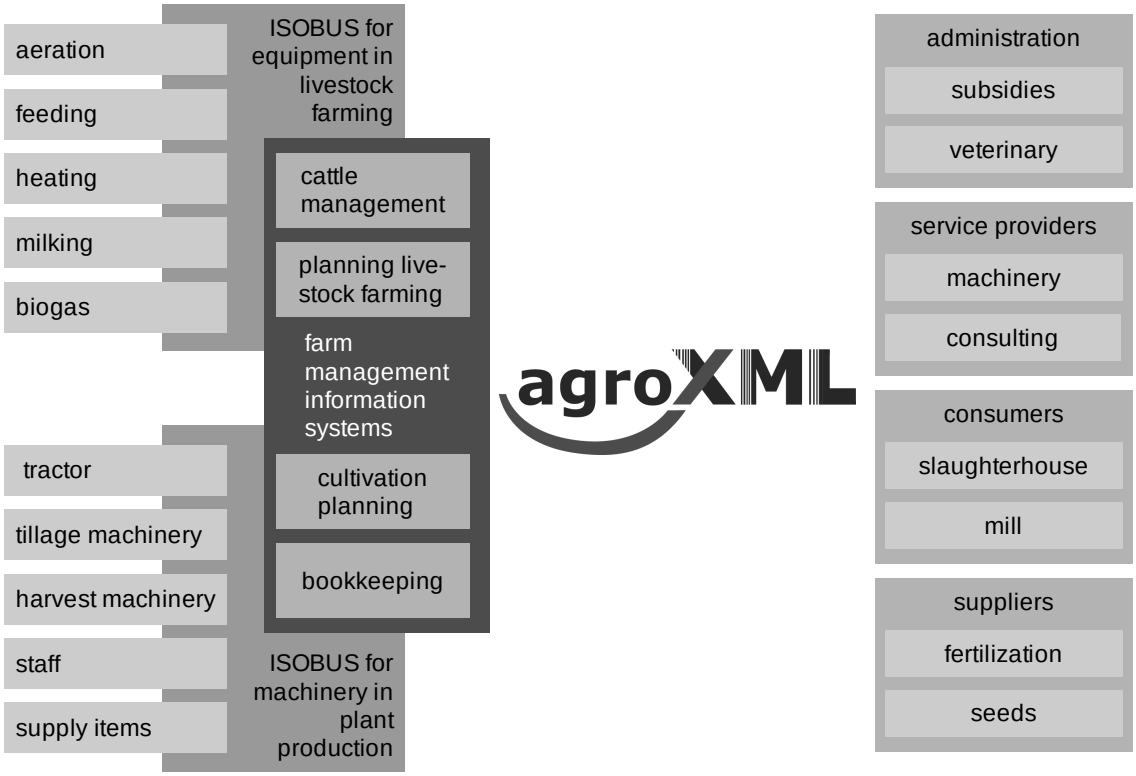

Fig 2 Sphere of action of agroXML.

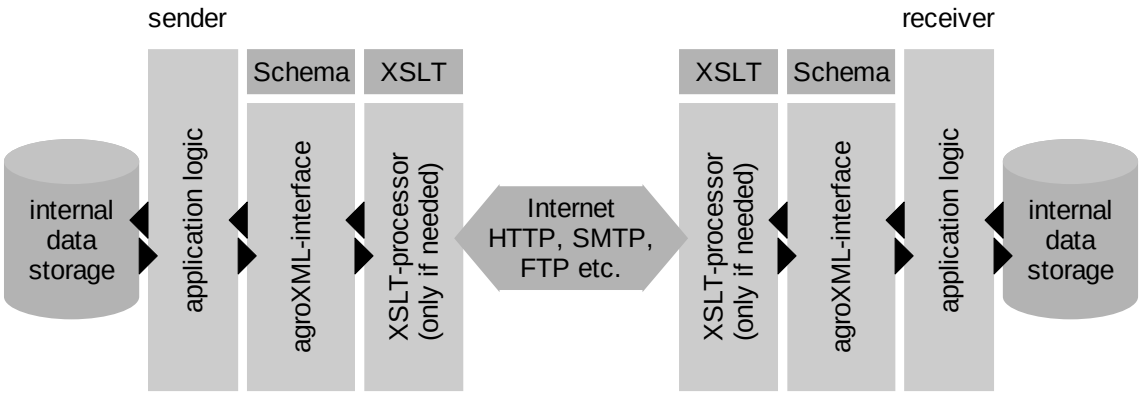

Fig. 3 Schematic drawing of the data exchange layers in agroXML.

functionality for reading but also for processing and writing the tree is provided. As such, this API can be used by the sender of an instance as well as by the receiver.

The transport of an agroXML instance on the internet can be conducted using standard protocols like HTTP (Hypertext Transfer Protocol), FTP (File Transfer Protocol) or SMTP (Simple Mail Transfer Protocol). Exchange is currently done in a document-oriented manner. A complete agroXML document is transferred in a single file. For the transfer of sections in a dialog-enabled system, query mechanisms are needed. For this purpose, Web Services based on service oriented architecture (SOA) can be used. But such systems are complex and resource-hungry during runtime. A lightweight alternative would be to use standardized XML query language, e. g. XQuery.

In some cases the representation of data of external partners conducting electronic communication with the farmer does not conform to an agroXML interface. One possibility to interoperate with such systems is to use XML Stylesheet Language Transformations (XSLT). With their aid, it is possible to specify conversion rules in a file. The conversion itself is performed by an XSLT processor.

The layers shown in Fig. 3 can be implemented using different programming tools, partly even running on different computers. This approach allows for a flexible architecture, which is adaptable to different requirements.

5 Applications

Currently, different companies are implementing agroXML as a data exchange standard. Several examples are presented in the following text. Producers of agricultural equipment like e. g. Claas (Frerichs 2007) and John Deere (Engel 2007) support development of agroXML. Especially for the agricultural software industry, agroXML has a high priority (Bosch 2007).

5.1 Field work calculator

Currently in operation is access to the field work calculator of the KTBL (www.ktbl.de) from farm management systems of Helm and BASF. Using this tool, the user can calculate data concerning machinery costs and working time of flexibly compiled machinery combinations and import and automatically file them into his farm management information system. Usage of this system is also open to others.

5.2 EurepGAP

The example of the EurepGAP application shows how to transform agroXML documents automatically into instances, which conform to the requirements of an existing interface using XSL-Transformations. Involved in this use case is information, which is needed by EurepGAP for documentation of plant

production (the so called field passport). This information is filed to the EurepGAP database. In this case, a separate application transferring the resulting files to EurepGAP is necessary, because the interface of EurepGAP is dialog-based. The application transforms the agroXML instance delivered by the farm management system into an XML representation readable by the EurepGAP interface. It then sends the resulting files using SOAP (Simple Object Access Protocol) to the EurepGAP server. From there, data is handed on automatically to the backend database.

5.3 KTBL-Tool geodata

The application geo-data is developed by the KTBL in the course of a feasibility study supported financially by the BMELV and the Landwirtschaftliche Rentenbank (GEISSNER et al. 2007). The prototypical application enables farmers to collect geospatial data from different providers in a simple manner and transform them into the agroXML format readable by farm management information systems.

One usage scenario is that the application reads the field outlines available for InVeKoS at the ministries of agriculture in the different federal states. These data are extended by data in other formats concerning cultivation planning or data with spatial reference, e. g. outlines of water protection areas, which are provided by environmental agencies. This process can be automated to a large extent. The application has a recent list of providers of geographic data for the specific region available. It analyzes the provided data and transforms it with correct relations and references into agroXML. This file can then be read by the farm management information system.

5.4 Work commission using AGRO-NET of agrocom GmbH & Co. Agrarsystem KG

More information concerning this use case can be found in OETZEL (2007).

Today, the commission of a machinery cooperative happens using the telephone. Especially in seasons of high workload, when the commission is simply captured on a note placed on the desk, misunderstandings are possible. In the described use case, the electronic commission of services using agroXML has been developed. Using it, the farmer can enter his planned measure into his AGRO-NET management system and hand it on to the machinery cooperative at appropriate times.

Exemplarily, this communication path has been realized between the farm management software AGRO-NET and the machinery service provider software AGRO-LU. The farmer puts all the relevant information for the order into a planned booking. These are for harvest commissions e. g.:

- Organization receiving the order
- Name of farm including address
- Designation of the field
- Cultivated fruit and variety
- Timeframe of execution
- Additional hints concerning execution

The order is exported from the planned booking into an agroXML file and can then be sent by Email as and electronic order to the service provider. There, this electronic order is taken over into AGRO-LU and is available for further processing. The bill of delivery can be prepared and the process data for control of the machine can be written onto a memory card.

The electronic work commission using agroXML is one of the building blocks in an architecture, in which besides the content of the order also aspects of transfer, access rules, security considerations and billing functionality are regarded.

5.5 Helm Software's Farmbox®

Detailed information can be found in HELM (2007).

Farmers willing to communicate using the Farmbox need a FarmboxID. This ID also contains the

geographic position. Using it, the spatial location can be determined without further information. The position can be decoded using free software.

To be able to send or receive agroXML documents using the Farmbox, a small program, the Farmbox Connector is necessary. It can be invoked directly from the farm management information system to send provided documents to one or more receivers. At the same time, the program checks for new documents. The Farmbox Connector – available free of charge - is part of the Helm farm management information system. Other suppliers can simply couple it with their products.

Additionally, the content of the own Farmbox can be administered via the internet at www.farmbox.eu. This page informs about incoming and sent documents and when they have been retrieved. An agroXML viewer allows reading the documents on screen.

The Farmbox server can not only transport data, it can also manage different content lists and languages, so that data exchange in Europe is possible. For its usage, fees per transaction have to be paid.

The benefit for the farmer lies in simplification, centralization and automation of his data exchange requirements. He only needs his access code and password to exchange information for documentation, applications, soil sample analysis, pesticide application recommendations or work commissions. Prerequisite for this is that the participants use the Farmbox as their central network node.

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