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Pesticide Application Manager (PAM) - Decision Support in Crop Protection based on Terrain-, Machine-, Business -and Public Data

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ABSTRACT

Pesticide Application Manager (PAM) is a project co-funded by the German Federal Office for Agriculture and Food (BLE) that aims to develop solutions for automating important processes in crop protection by using ICT.

Keywords: crop protection**,** precision agriculture**,** GIS, data, decision support

1. INTRODUCTION

Due to a series of rules and legal requirements for planning, implementation and documentation, crop protection is one of the most information intensive activities in modern agriculture. One example is the legal obligation to leave buffer zones at field boundaries to protect adjacent natural and aquatic ecosystems. In agricultural day-to-day reality the planning and implementation of crop protection measures as well as the compliance with laws, rules and any sort of documentation are mostly due to the responsibility of the operator who is conducting the action. Much of this work is still done manually and without the support of information technology which results in high workloads as well as an increased error-proneness.

The objective of the project PAM is to develop tools to automate and therefore optimize the processes mentioned above. PAM aims to integrate data available online from different private and public sources using up-to-date ICT-technologies with a special focus on mobile technologies. This will make crop protection measures less error-prone and easier documentable as well facilitate a reduction of pesticides. The result is a reduction of costs for farmers as well as an improved pollution control.

2. TECHNICAL BACKGROUND

Recent advances in different technical fields offer possibilities to support crop protection measures and are basis for developments in the PAM project:

2.1 Mobile Networks

Mobile networks following the common GSM, DCS1800 or UMTS-standards do not only allow voice communication but also data transfer. Suitable user devices (e.g. smartphones or tablet-PCs) as well as lower prices for mobile internet have become more and more common, which has opened the market for a growing number of potential users. Especially in agriculture there is a need for applications on mobile devices since most of the decision makers (e.g. farmers, contractors) spend considerable amounts of times out in the field.

2.2 Semantic Technologies

Semantic technologies allow reusing data in unexpected contexts and use cases. This goes beyond general standardization of syntax and protocols because it facilitates reusability, flexibility and expandability. Data formats can be translated, new information can be derived from existing data which allows e.g. to support search and selection processes for terms related to each other. In the field of crop protection this is important e.g. to group crop protection products following certain criteria. Different technologies with varying degrees of maturity are available already. Examples are Ressource Description Framework, ISO Topic Maps or Web Ontology Language.

In the project PAM an information and communication platform based on semantic technologies is being developed. One technical challenge integrating the different stakeholders involved is to connect the data collected in different steps of the crop protection process and the integration of information that is being provided by external sources. To be able to handle this variety a superordinate domain model of the crop protection process is needed.

The domain model will describe data content and structures in such a specific way that the development of services and software modules for communication and analysis can be implemented consistently. At the same time there has to be sufficient flexibility to easily use and integrate existing systems and standardized formats.

3. PROJECT OBJECTIVES

PAM aims to develop solutions for automating several processes in crop protection. Important specific outcomes of the project are:

3.1 Development of an electronic system to read bar code labels of crop protection product (CPP) containers and connect to different public and private databases to get related information

Information about crop protection products is mostly only human-readable, e.g. labels on CPP-containers. This poses the risk, that information in not considered in the right way or even not at all. Manual transfer into Farm Management Information Systems (FMIS) is error-prone as well. Using electronically readable crop protection product information helps users to avoid errors and make sure all relevant information is being considered.

In the project PAM a system for electronically readable bar-code-labels is being developed in cooperation with partners from the agrochemical and the engineering industry. By connection to different private and public databases product specific information is being made accessible on site. Examples are:

- Information about miscibility of different crop protection products
- Information about legal regulations (e.g. legal buffer zones to rivers)

3.2 Development of legal proceedings that allow farmers to automatically digitize field geometries as well as non-target zones (e.g. rivers, hedges) using high-precision GPS

Field tests using public geo-data of rivers, forests and hedges have shown that this data is often incomplete. Additionally the currently available location accuracy of around 3 meters is not good enough for precision farming processes.

To overcome this restriction the PAM-services cannot only run on public geo-data but as well on high-precision GPS-data recorded by the farmer himself using e.g. high precision RTK. The project partners in PAM cooperate with German supervising authorities to develop a process to digitize field geometries and adjacent rivers, forests, etc. Data recorded this way should be officially accepted and can additionally be used to improve public geo-data.

3.3 Development of a web service to automatically generate machine-readable application maps that include legal buffer zones

In the scope of the project PAM different web services are being developed. One example is a tool that creates machine-readable application maps using the non-proprietary ISO-XML format. These application maps include legal buffer zones depending on the pesticide and the spray nozzle used. Databases from different public institutions in Germany are included to access the necessary information:

- Federal Agency for Cartography and Geodesy,
- Federal Office of Consumer Protection and Food Safety
- Julius Kuehn-Institut (JKI), Federal Research Centre for Cultivated Plants.

Application maps offer the possibility to automate the spraying process as well as its documentation. Figure 1 illustrates this process:

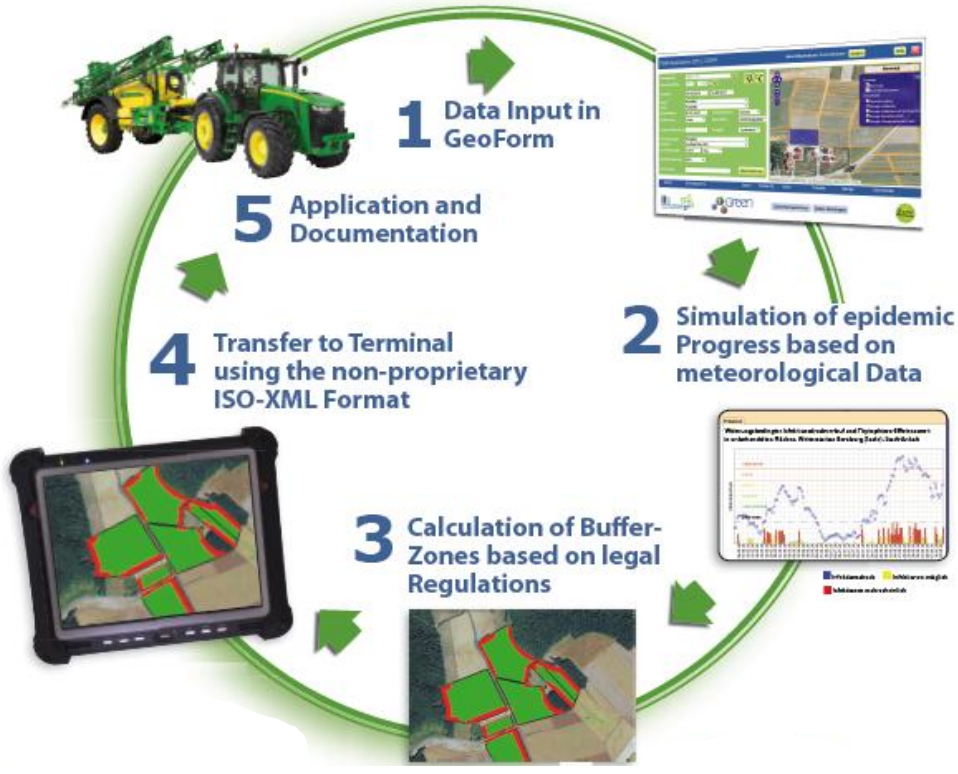

Figure 1: Process of creating machine-readable application maps

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3.4 Development of a web service for profitability analysis

Another web application is being developed to analyze economical aspects based on changes induced by legal buffer zones. Reduction of fuel as well as changes in wear of application machines will be shown. The project partner *Association for Technology and Structures in Agriculture* (KTBL) provides data on cost, working times and fuels usage that will be used additional to the calculated pesticide application area.

To be able to come to conclusions regarding the specific situations on the field, all the machines available on the farm have to be assigned to established categories. To make this possible algorithms and methods are being developed.

The profitability analysis will be based on machine type, recorded field geometries including not treated buffer zones, working width, driving speed and other possible parameters.

Open interfaces are being developed to include those services in Farm Management Information Systems (FMIS). This will support farmers to comply with reporting commitments (to supervisory authorities or customers).

4. CONCLUSION

The project PAM is implemented by a consortium of public and private organizations under the lead of the German Central Institution for Decision Support Systems in Crop Protection (ZEPP).

Project partners are:

- Association for Technology and Structures in Agriculture (KTBL),
- Julius Kuehn-Institut (JKI), Federal Research Centre for Cultivated Plants,
- BASF SE
- John Deere GmbH & Co. KG, Intelligent Solutions Group.

The project duration is three years, from 2013 to 2016.