Management of zones in precision farming

Management zón v precisním zemědělství

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Abstract: Precision farming is a very fast developing form of the Farm Management System, especially in crop production, in whole world and in our country as well. There, it is adopted since the second half of the 90s of the 20th century. The system of data collection, analysis, presentation and application of information in precision farming is reaching over the possibilities of their use by common farmers or agricultural companies. Service companies in this case play a very important role as an executor of exacting analysis, data collection and their presentation. Management zones present simplification of the difficult operations and recommendations including economic calculations for the common user involved in the precision farming management.

Key words: Precision Farming, PREFARM, Map Server, GIS, GPS, open source

Abstrakt: Precizní zemědělství je velmi se rychle rozvíjející formou Systému řízení farmy a zvláště pak rostlinné výroby, ve světě a rovněž i u nás, kde je postupně zaváděn ve druhé polovině 90. let dvacátého století. Systém sběru, zpracování, prezentace a aplikace informací v Precizním zemědělství již plně přesahuje možnosti jejich samotného využití běžnými zemědělci či zemědělskými podniky. Servisní společnosti v tomto případě hrají důležitou roli v podobě provádění náročných operací, sběru dat, jejich analýze a prezentace. Management zóny jsou zjednodušení složitých analýz a doporučení včetně ekonomiky pro běžného uživatele využívající Systému Precizního zemědělství řízení farmy či podniku.

Klíčová slova: Precizní zemědělství, PREFARM, Map Server, GIS, GPS, open source

INTRODUCTION

Precision Farming (PF) is a system approach to managing crops and land selectively, according to their needs. It utilises expertise from many disciplines and integrates the latest information technology tools and techniques to enable farm managers to get a better understanding and control of their fields. Management is the essential factor to achieve the stated outcome for the farm.

The Management Zones (MZ) solution improves information access for the decision makers in agriculture production. High quality information is the basis for effective management. Therefore, initial investments into information like boundary mapping, soil sampling and management zones identification, mapping etc. are also unavoidable. These investments into information and information technologies should be viewed as durable and calculated costs inside the existing management zone and it should be amortised as fixed costs, management zones on the farm must be done correctly and professionally. This process needs an initial investment into data, knowledge and GIS tools. One of the possibilities how to reduce fixed cost in the beginning is to use services of specialised companies, which are working for a bigger number of farmers. In this case, the cost of technologies and software is spread among a bigger number of users.

Generally we can say that good data or information is only that in right place and in right time. This simple rule is applied in agricultural production too. For many people, farming is still very hard work without any free time during spring, summer and fall season, but reality is a little different. And just precision farming brings the latest technologies into the farm work. Since the time, when GPS system was unblocked for civil use, precision farming has got better and better conditions to grow up year by year. The most important question solved in past is to find the optimal level of using fertilisers and chemicals in crop production and their application in the field with reducing bad influence on soil, crop and surrounding environment. Basically, we want to set a right agronomic recommendation founded on precise data, information, technologies and which is continually updated and corrected. Research in the field of precision farming goes very fast ahead, but a very important thing is how close is co-operation between universities and research institutes on one side and farming on the other. At the present time, there exist many systems and tools of precision farming in Europe. Using these tools and systems in farming differs state by state; according to how big is the

pressing of government to farmers and of course to farming conditions and market competition.

COMERCIAL AGRICULTURE DATA SUPLIER

The smallest existing unit in precision farming database is one field. A bigger unit is a farm, which is built up from several fields. In farm, using and testing is optimally working on these two levels. In a service company, where there is the working level and number of fields and farms much higher, this kind of model and data structure becomes very complicated. In this case, it is much more useful to set one farm as the smallest units for data analysis.

Changes in the EU subsidy policy encourage demands for agriculture information systems. New agriculture machines are routinely equipped with board computers, GPS station, digital sensors and recording devices necessary for data capture. This situation provides necessary conditions for rapid adopting of the precision agriculture systems in the European context. Because of smaller field sizes, farm data management is divided between service companies and single farmers. Service companies were mostly focused on agricultural machine services in the past. Now they start to offer services for precision farming and use GIS technology for data capture and management. They are expected to prepare field maps for each farm and to create yield maps (based on harvest data). They will provide optionally more sophisticated services, such as processing of aerial photographs and satellite images, GPS surveying etc. Single farmers are expected to observe the current situation in simple map viewers and plan production in specialised precision farming tools. This scenario decreases instrument expenses and knowledge demands for a typical (small and mid-size) farmer.

Management zones – theories and practical use

Management zone is a result of map analysis to get an optimal amount for each input in crop production, founded on the variability of soil characteristic and the other factors conditioning a crop yield. In this case, we define locations within field, farm or regions with the same or very similar conditions for crop planting. We can set locations with a very high resemblance of soil conditions or others elements and characteristic. The Geographic Information System for farm management allows to us to analyse data and yearly results in crop production. Many researches are currently running in the whole word, so we can focus on the running practical research in the Czech Republic in a service company.

The solution improves information access for the decision makers in agricultural production. High quality information is the basis for effective management. Therefore, initial investments into information like boundary mapping, soil sampling and management zones identification, mapping etc. are also unavoidable. These investments into information should be viewed as durable and their costs should be amortised as fixed costs over a number of years. There was documented in *Premathmod IST-2000-28177* project deliverable 2.1 Process model, which effectively works for precision farming that it is necessary to reduced fixed cost. One of the possibilities, how to reduce fixed cost, is to use services of specialised companies, which are working for more farmers. In this case, the cost of technologies and software is spread among a bigger number of hectares. For this reason, the Premathmod system is constructed as Internet solution, which offers through Internet not only a possibility of data access, but also their updating, analysis and good communication between the user and service company. To reduce any costs, Premathmod system is built mainly on the base of Open Source solutions.

The first type is spatial variability, which can be seen as changes across the field. An example: one part of the field has produced a higher crop yield than the other. We can mark on one field with one crop several homogenised yield zones.

Temporal variability is identified when parameters change over time. This can be seen when a crop starts to grow well but the result is a poor yield.

Predictive variability is the difference between what the manager had predicted that would happen and what actually happened. The classical example of predictive variability is when the manager predicts that a certain yield will be achieved if a certain amount of fertiliser is applied, but the crop does not achieve it because the weather changes.

Practically, before the service company starts to present collected data and results to farmers, the data must be uptaken and treated in the central database. The data are divided to several groups up to the using. The first group of data includes parcel and field identification as well as parcel and field boundary definition. Service companies should typically collect such data and general GIS systems should be used for spatial data capture. These systems include wide range of necessary functionality – map digitalitising, GPS data capture, digital photogrammetry, non-spatial attribute annotation. This data are created mainly for long-term using and future changes are minimal.

The second group of data are coming from soil analysis (nutrients), yield mapping by harvester combine, remote sensing and agronomic data (from farmer). This data are used as a main sources for nutrient recommendations, yield estimations and measuring. They are periodically restored and complemented.

Third group of data are picked for very short term using (application) and their using in database has only an information character. This data are picked for variable spreading of nitrogen or variable applications of chemicals. In that case, the time between data collecting, analysing, and preparation of recommendation, decision and application must be minimized. Wireless communication for data transfer between field and database seems to be the best way.

Farm management forms a group of necessary tasks, which consists of ownership and renting plan management, monitoring of seeding plans and plant production for each field. In the European context, one of the most important results of such module seems to be reports for grant applications. Precision farming requires the most advanced precision agriculture software. Such systems are designed to monitor, analyse and control plant production with the aim to optimise expenses and environmental effects. Fields are typically divided into grid cells and the influences of plant factors are analysed for each cell. Seeding, fertilising, irrigation and other agronomic procedures can be optimised for each cell of fields and the GPS systems help in correct application of all calculated processes. Farmers or service companies use specialised applications, which should be based on GIS system to accomplish such complicated demands.

Data are divided into two main categories as follows:

Information on farm unit levels:

– Air photos – background layer
– Satellite imagery – background layer
– Field boundary – basic data layer
– Geographic map of field owners – basic data layer
– Soil types maps - basic data layer
– Soil sample control points grid – basic data layer
– Soil test maps – P, K, Mg, Ca, pH – basic data layer
– NDVI – vegetation analyzing in several vegetation period – basic data layer
– Crop sample control points grid – basic data layer
– Yield prediction – basic data layer
– Crop rotation – basic data layer
– Organic matter application – basic data layer
– Variable recommendation for Potash – basic data layer
– Variable recommendation for Phosphorus – basic data layer
– Variable recommendation for Lime – basic data layer.

I*nformation on field units level:*

– Field area – number of hectares and four years crop rotation – basic data layer
– Soil sample grid – control points inside the boundary – basic data layer
– Yield maps – yearly – basic data layer
– Soil test maps – laboratory result from testing period. If the user has got more than one testing period, the results can be combined – basic data layer
– Variable application maps for Phosphorus, Potash, Lime, Nitrogen – basic data layer
– As apply map – variable application map controlling – basic data layer.

By Internet technologies, farmer can get much more easily the Management zones – essential information for crop growing, weather, farm management, grain market and so on. One of the most important knowledge of the farmer on beginning this different way of farm management is an elementary experience of using IT technologies, Internet environment and Precision farming system in the daily farm work.

CONCLUSION

Management zones and their creation are focused on doing the farm job much more easy without loosing any information important for crop management. How difficult or simple is using of the existing technologies by a farmer, this depends more or less on the production region and also on the farmers, but the essential role in this adoption process will be played by the direct or indirect support from a service company and university research. We should not forget also the influence of food market and state conditions created by the government and parliament. Adoption of Management zones in crop management has got also a good basis in the Czech Republic. However, the future development of these new technologies is depending on the stable economical situation in agricultural production.

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Arrived on 10th July 2003

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