LM3: Data Analytics in Farm Management Information Systems

1.1 Module objectives

"The primary aim of this module is to provide an insightful understanding of farm management information systems and summarise data analytics methods that are at the core of farm management information systems. Practical demonstrations of basic data analytics concepts in farm management information systems will also be included as an important part of this module."

1.2 Learning outcomes

There is increasing pressure on the agricultural sector to change the production focus from quantity to quality and sustainability. In that manner, managerial tasks are currently shifting to a new paradigm, requiring more attention on environmental impact, delivery terms, and documentation of quality and growth conditions. Advances in precision agriculture, in terms of information and communication technologies, along with development of agricultural machinery, allow farmers to gain a vast amount of site-specific data which ultimately can optimise decision making on a fine resolution. However, this automatically collected data is not used because of data logistic problems, leaving a gap between data acquisition and its efficient use in current farm management practice. To overcome this gap and provide the most appropriate on-farm management interventions, an integrated solution is needed to improve decision making in the future.

The aim of the Farm Management Information Systems is to help and improve operational farm management with optimal on-farm decisions. With a rich source of information coming from heterogenous sensory technologies coupled with data analytics, FMIS allow locally based planning and enable applications of site-specific agricultural management using the tools and knowledge of crop science, agricultural engineering, and geo-statistics.

This course will equip the student with the knowledge required to understand Farm Management Information Systems that integrate precision agriculture activities into a holistic system. On completion of this module, students will clearly understand a range of aspects of FMIS, including basic concepts of data analytics that are at the core of such systems. Lectures will also include practical demonstrations of data analytics methods in FMIS.

To summarise, the learning outcome of this course are:

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- To provide a brief overview of different data sources.
- To provide understanding of agriculture data-driven solutions in FMIS.
- To equip course participants with a basic set of skills to handle geographic information systems data and provide interpretations with data analytics.
- To enable students to run Python exercises and visualise results in QGIS and thus understand principles of data analytics in FMIS (e.g., deriving satellite-based indexes, yield monitoring, variable rate applications, etc.)
- To provide students with a set of skills to evaluate different FMIS and provide consultancy on their usage and to use it in future projects.

1.3 Course content

1. **Core concept of precision agriculture**
   - Current practices of FMIS
   - Understanding and identifying temporal and spatial variability
   - Drivers of variability (e.g., soil, weather, farm management)
2. **Data sources**
   - Drone and satellite images
   - Climate data
   - Yield production data
   - Proximal soil and crop sensing data
   - Internet of Things (IoT)
3. **Data analytics in FMIS**
   - Data management
   - Geographic information systems
   - Machine learning: clustering, classification, prediction
   - Examples of data analytics (Python and QGIS demonstrations)
4. **Case studies**
   - Yield monitoring and mapping
   - Weed mapping
   - Variable-rate applications
   - Crop production cycle optimisation

1.4 Mode of teaching

- Lectures;
- Literature study;
- Hands-on exercises in Google Colab and QGIS;
- Case study, and
- Presenting the results to the group;

1.5 Recommended study material

Selected examples of articles, book and online study material.

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- D. Kent Shannon, David E. Clay, Newell R. Kitchen (2020). Precision Agriculture Basics. John Wiley & Sons.
- Nicolas Baghdadi, Clément Mallet, Mehrez Zribi (2018). QGIS and Applications in Agriculture and Forest. John Wiley & Sons.
- Villa-Henriksen, A., Edwards, G. T., Pesonen, L. A., Green, O., & Sørensen, C. A. G. (2020). Internet of Things in arable farming: Implementation, applications, challenges and potential. Biosystems Engineering.
- Saiz-Rubio, V., & Rovira-Más, F. (2020). From smart farming towards agriculture 5.0: a review on crop data management. Agronomy.
- Bacco, M., Barsocchi, P., Ferro, E., Gotta, A., & Ruggeri, M. (2019). The digitisation of agriculture: a survey of research activities on smart farming. Array.
- Maestrini, B., & Basso, B. (2018). Predicting spatial patterns of within-field crop yield variability. Field Crops Research.
- Van Evert, F. K., Fountas, S., Jakovetic, D., Crnojevic, V., Travlos, I., & Kempenaar, C. (2017). Big data for weed control and crop protection. Weed Research.

1.6 Coordinator

BioSense Institute / AgTech7 online platform

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