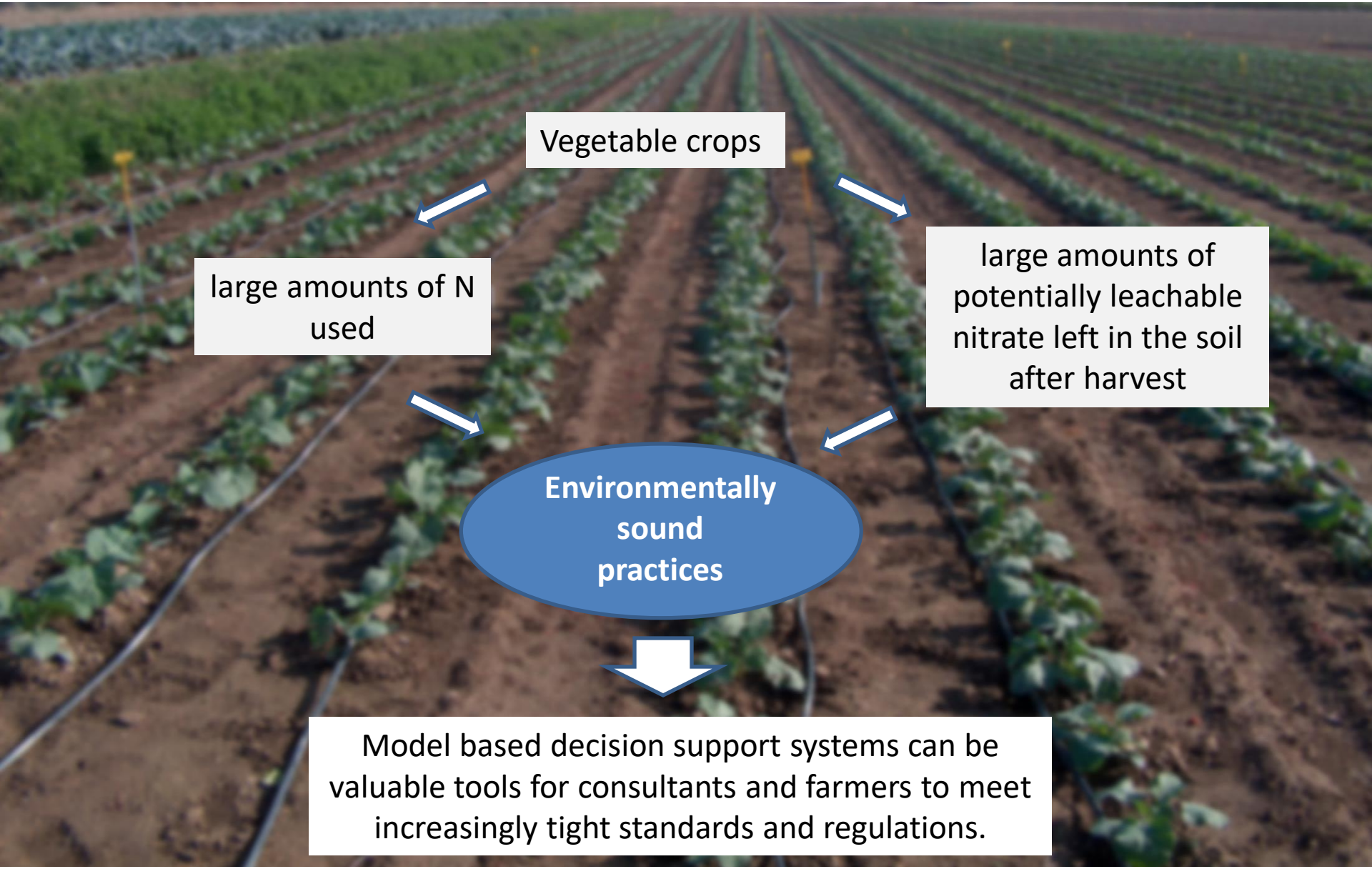
Decision support systems for managing irrigation and fertigation in vegetable crops



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DSS as an integrated or holistic system

It is not just the sum of knowledge provided by each of the system's components, but it produces new knowledge (Schreidera and Mostovaia, 2001).

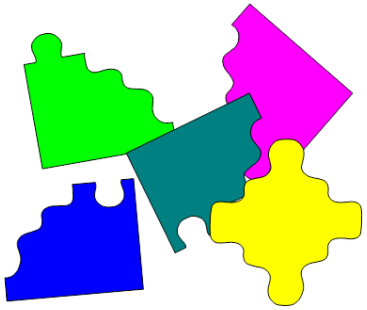
multidisciplinary decision-making process

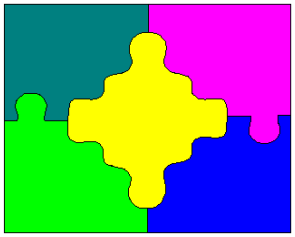
Integrated assessment

Plant/crop physiology
Plant nutrition
Soil science
Hydrology
…

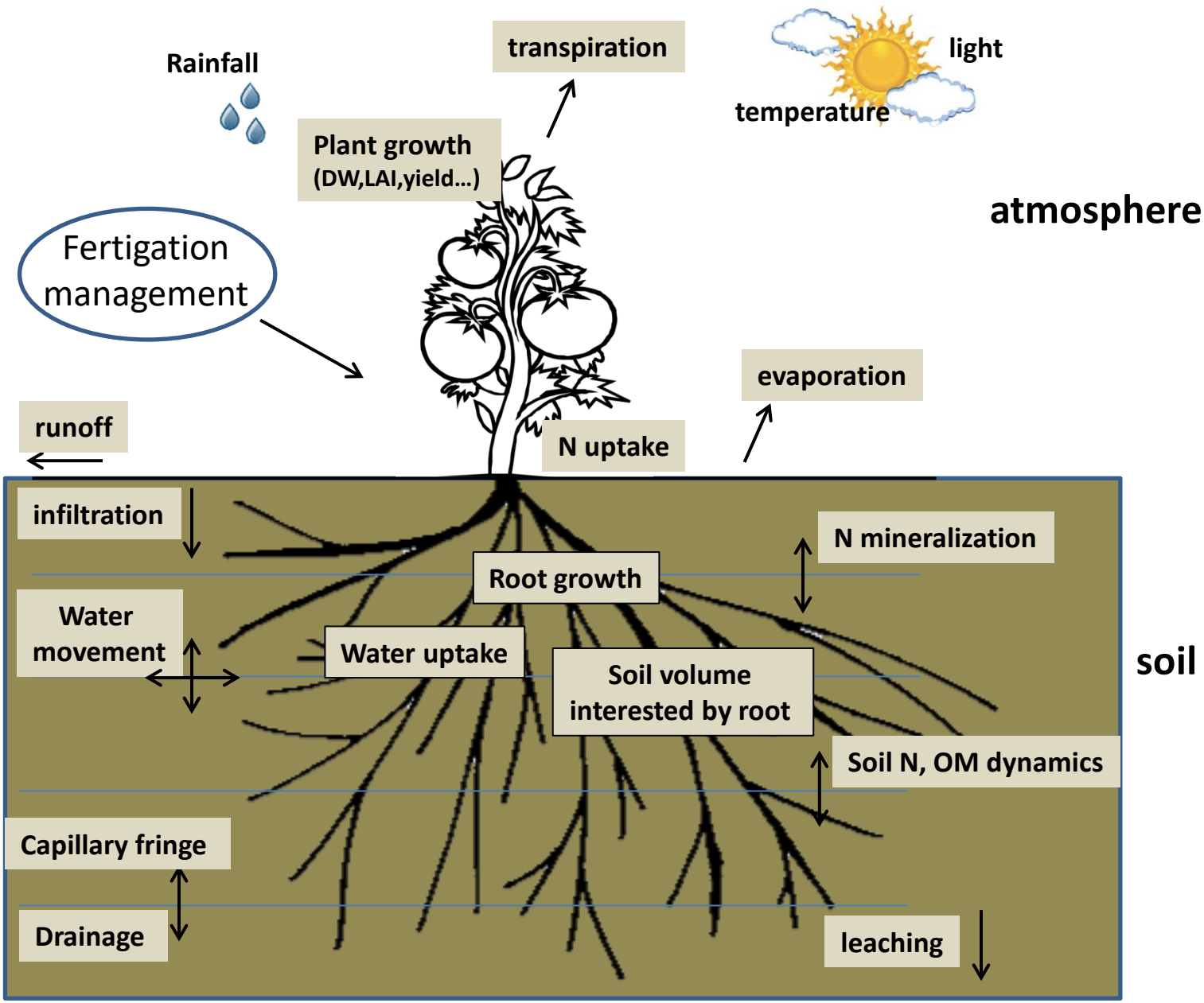
→ New knowledge

Holistic approach

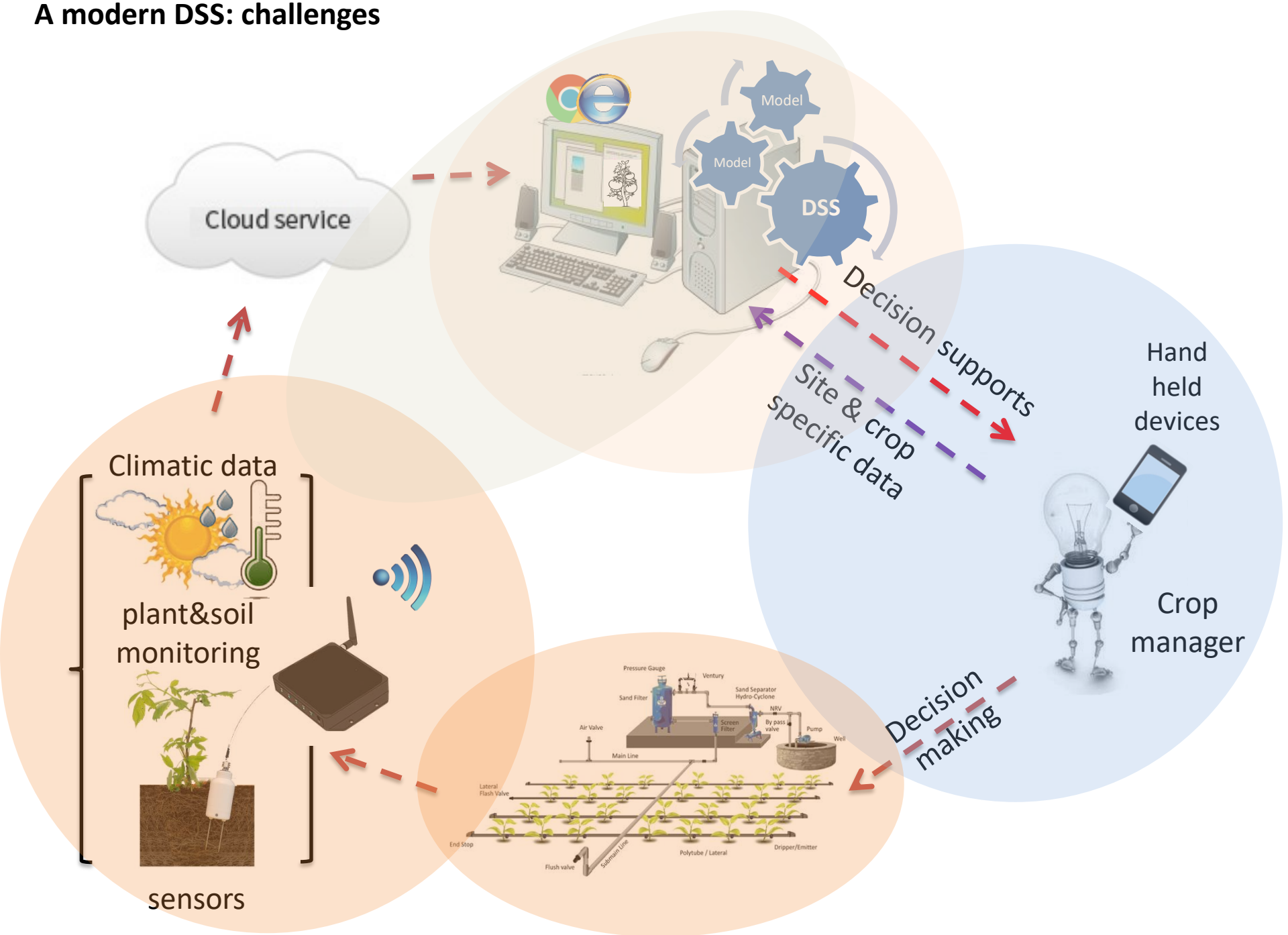




The pieces of the puzzle

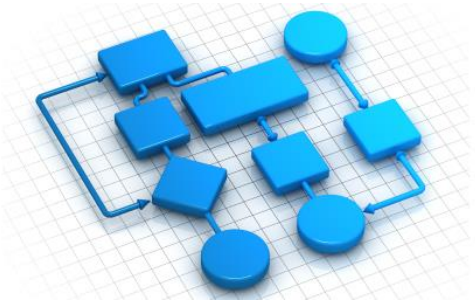


A modern DSS: challenges



Challenges 1: on the software side

- To include the main contemporary concepts on the processes which are sensitive to fertigation management
- To have a dynamic approach, reflecting the actual growing conditions
- Modularity: built in such a way that each segment can be removed and changed by better models
- To have a compromise between being “sufficiently simple” and “sufficiently complex”, allowing both manipulation and understanding, and extrapolation of accurate conclusions
- Capable to work at different time and space scales
- Reliability: site and crop specific validations
- A clear and comprehensible representation of the output
- Single program (computer program) and web-based application
- A clear and documented chart flow of the simulated processes, and a logical chart flow of the computerized software



Challenges 2: the user's expectations

- User-friendly: the simpler the better, complex system for expert growers/researchers
- Limited number of daily input by the growers
- Automatic data collection
- Updated to the smart technologies: smarthphone/hand held devices. APP for messages/advices, inputs, operativity. (ICT Technology continues to change, improve and evolve every 18-24 months)

Challenges 3: integration

- Possible implementation and integration in holistic DSS for crop management
- Scaling up from pilot to practical applications
- Site specific weather history and forecast (connection with web-services)

- Functional integration in the farm system:
  - ✓ to work with monitoring sensors and to operate with feed back checks on crop and soil
  - ✓ to work at a single crop level or/and at a whole crop rotation scale

There is a general consensus that DSSs are interesting, but they must be user-friendly, reliable and results must be comprehensible to growers or technicians.

There are a number of DSSs available. E.g.:

- **Aquacrop** (Steduto et al., 2009; Raes et al., 2009; Raes et al., 2016)
- **CropSyst** (Giménez et al., 2013)
- **DSSAT** (CERES, SOYGRO, CROPGRO, CROPSIM, TOMGRO,…) (Jones et al. 2003; Jones and Kiniry, 1986; Ritchie and Otter, 1985; Wilkerson et al., 1983; Boote et al., 1986)
- **DSS-FS** (Barradas et al., 2012)
- **Fertirrigere** (Battilani et al. 2003)
- **GesCoN** (Elia and Conversa, 2015)
- **N-Expert** (Armbruster et al., 2013; Große Lengerich and Rather, 2013; Wiesler et al., 2013).
- **Veg-Syst** (Gallardo et al., 2013; Suárez-Rey et al., 2013; Thompson et al., 2013)
- **Well-N, EU-Rotate_N** (Rahn et al., 1996, 2010)
- ……

- They have different approaches (pieces of the puzzle) and different levels of complexity.
- Some of them are designed to work on field arable crops, or on field vegetable crops or on greenhouse vegetable crops.
- A comparison of the criteria used by the different systems and on their potential large applicability (including calibration and validation) to the EU wide vegetable crop industry should be promoted.