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Real-time Monitoring of Soil and Surface Water Quality in Agricultural Areas

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Improving Water Quality by Monitoring

Heavy pollutant loads from intensive agricultural practices have deteriorated the soil and surface water quality, threatening human health and the ecosystem. The Water Framework Directive (WFD) has set a deadline to improve overall water quality status in the EU by 2027 [1]. In this case, continuous water quality monitoring in agricultural areas becomes a critical tool for the predicting the water quality status, understanding the pollutant dynamics, and assessing the impact of farming practices. However, real-time water quality monitoring in agricultural fields is often bypassed, hindered by the lack of affordable nutrient sensors [2]. Therefore, advancing this technology is crucial for improving water quality.

Challenges in Sensor Data Fusion

Sensor data fusion (SDF) is a promising approach for real-time estimation and prediction [3]. The key challenges include:

- **Generating a high-quality time series dataset** that reflects water quality in agricultural areas. Our approach uses a cost-effective multisensor dataset deployed in local agricultural fields and ditches to indirectly measure the water quality variables [4].
- **Building a suitable dynamic model** for SDF that is accurate, compatible with data availability, and has low complexity. We will construct a straightforward soil water quality model enforced with physics, machine learning, and spatial analysis to simulate nutrient pollutants (Total Nitrogen, Total Phosphorus. and Total Organic Carbon) and related water quality variables.
- **Assimilating the sensor data** and **model predictions** using SDF to estimate the physicochemical variables of water quality and evaluate their relation to fertilization and irrigation practices.

Research goals

1. Develop a dynamic model of soil water quality to predict the water quality in real time.
2. Develop a dynamic model of surface water quality to estimate the water quality in real time.
3. Build an integrated soil and surface water quality model to estimate the water quality in real time.
4. Evaluate the relationship between water quality and farming practices.

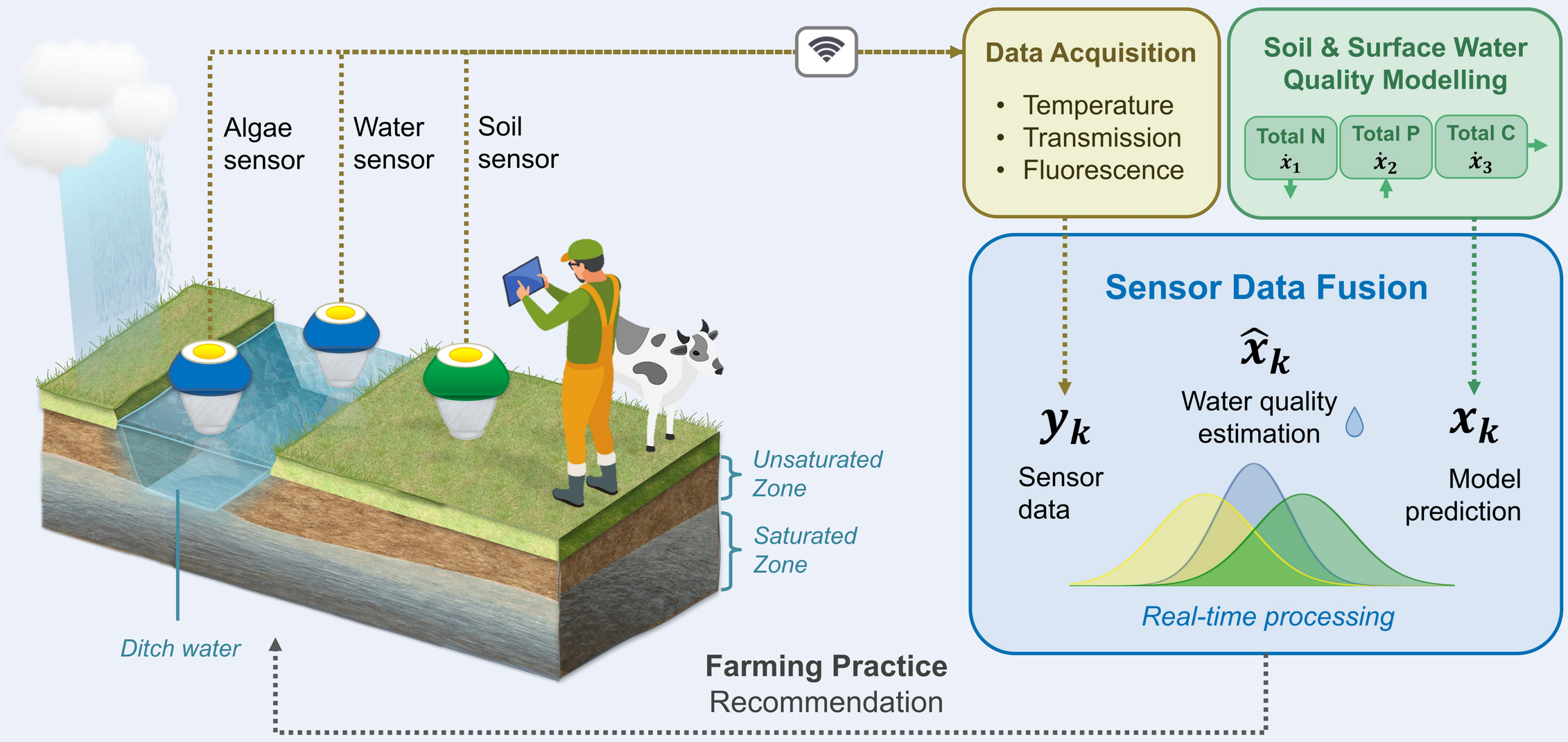

Fig 1. A schematic framework of real-time water quality monitoring approach in agricultural areas with a time index *k*

References

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[3] Ross, E. A. (2024). *Monitoring chlorate through sensor data fusion: A digital twin for electrochlorinator*s. [internal PhD, WU, Wageningen University]. Wageningen University.

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