Study scenarios to analyze the Full Life Cycle of IoT-Based Solutions for Smart Agriculture

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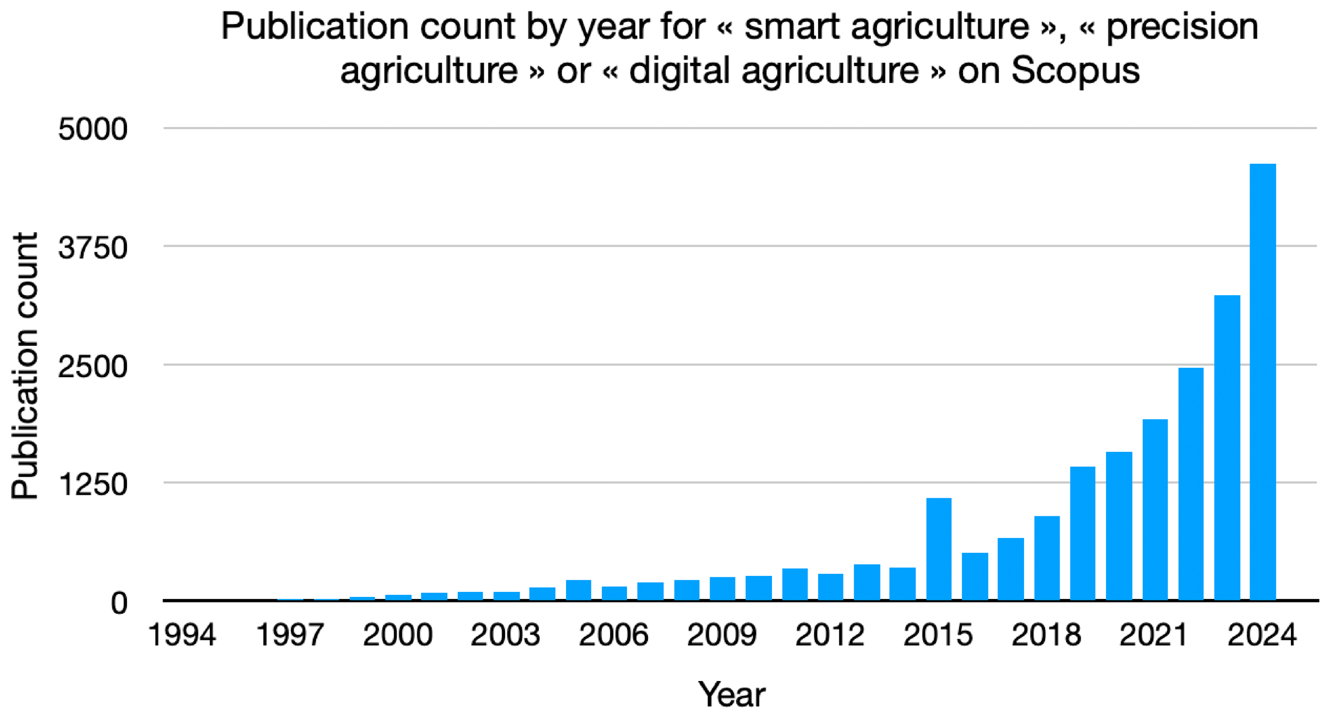
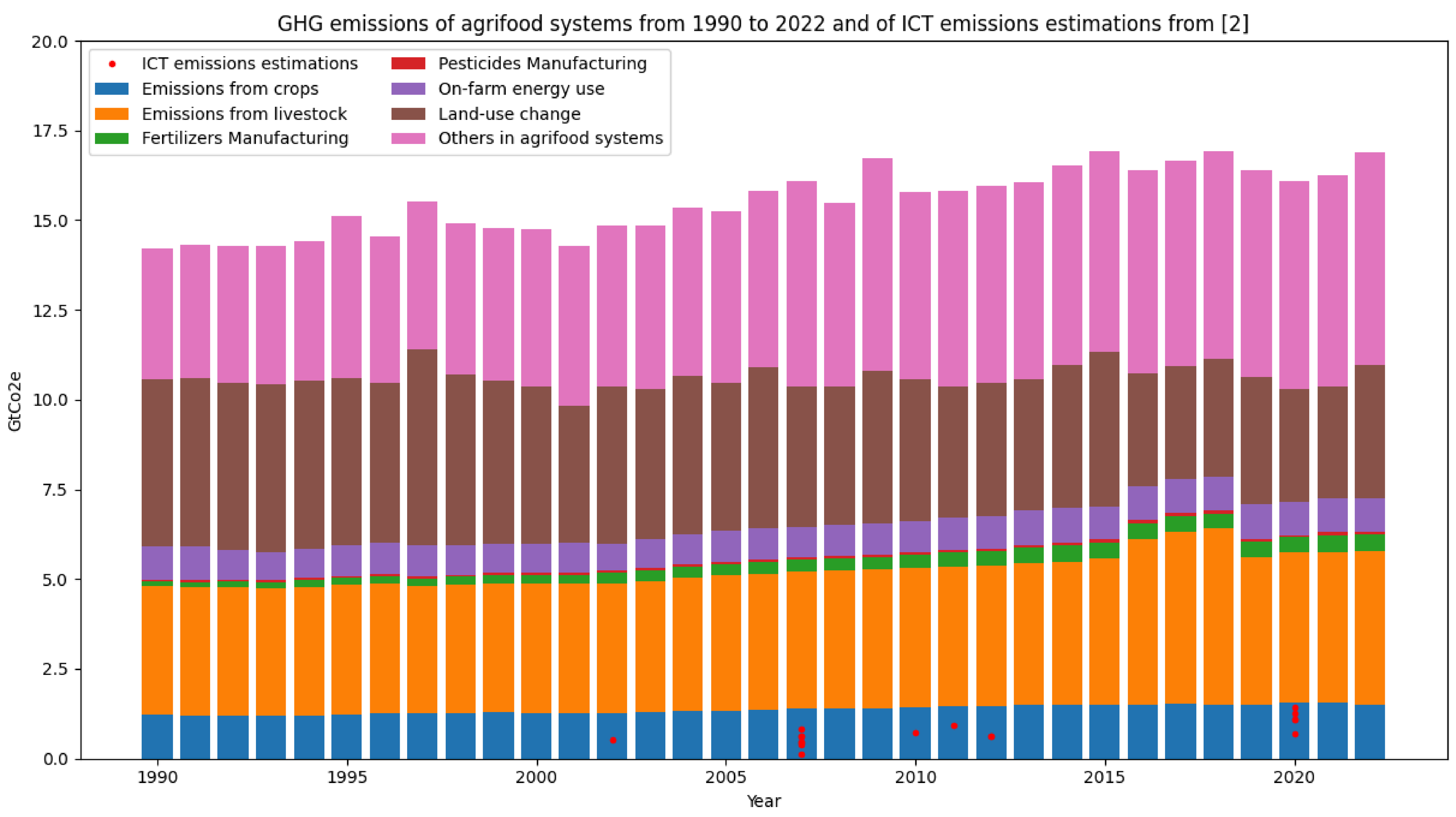
Context

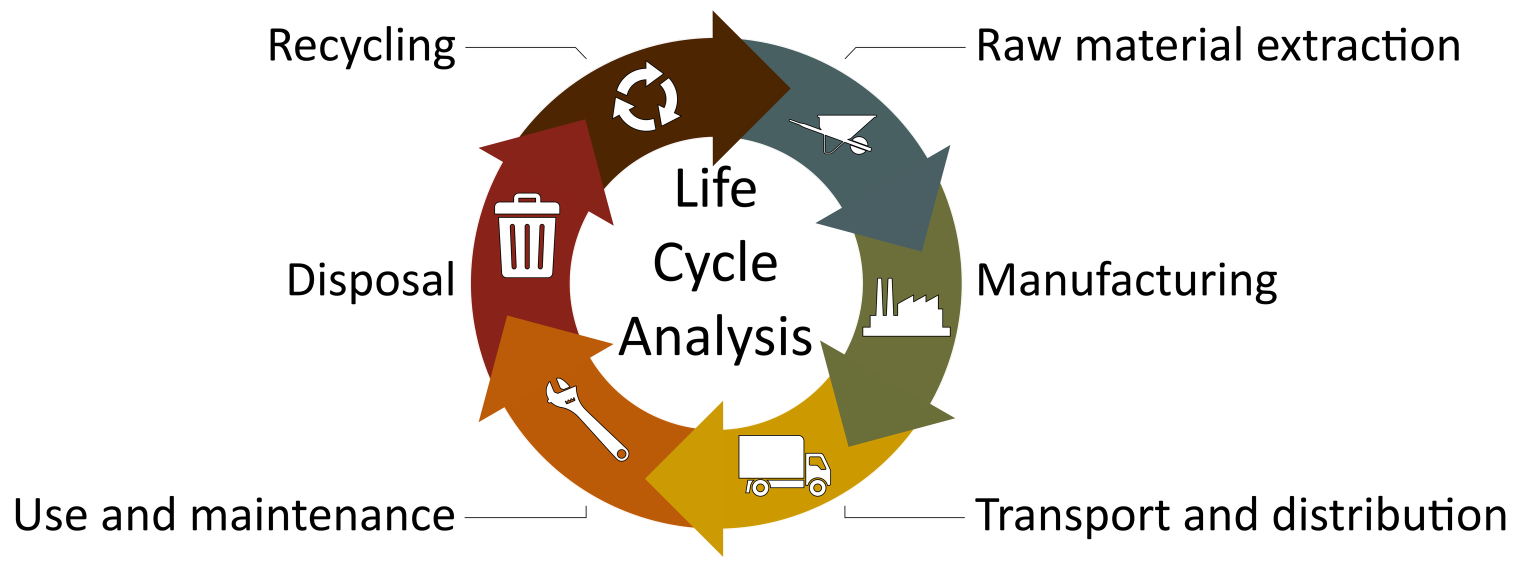
- Smart/precision/digital agriculture is a trending research topic.



- The environmental impacts of information and communication technologies (ICT) are not well taken into account when designing ICT to mitigate the environmental impacts of agriculture [1]

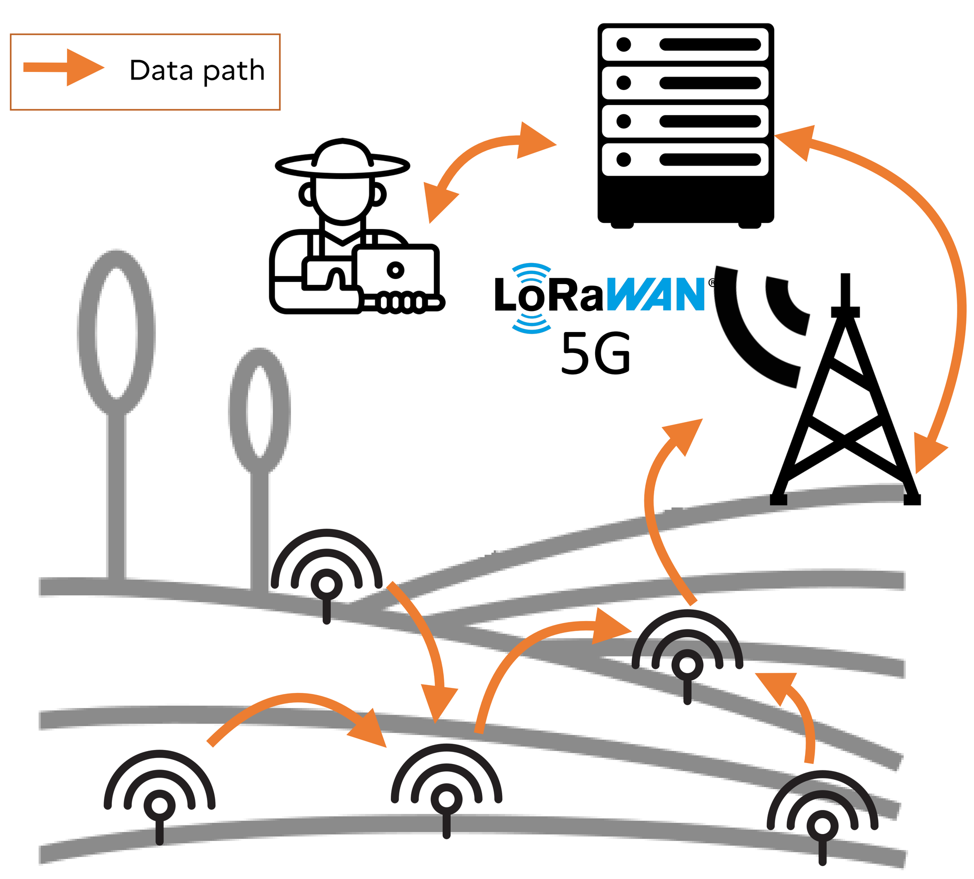


Methodology



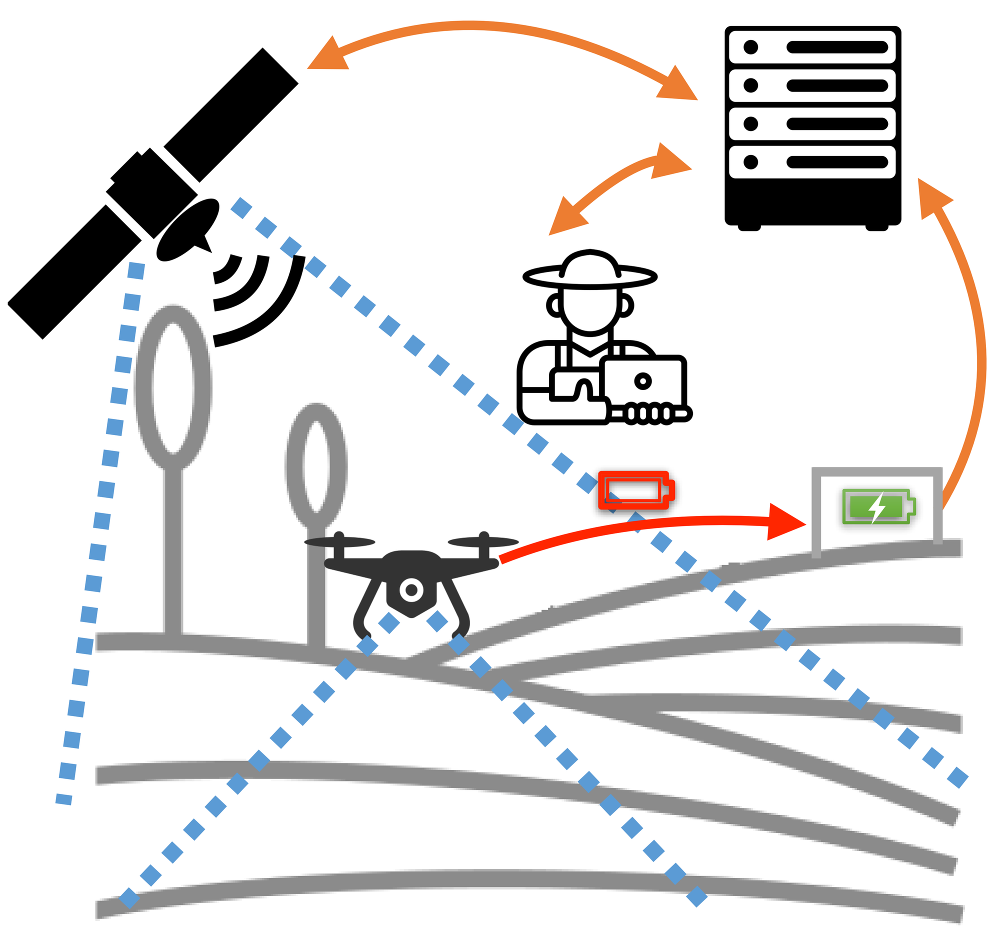
- 3 scenarios were defined based on existing Internet of Things (IoT) technologies and research in the smart agriculture area.
- We will assess their environmental impacts through a Life Cycle Assessment (LCA), which allows for a multi-criteria evaluation over the entire life cycle.
- For each scenario, we will consider the environmental impacts of the ICT system, including the IoT technologies, the networks and the cloud services. We will also consider the impacts of the IoT on the agricultural practices.
- The aim of the LCA is to better understand the ability of IoT technologies to mitigate the environmental impacts of agriculture, and to identify the mapping and distribution of the associated footprint.

Wireless Sensor Network (WSN) for monitoring moisture and nutrients in market gardening and grain farms



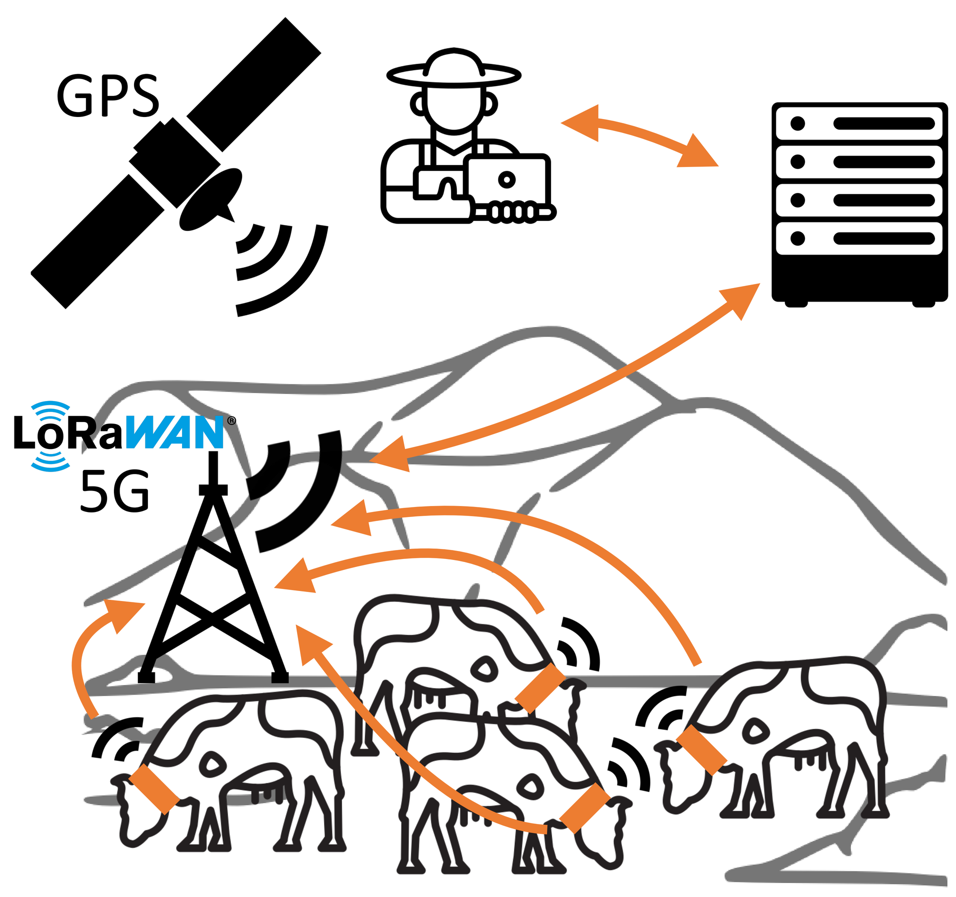
- Type of data used :
  1. Soil moisture
  2. Concentration of nutrient
- Multi-hop WSN
- Machine learning algorithms in cloud computing services to determine optimal irrigation and fertilisation
- The farmer can access recommendations anytime or be notified when a fast intervention is necessary

Unmanned Aerial Vehicles (UAV) and satellite images analysis for vineyard disease and pest detection



- Type of data used :
  1. High quality images captured by an UAV
  2. Satellite images
- Data transmitted when the UAV returns to its loading station
- Cloud services analyze the data to determine factors such as disease and pest presence
- Based on this analysis, machine learning algorithms help determine the most suitable management solutions

Behavior and health sensors for cattle grazing, and methane mitigation through oxidation



- Type of data used :
  1. Behaviour data collected with a collar: movement, location, rumination, eating patterns
  2. Methane emissions
  3. Satellite images
- Data transmitted either through LoRaWAN or through mobile networks
- Machine learning algorithms in cloud services analyse the data to help easier cattle management

[1] C. Huck, A. Gobrecht, T. Salou, V. Bellon-Maurel, E. Loiseau, Environmental assessment of digitalisation in agriculture: A systematic review, Journal of Cleaner Production 472 (2024) 143369

[2] C. Freitag, M. Berners-Lee, K. Widdicks, B. Knowles, G. S. Blair, and A. Friday, “The real climate and transformative impact of ICT : A critique of estimates, trends, and regulations,” Patterns, vol. 2, p. 100340, September 2021.

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