UNIVERSITY OF TWENTE.

Integration of a wireless sensor network and a participatory soil monitoring system for smallholder agriculture

PhD proposal qualifier presentation

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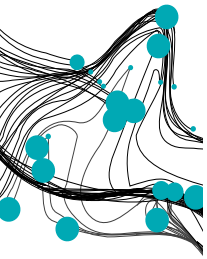
Outline



Overview

High-end agriculture

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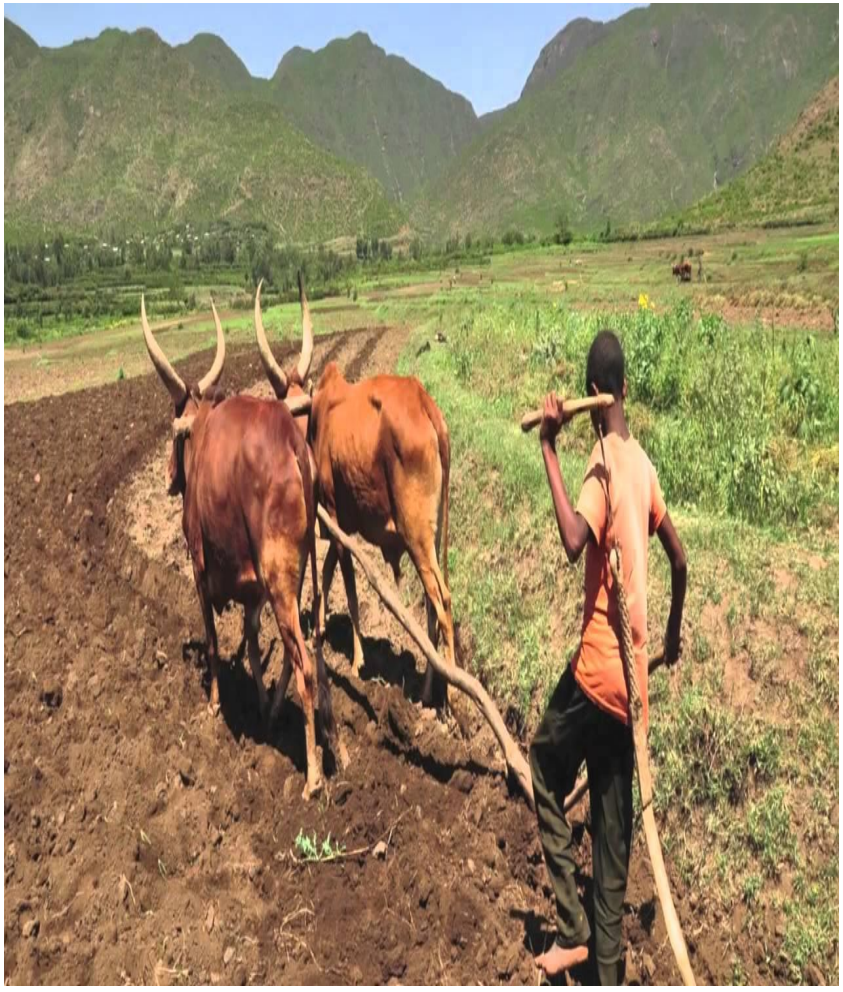
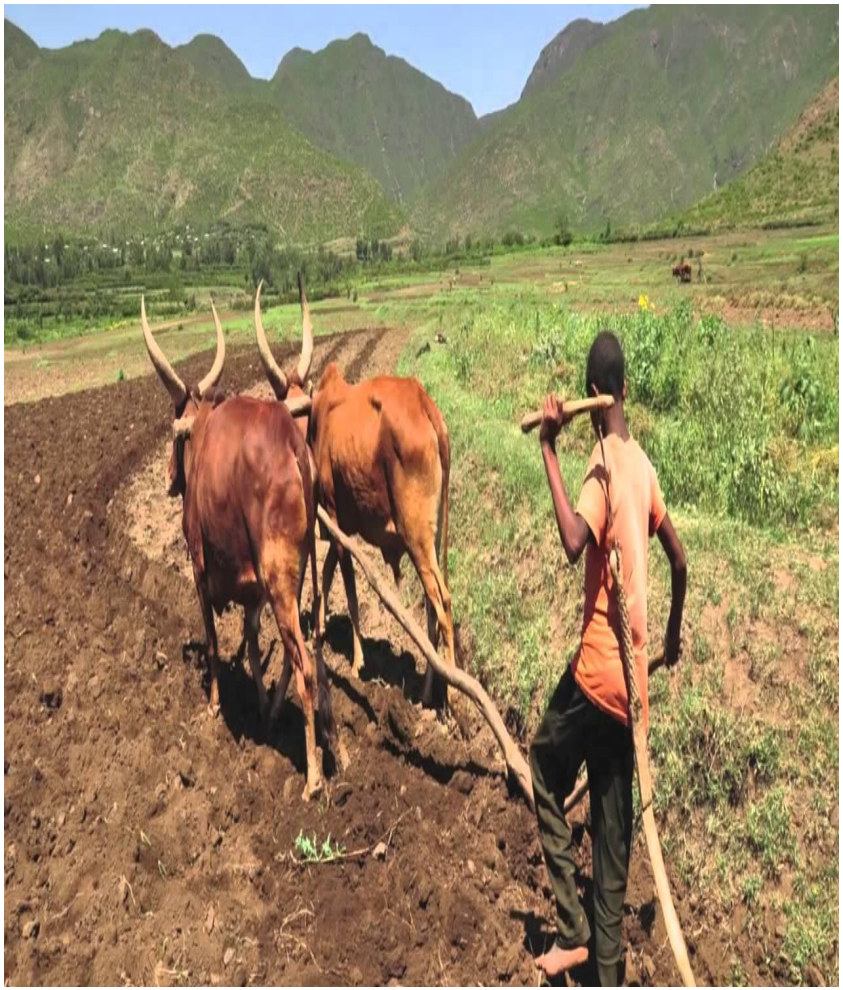
- Digital information and technology support
- Adequate production: quality and quantity
- Nature resilience
- Mechanized and large farms
- Regular follow-up and advises

Low-end agriculture

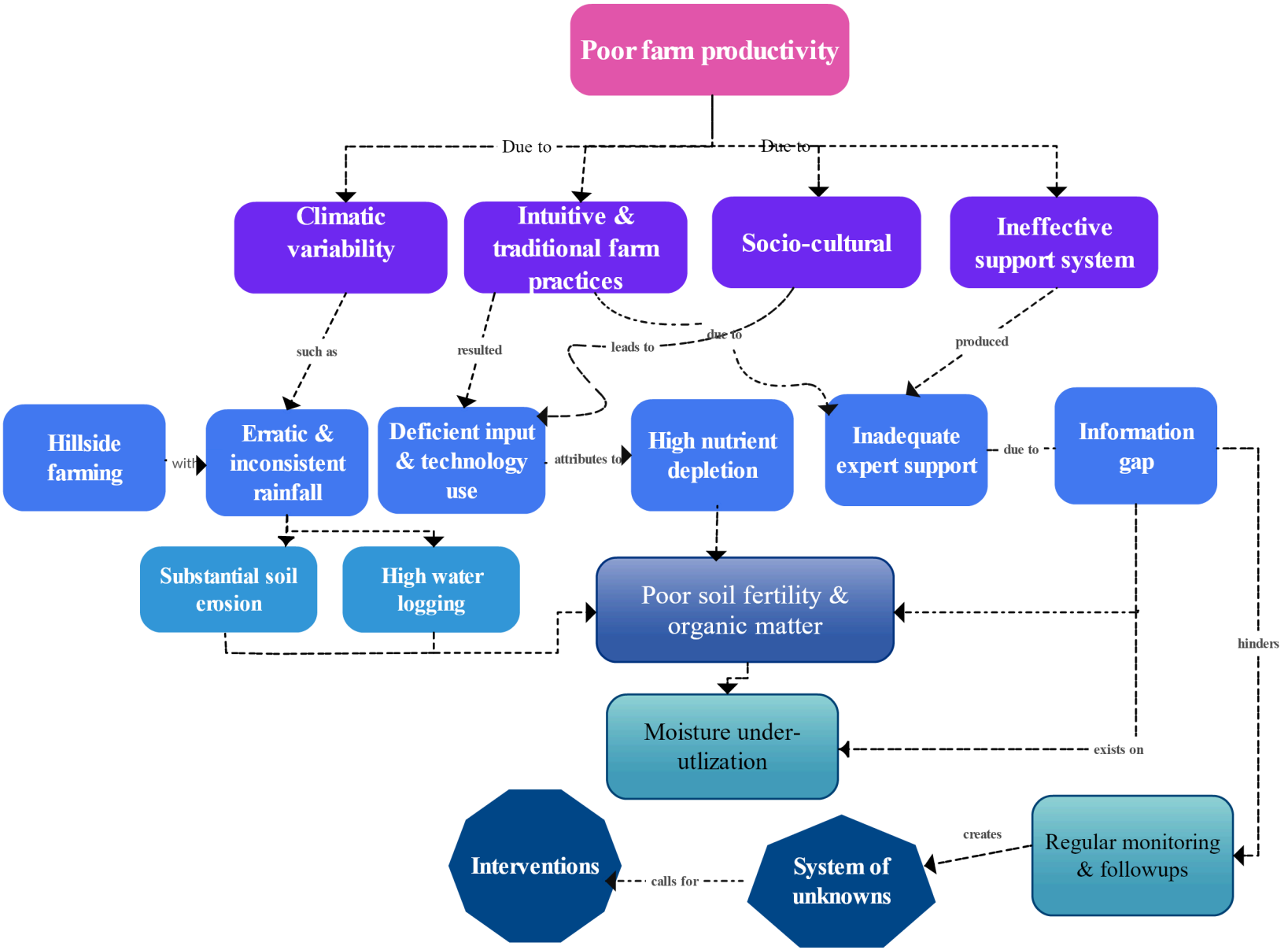


Low-end agriculture



- Smallholders and subsistence-oriented
- Intuitive farming
- Very low technological base and advisory support
- Deficit production

Key drivers: Concept diagram



Gaps

- Extreme scarcity of up-to-date soil data at farm field level
- Inefficient and intuitive use of inputs
- Soil data collection is resource-intensive and difficult
- Advisory systems lack crop-specific soil requirements
- Deficiencies remain undetected until too late

Intervention

- An integrated solution of natural, bio-physical, cultural and technological flavors are needed

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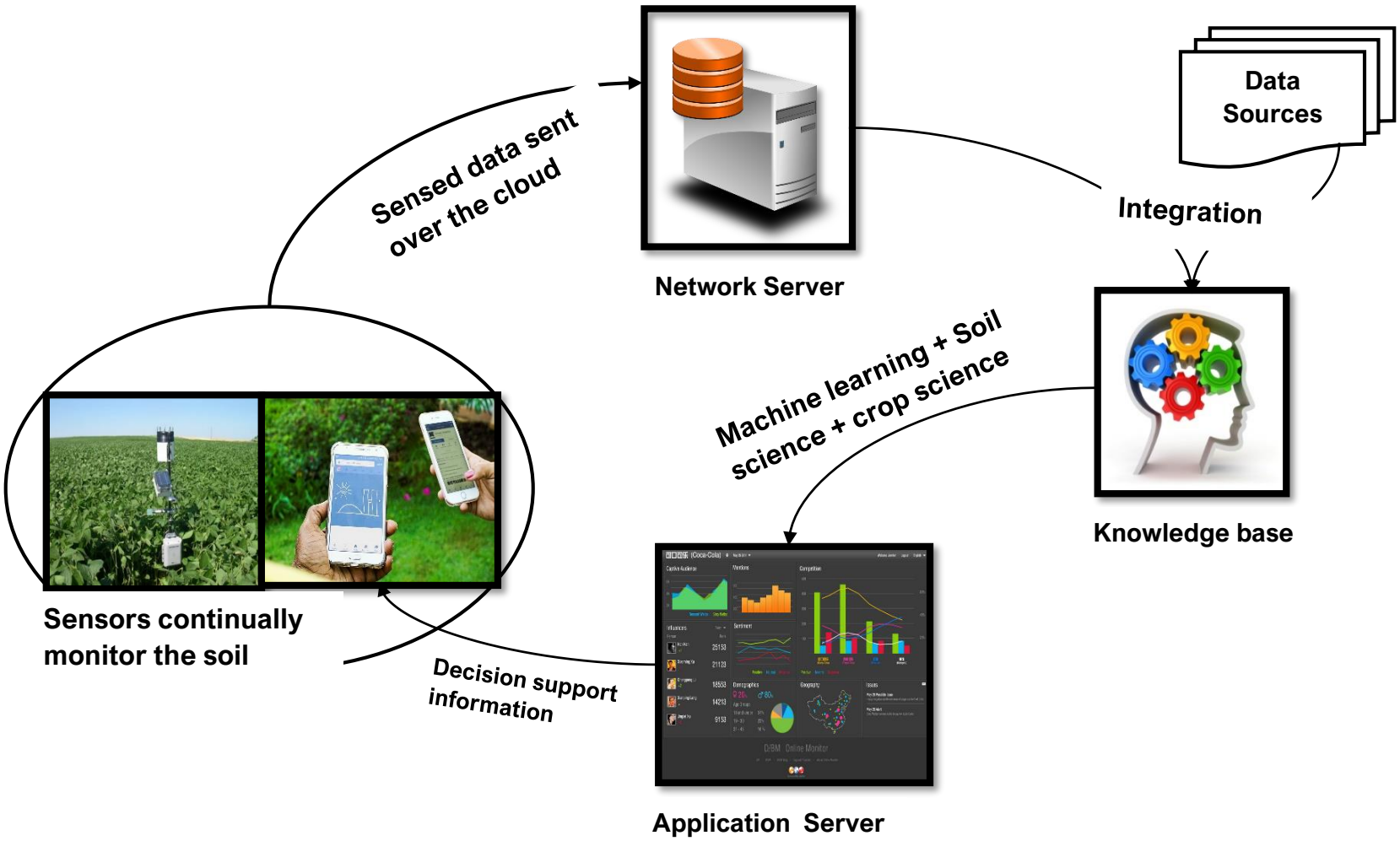
- An integrated solution of natural, bio-physical, cultural and technological flavors are needed
- Implement a (near) real-time, robust, usable, rapidly deployable and affordable soil data collection and analysis tool at farm field level
- Create a platform for improved information flow from multiple sources to improve agriculture yield predictions and projections

Soil

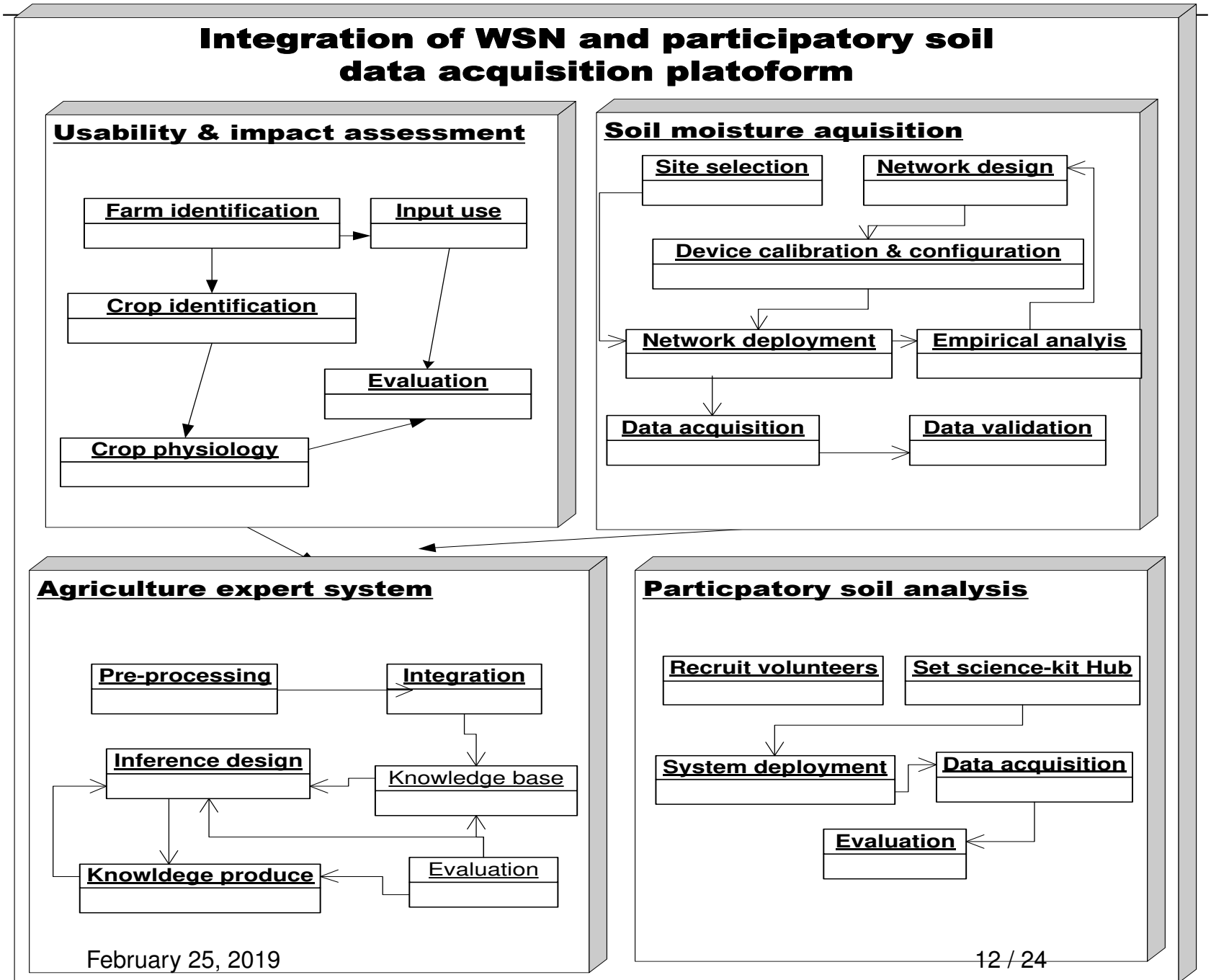
- A source that supplies plants with water and nutrients
- Every crop needs a special composition of the soil to achieve its potential
- Moisture links drought-climate-vegetation
- Nutrients determine yield quality and quantity

Overview

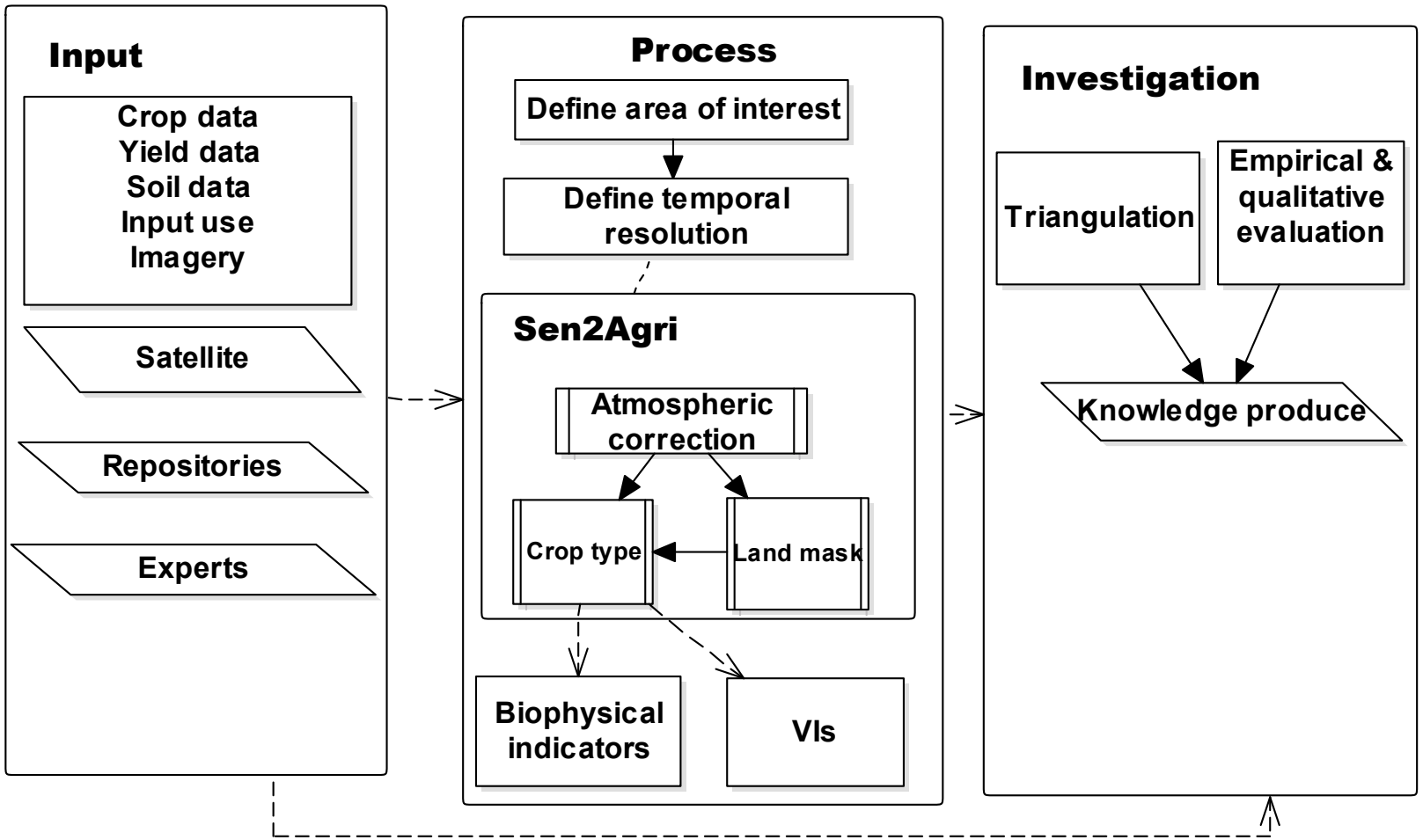
From ground to ground



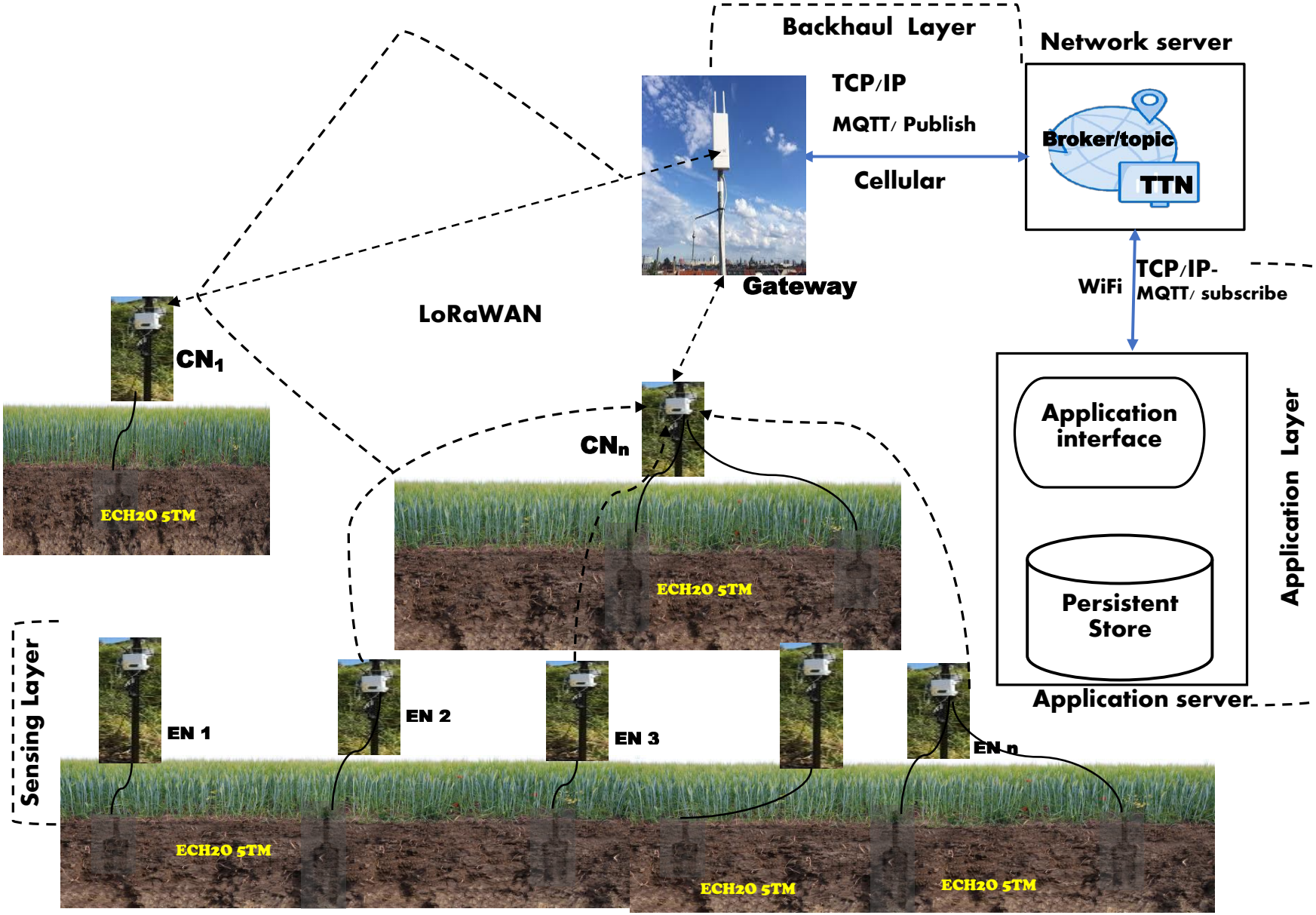
Methodology: system decomposition



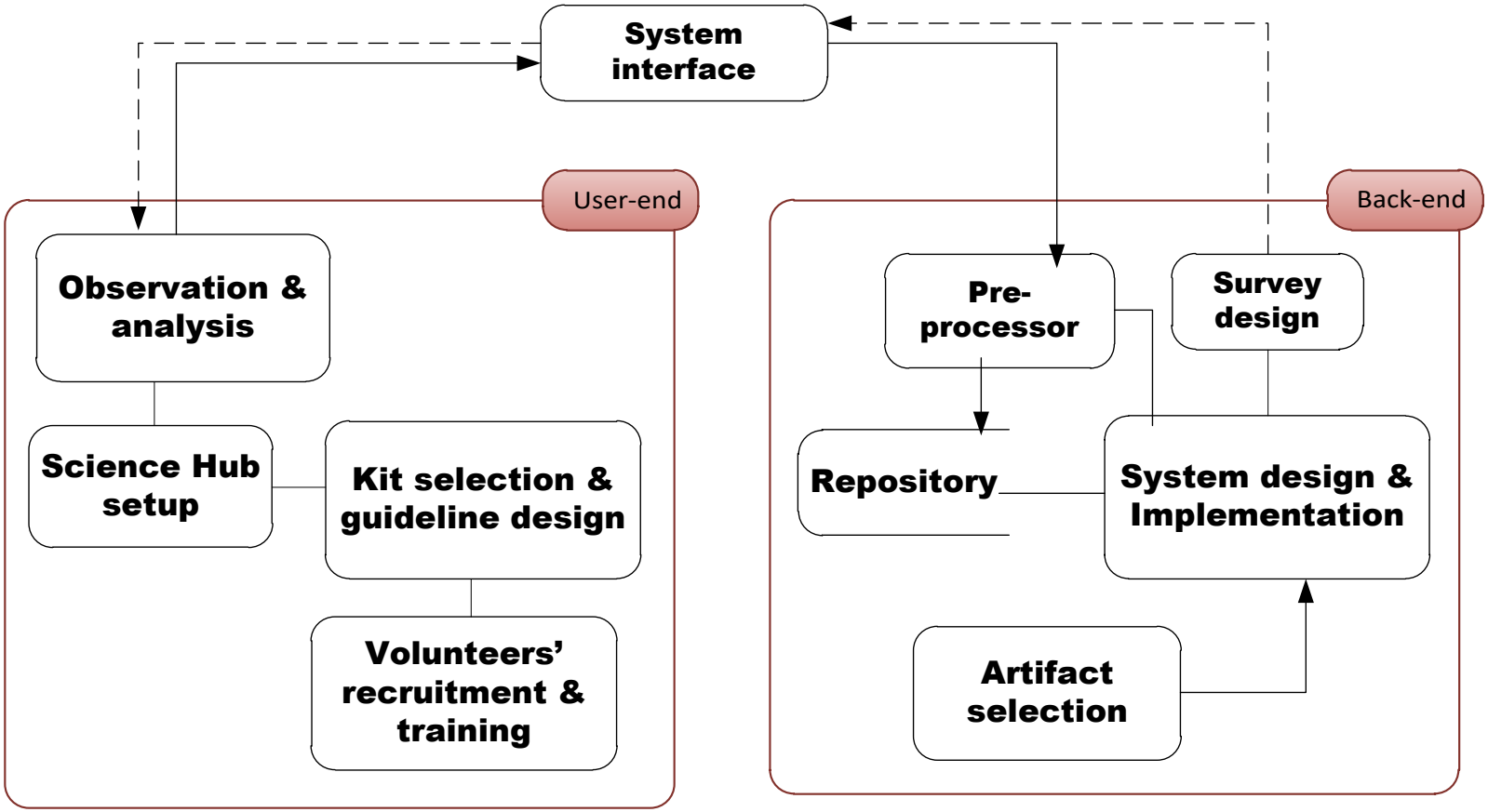
Usability and impact assessment: Hypthesis-driven approach



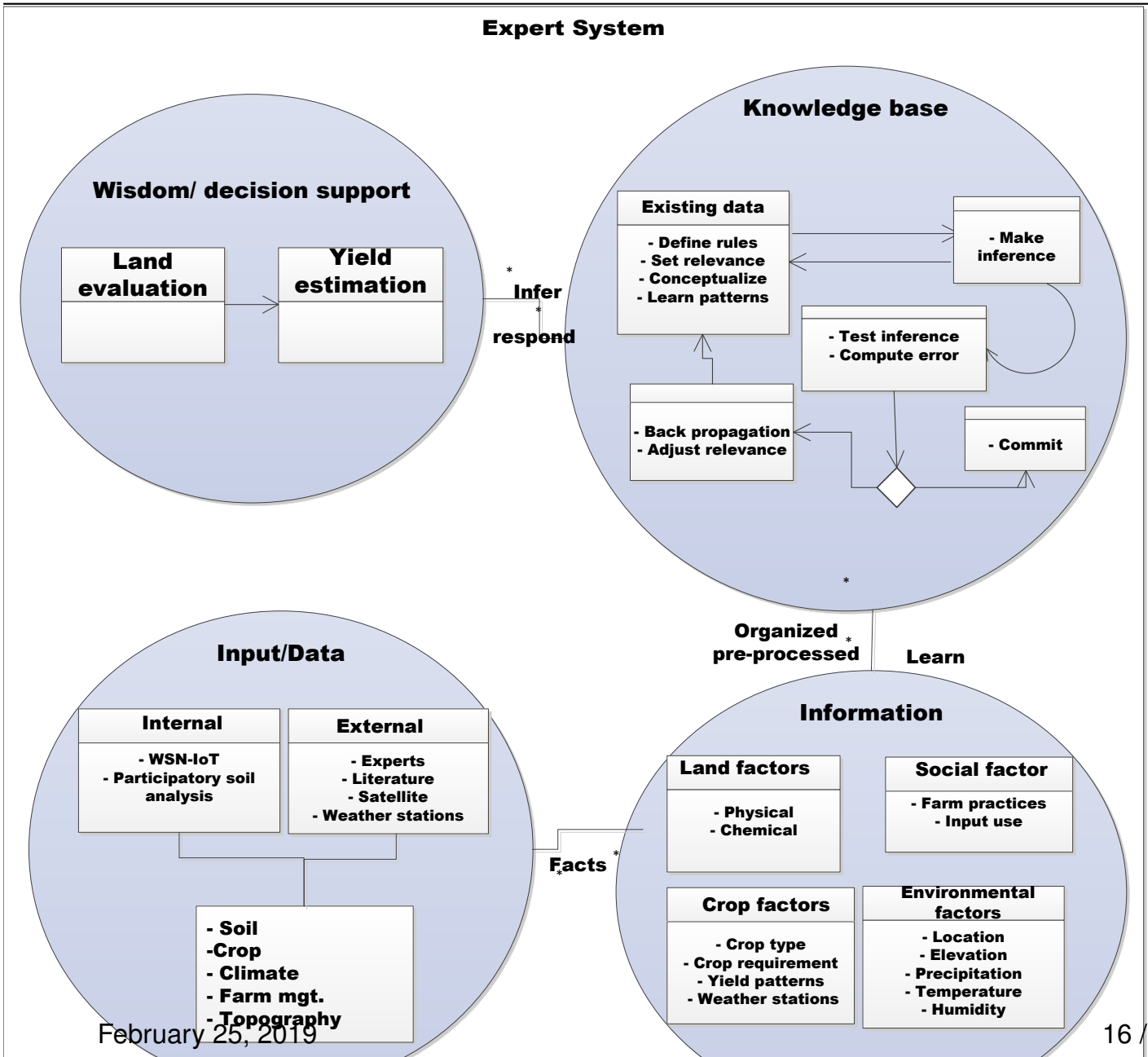
Soil moisture aquisition: Wireless Sensor Network



Participatory soil analysis: Digital citizen science

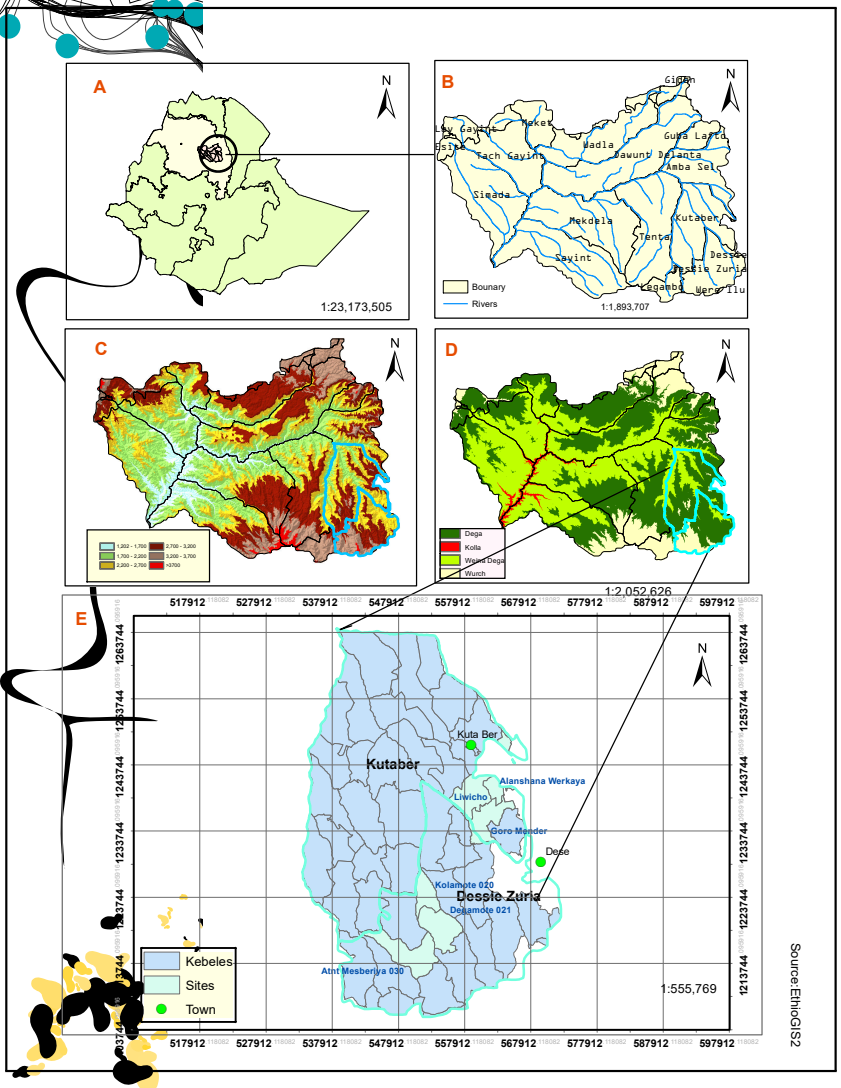


Agriculture expert system: Artificial Neural Network

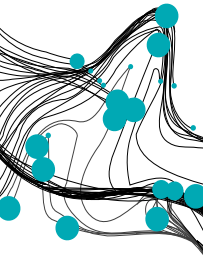


Overview

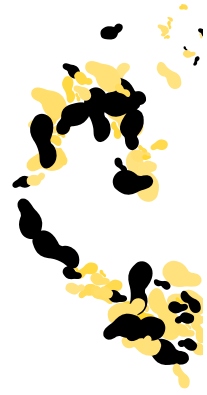
Study area: Beshilo basin



- Two districts: Kutaber and Dessie Zuriya
- Total area of 2206 km^2
- More than 300,000 population
- Rurally dominated and agriculture-dependent livelihood
- Severely damaged soil and high prevalence of food insecurity



Collaborations



Collaborations

- Research collaborations
  - Application of digital image processing for parcel delineation using remote sensing and GIS
  - Design and implementation of standards for heterogeneous data acquisition, integrations and retrieval

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Logistics collaborations

- Equipment are offered by Dr. Rogier from WRS
- Network back-end configuration & maintenance assist from Mr. Joreon:LISA (ITO)
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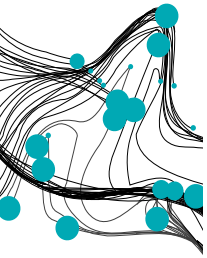
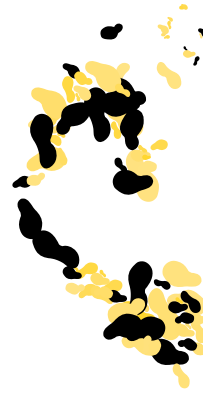
  - Grant proposal to USAID: ” Building civic participation, good governance, and resilient communities”
- Possible coherence with parallel PhD works of the EENSAT project

Overview



Work significance and contribution



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- Real-time, affordable, and participatory field-level soil data acquisition system
- Integration of multiple data sources to complement agricultural decisions
- Produce baseline for satellite data calibrations & validations
- Fill farm-level information gaps to precision farmings

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Way forward and possible outcomes

March 2019-Feb. 2020
- Field visit & site selection
- Network deployment
- As-Is assessment

March-Sep. 2020
- Preliminary analysis
- Phase I deliverable

Oct. 2020-Sep. 2021
- Participatory data collection
- Date pre-process

Oct. 2021-July 2022
- Modeling & analysis
- Final deliverable

Farm-level soil data acquistion: opportunities & challenges

- A WSN design & implementation to support sustainable farming practices
- Empirical evaluation and performance assessment of WSN in remote out-door setup

- Digital citizen science for continous soil monitoring : the case for smallholder farmers
- Use of mobile soil chemical laboratories: pros & cons

- Integration of IoT, citizen science and Remote Sensing (RS): robust and scalable primary data collection tool for agriculture
- AI for agriculture decision support

Thank You