ADD|Ferti
Precision Fertigation for Sustainable Farming

ERA-NET COFUND ICT-AGRI FOOD

ADDFerti
A Data-Driven Platform for Site-Specific Fertigation

Abdul M. Mouazen

2019 cofunded Call
End-term Project Seminar
30th January 2024

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grand agreement no 862665 ICT-AGRI-FOOD.

HORIZON 2020

Involved countries and partners:

6 partners in 5 countries: Belgium, Germany, Swiss, Greece and Turkey

Duration: 36 + 6 months

Overall budget: 1.2 M€

UGent, BE Coordinator

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Objective

- Problem:
  - Climate change affects land productivity
  - Declining water reserves in many places
  - Environmental contamination from excess use of chemical fertilisers.
  - Homogenous application of fertilisers and water results in over- and under-application. Consequences are poor yield, N & P leaching, and water scarcity

- Solution:
  - Variable rate fertigation (VRFI) at field scale, by applying the right rate on fertilisers and water for irrigation at the right time

- Aim:
  - Development of a fully automated ICT platform for VRFI in maize and potato

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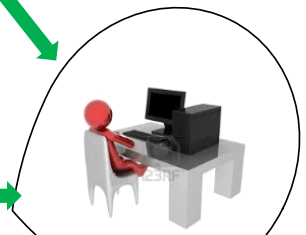
Selected research approach, methodology

Maize and potato

Sensing

Real-time information on MC

Cloud intelligence



Modelling

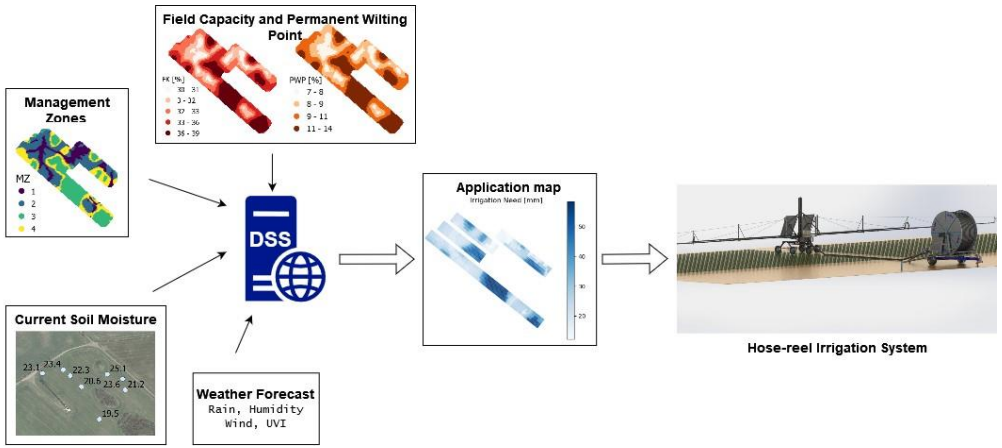
Weather data

Control

Hose-reel Irrigation System

Major results:

- Modification of a mid-size commercially available Sezer HIS machine for implementation of VRFI:
  - 4 independent section control for irrigation.
  - 4 independent section control for fertilization.
- Created a DSS to automatically process input data (soil scanning data, live soil moisture data, weather data) and calculate fertigation application maps.
- A Neural Network was included into the DSS, to predict water for irrigation.



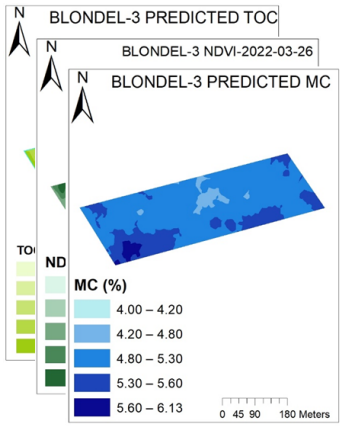
Hose-reel Irrigation System

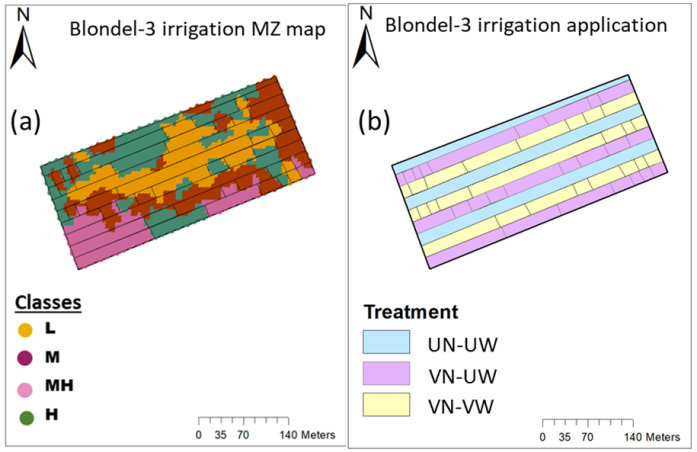
Selected research approach, methodology

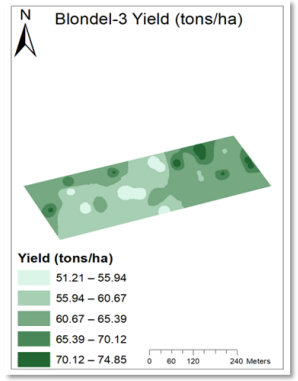
A field in Belgium with potato

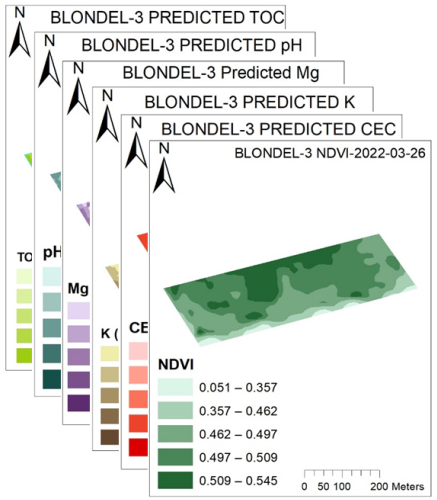
- Common Raster Grid Creation
- Data Fusion by Clustering or other ML tools
- Mapping

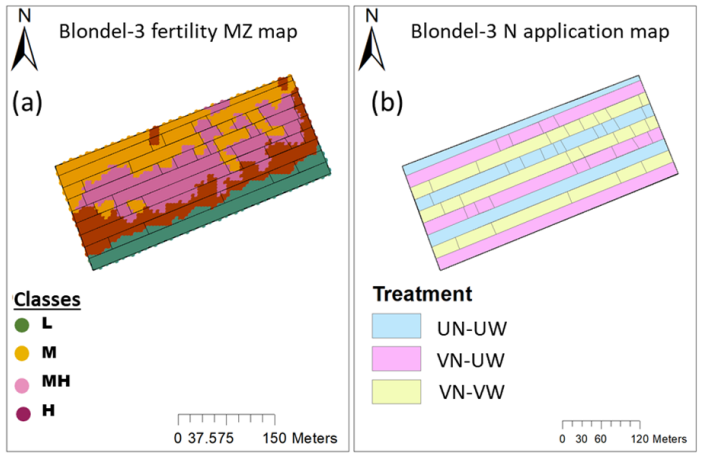










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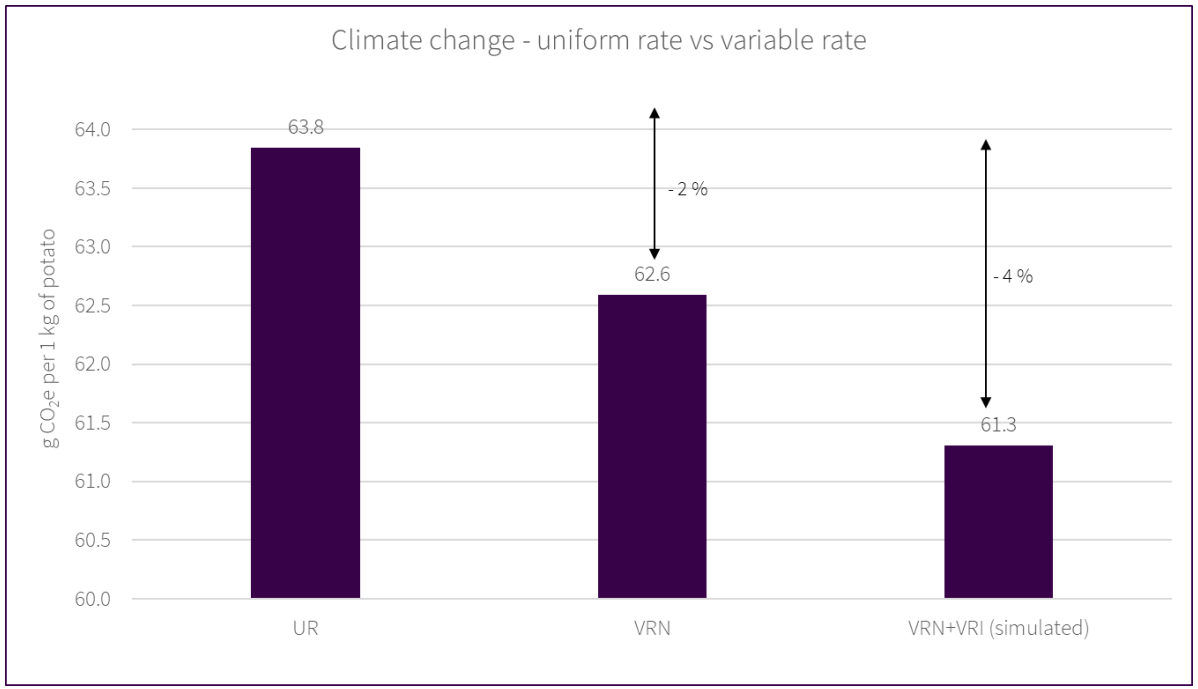
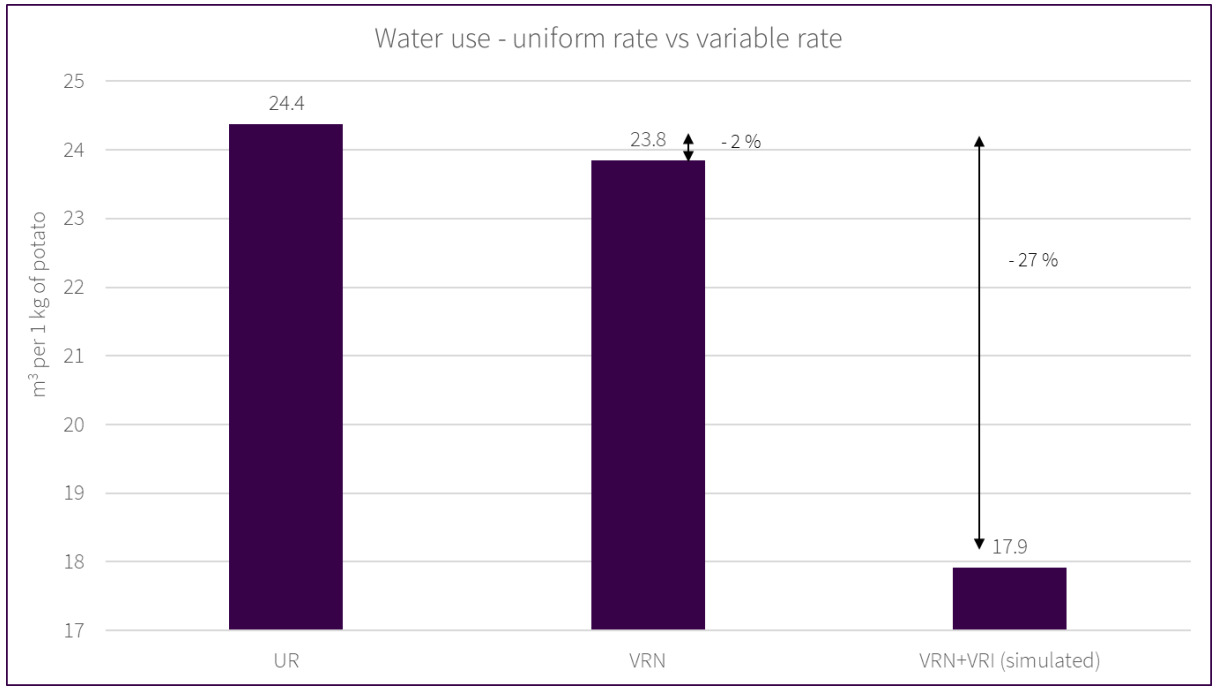
Major results: Cost Benefit Analysis

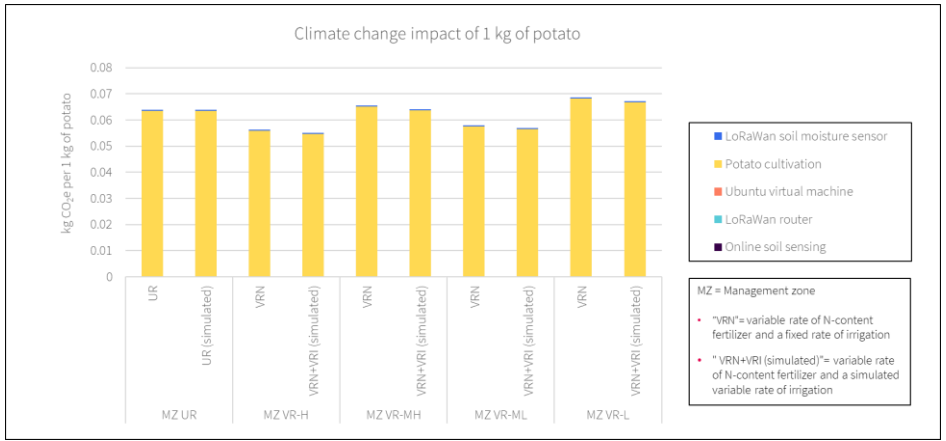
		Treatment	Area(ha)	Total area of treatment	Fertilizer dose (L/ha)	N applied per treatment (L)	Total N applied (L)	total N used per ha per treatment (L/ha)	Fertilizer rate (Kg/ha)	Fertilizer cost (€/ha)	Yield per treatment (ton/treatment)	Yield per treatment (ton/ha)	Average yield (ton/ha)	Simulated Yield (ton/ha)	Average simulated yield (ton/ha)	No of Irr application	Amount of water inc. pre irr(mm)	Irrigation cost (€/ha)	Revenue (€/ha)	gross margin (€/ha)	Relative gross margin (€/ha)
URN+URI		UR	2.00	2.00	100.00	200.00	200.00	100.00	39.00	52.72	117.34	58.67	58.67			3	90.00	135.82	11734.00	11545.46	-
VRN+URI	sensor 9	VR-H	0.79	4.63	50.00	39.50	477.81	103.28	40.28	54.45	50.12	63.44	60.82	63.07	60.73	3	90.00	135.82	12163.03	11972.76	427.31
	sensor 28	VR-MH	1.39		75.00	104.55					77.28	55.44		55.16			90.00				
	sensor 4	VR-ML	1.30		125.00	163.06					87.48	67.06		67.09			90.00				
	sensor 10	VR-L	1.14		150.00	170.70					65.23	57.32		57.61			90.00				
	total		6.63																		
URN+URI		UR	2.00	2.00	100.00	200.00	200.00	100.00	39.00	52.72	117.34	58.67	58.67			3	90.00	135.82	11734.00	11545.46	-
VRN+VRI	sensor 9	VR-H	0.79	4.63	50.00	39.50	477.81	103.28	40.28	54.45	50.12	63.44	60.82	63.07	60.73	2	56.60	90.55	12163.03	12018.04	472.58
	sensor 28	VR-MH	1.39		75.00	104.55					77.28	55.44		55.16			57.40				
	sensor 4	VR-ML	1.30		125.00	163.06					87.48	67.06		67.09			54.00				
	sensor 10	VR-L	1.14		150.00	170.70					65.23	57.32		57.61			53.20				
	total		6.63																		

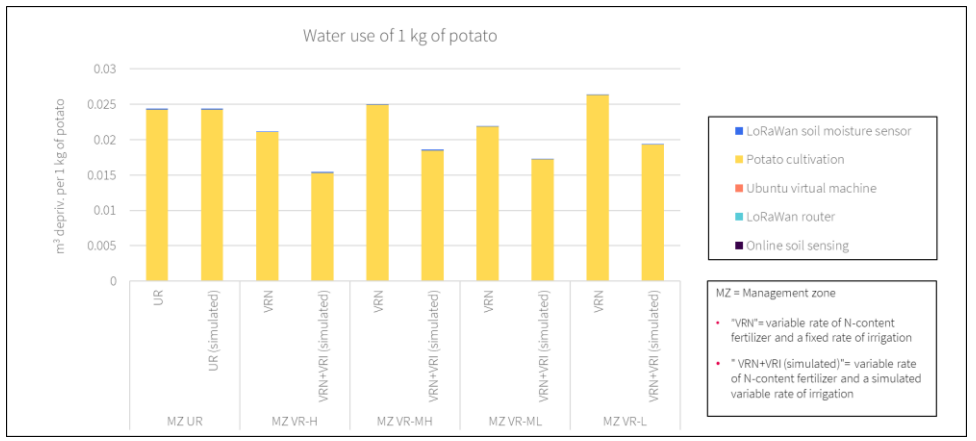
- A field in Belgium with potato
- An area of 6.62 ha
- 2023 cropping season

Major results: Life Cycle Analysis (LCA)





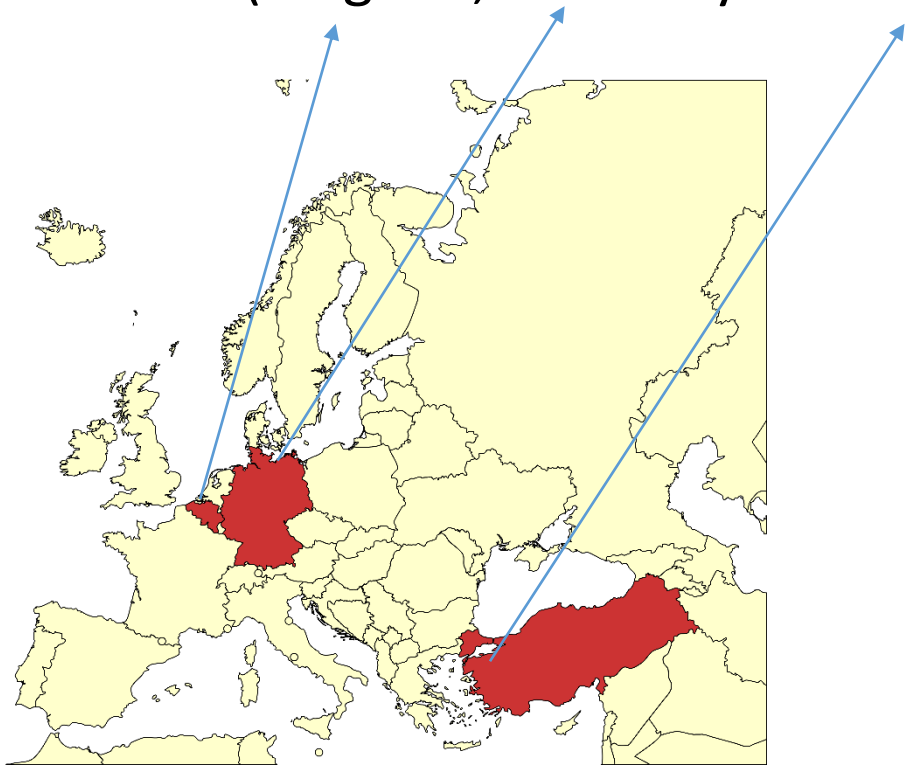




Cooperation with stakeholders, industry partners and/or public and private sector

- 1 industry partner (SEZER, Turkey)

- 3 (private) commercial farms (Belgium, Germany and Turkey)



Opportunities

1. Closed-loop system integration

- ✓ A validated closed-loop fully automated framework of sensing, modeling, and control for precision irrigation, fertilization and fertigation.

2. AI implementation:

- ✓ Implementation of ML for irrigation recommendations, irrigation scheduling and yield prediction.

3. Incorporation of IoT Devices:

- ✓ Expand the use of Internet of Things (IoT) devices in smart agriculture, enabling better monitoring and control of farm equipment, e.g., irrigation systems.

4. Adaption to changing climate conditions:

- ✓ Innovations in precision irrigation technology for water saving, in support for sustainable farming practices.

Next steps for innovation

1. Pilot Testing in Different Regions:

- ✓ Conduct pilot tests of the ADDFerti solution in different geographical regions.
- ✓ Recommend more robust tailor-made recommendations based on future feedback of pilot tests.

2. Commercialization and Market Expansion:

- ✓ Potential to commercialize the new fertigation machine with a 4-section control mechanism by SEZER.
- ✓ Potential to commercialize the integrated solution as a service provider.
- ✓ Custom products tailored for specific needs.

3. Engagement of Robotics and Automation:

- ✓ Investigate the potential use of robotics and automation in ADDFerti solution.
- ✓ Increasing system safety while decreasing labor costs.

4. Education and Training Programs:

- ✓ Develop education and training programs to effectively use and benefit from the outcome of ADDFerti.

Summary and Conclusion takeaways and lessons learned

1.Technology

- ✓ All components of the ICT platform for VRFI is completed.
- ✓ The solution will be tested in the 2024 cropping season in Germany, Belgium and Turkey.

2. Economic impacts:

Increased profitability by increased yield while using less N fertilizer and water:

- ✓ VRN: ≈ **430 €/ha** gross margin (≈ **3%**), compared to URN.
- ✓ VRN+VRI (Simulated): ≈ **470 €/ha** profit (≈ **4%**), compared to URN.

3. Environmental impacts:

- ✓ A reduction of **-2% CO^2eq** and **-2% of water use** with VRN, compared to the applied UR.
- ✓ Reduction of **-4% CO^2eq** and **-27% of water use** with VRN+VRI (simulated), compared to the applied UR.

Precision Fertigation for Sustainable Farming

LET'S KEEP IN TOUCH!

Please feel always free to reach out to us.

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Thank you for your attention!