PDM

River Severn Partnership

Advanced Wireless Innovation Region

Cranfield Water

Using sensor data to assess yields, water use and value in horticultural production

Data collection, crop modelling & economic assessment

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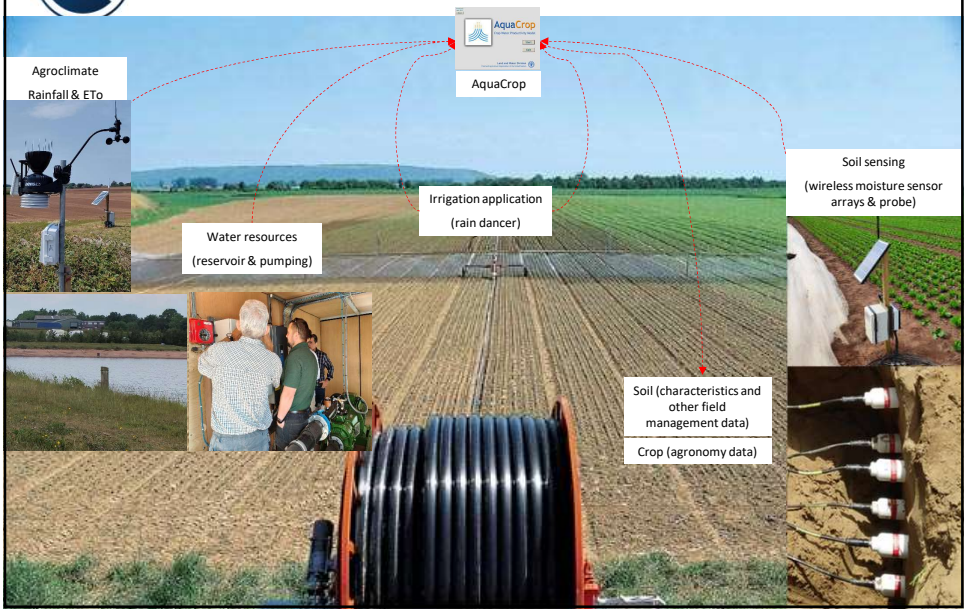
Integrating data to support precision irrigation



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Data collected for crop modelling

Variable	Data	Data source
Agroclimate	Daily weather data PDM Upton station (2020-2025) ET monitoring using Licor	Weatherlink (Agri-Tech Services) Licor (Cranfield)
Crop	Upton planting programme (2022-2024) Agronomy data include • Cultivar • Planting and harvest dates • Seed or transplants • Planting density (plants/m^2) • Max rooting depth (cm) • Date of full crop cover • Yield	PDM Agronomy manager Field visit/Literature review
Soil	Soil characteristics (texture, bulk density, water holding capacity). Soil moisture sensing (historical and 2024-2025) data	PDM Agronomy manager Agri-Tech Services Soil sensors (Cranfield)
Irrigation	Typical irrigation (rain-dancer data 2022- 2024) schedules by crop and by field at Upton farm	PDM irrigation manager
Water resources	Meter readings at reservoir pumphouse, volumes pumped (2022- 2024), pressure data etc.	PDM irrigation manager

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Lower Upton (PDM) farm site layout

Source: PDM

Variety of salads—including mixed baby leaf, spinach, and whole head (iceberg, romaine, gem) as well as speciality lettuces and celery— all irrigated via a pressurised water distribution system using hosereels with booms

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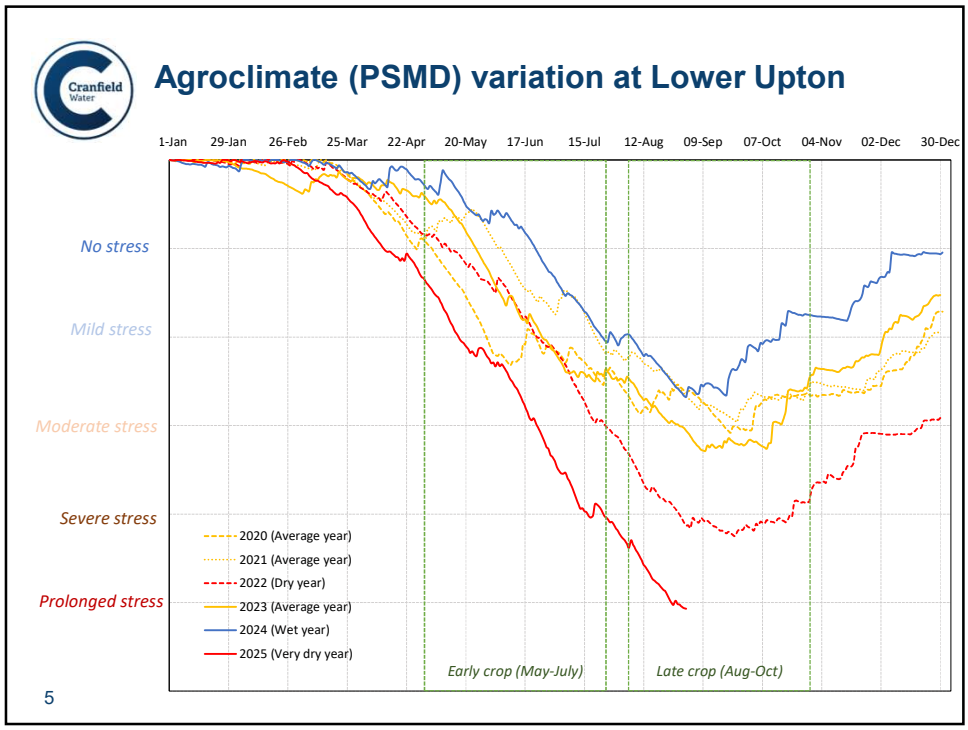
Agroclimate (PSMD) variation at Lower Upton
1-Jan
29-Jan
26-Feb
25-Mar
22-Apr
20-May
17-Jun
15-Jul
12-Aug
09-Sep
07-Oct
04-Nov
02-Dec
30-Dec
No stress
Mild stress
Moderate stress
Severe stress
Prolonged stress
2020 (Average year)
2021 (Average year)
2022 (Dry year)
2023 (Average year)
2024 (Wet year)
2025 (Very dry year)
Early crop (May-July)
Late crop (Aug-Oct)
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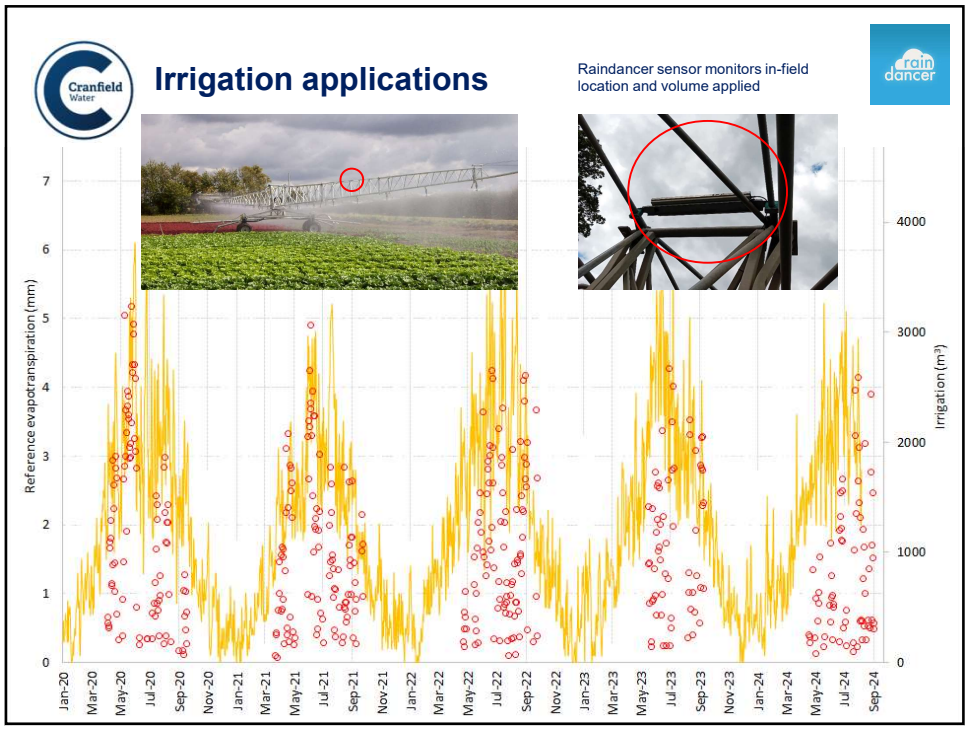
Irrigation applications
Raindancer sensor monitors in-field location and volume applied
rain dancer
Reference evapotranspiration (mm)
Irrigation (m³)
0
1
2
3
4
5
6
7
0
1000
2000
3000
4000
Jan-20
Mar-20
May-20
Jul-20
Sep-20
Nov-20
Jan-21
Mar-21
May-21
Jul-21
Sep-21
Nov-21
Jan-22
Mar-22
May-22
Jul-22
Sep-22
Nov-22
Jan-23
Mar-23
May-23
Jul-23
Sep-23
Nov-23
Jan-24
Mar-24
May-24
Jul-24
Sep-24

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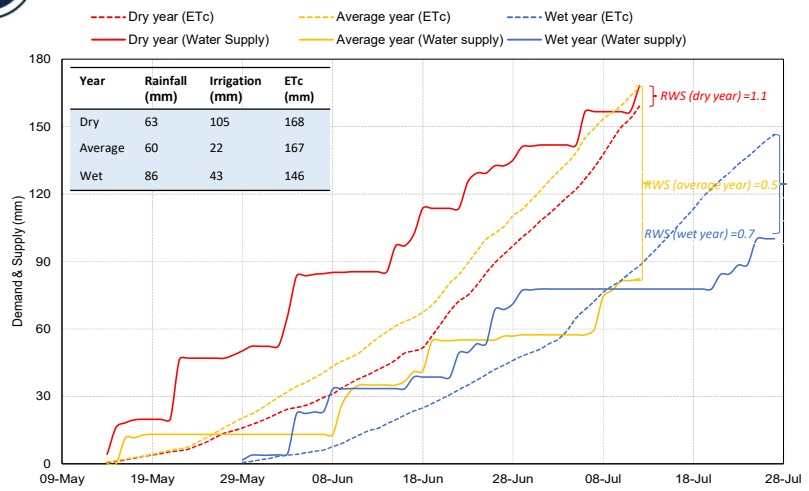
Demand and Supply (Early crop: May-July)



Year	Rainfall (mm)	Irrigation (mm)	ETc (mm)
Dry	63	105	168
Average	60	22	167
Wet	86	43	146

RWS defined as total amount of water made available to crop from all sources (rainfall, irrigation) in relation to theoretical crop water demand (ETcrop)

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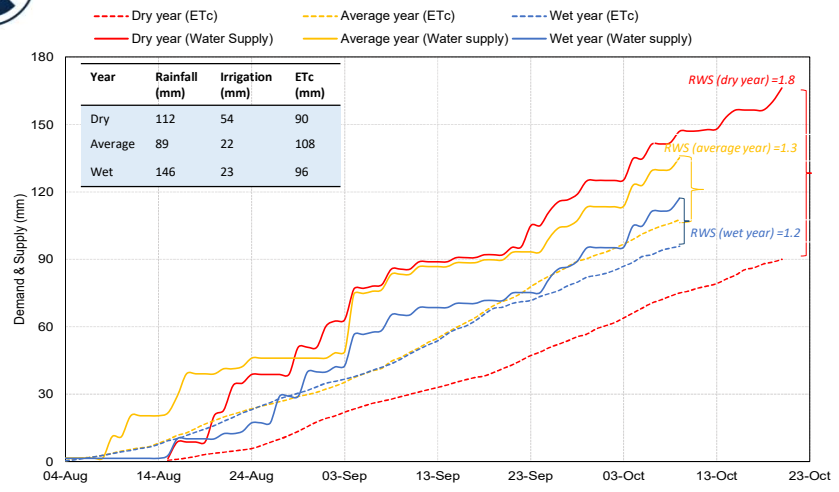
Demand and Supply (Late crop: Aug-Oct)



Year	Rainfall (mm)	Irrigation (mm)	ETc (mm)
Dry	112	54	90
Average	89	22	108
Wet	146	23	96

RWS defined as total amount of water made available to crop from all sources (rainfall, irrigation) in relation to theoretical crop water demand (ETcrop)

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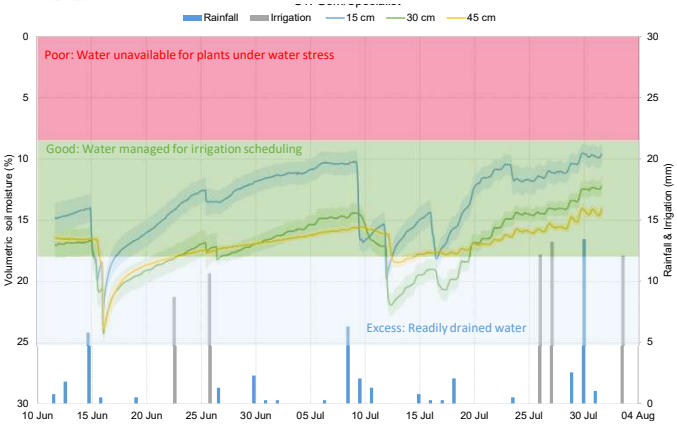
Soil moisture sensing (2024)



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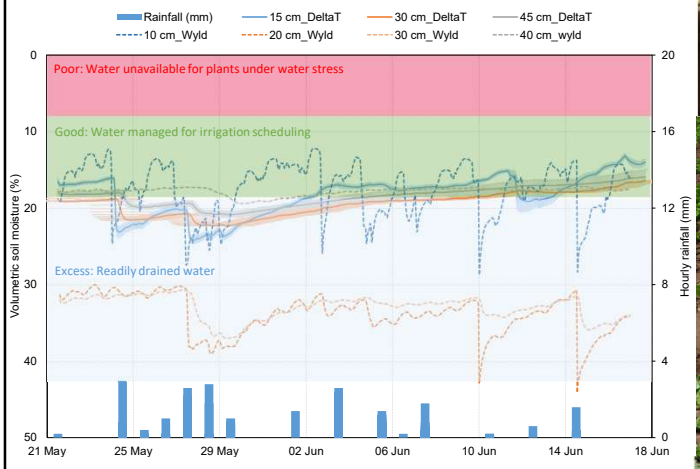
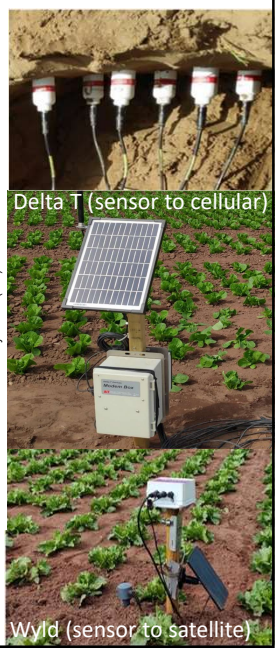
Soil moisture sensing (2025)





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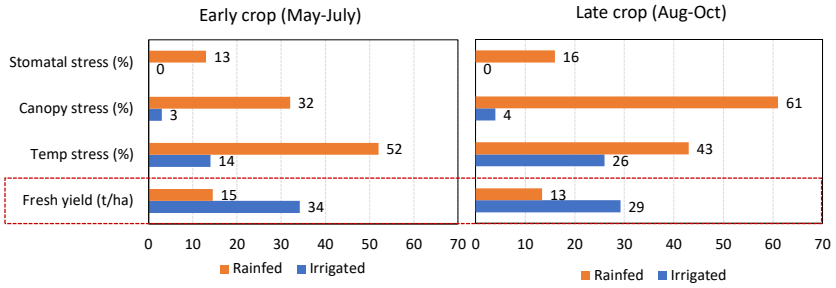
Modelled yield and water use for lettuces



Crop type	Rainfall (mm)	Irrigation (mm)	ET (mm)	Infiltration (mm)	Drainage (mm)
C1:Rainfed	63	0	102	84	17
C1:Irrigated	63	85	125	122	38
C2:Rainfed	98	0	142	98	31
C2:Irrigated	98	79	181	157	40

C1: early crop (May-July); C2: Late crop (Aug-Oct)

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Economic assessment of lettuce production
Based on typical values, not farm financial data

Categories	Dry year		Wet year	
	Rainfed	Irrigated	Rainfed	Irrigated
Irrigation water requirement (m^3/ha)	-	869	-	410
Productivity (t/ha)	18	34	18	37
Farm gate value (£/ha)	220	220	220	220
Output value (£/ha)	3238	7376	4028	8107
Irrigation infrastructure (annualized costs for application equipment and reservoir (£/ha)	-	165	-	165
Irrigation abstraction and operating costs (£/ha)	-	743	-	743
Variable labour (£/ha)	726	914	726	780
Variable energy (£/ha)	26	36	26	29
Variable land (£/ha)	840	840	840	840
Fertilizer (£/ha)	63	63	63	63
Gross margin (£/ha)	1584	4616	2374	5885
Financial investment appraisal (FIA) (£/ha)		3033		3511
Value of irrigation water (£/m^3) with reservoir		**3.5**		**8.6**
Value of irrigation water (£/m^3) without reservoir		**4.1**		**9.3**

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Summary

- **Identify suitable sensors for agroclimate, crop and soil monitoring**: connectivity, data extraction and interpretation key for farm-level decision making
- **Integrate key components into crop modelling**: agroclimate, soil, crops, water and energy inputs
- **Economic assessment:** Use data from sensors, literature and modelled outputs
- **Validate productivity and economic assessments with farm-level data** to ensure accuracy and reliability
- **Link to farm sustainability goals**: reduce carbon and water footprints by linking to environmental variables