



IoT Farm Ambassador Wrap-Up Meeting

22nd June 2021

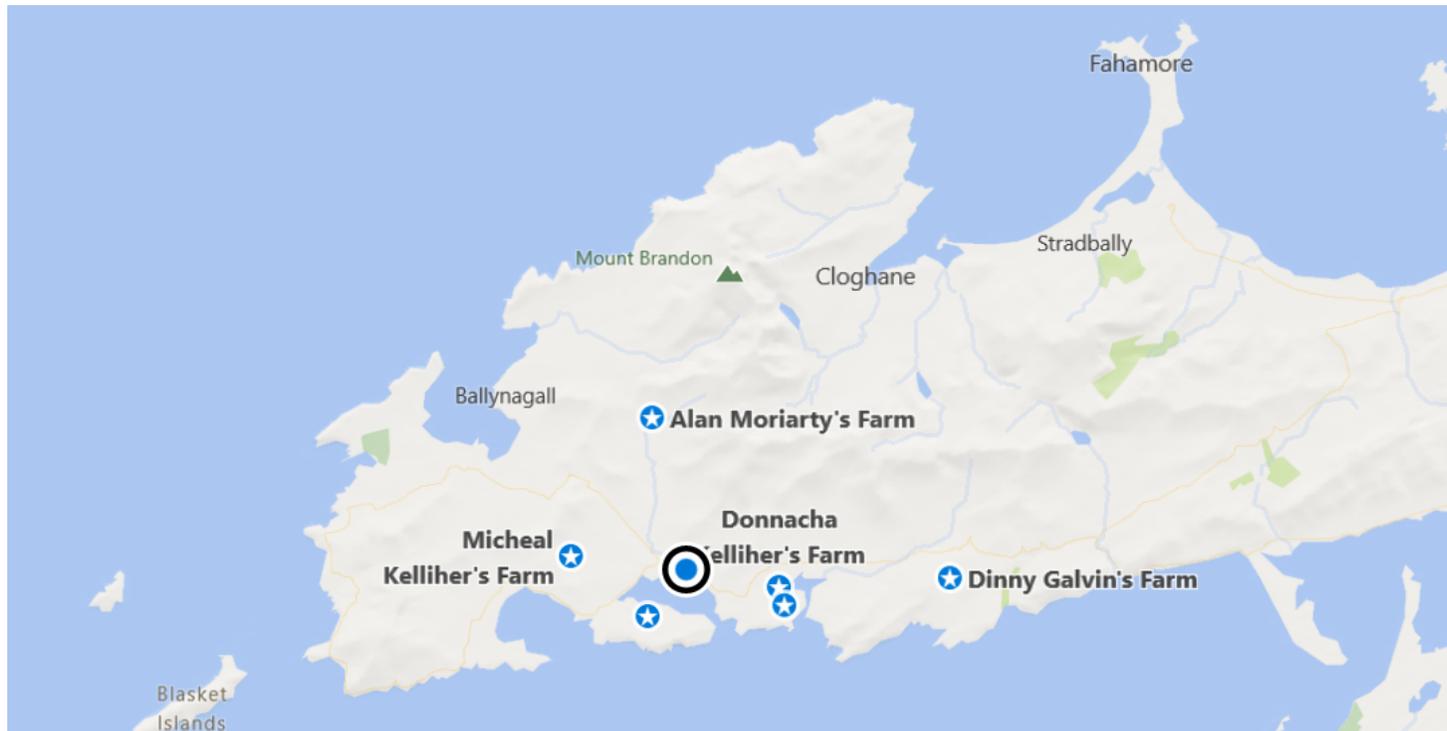
Presented by :
Ian O'Shea
Michelle Fitzgerald

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Project Overview

IoT Farm Locations



Farm Lat / Lon Co-Ordinates	
Dinny Galvin	52.135487, -10.138685
Seán Kennedy	52.126661, -10.225440
Micheal Kelliher	52.142639, -10.337639
Alan Moriarty	52.187563, -10.294962
Ronán Sugrue	52.123133, -10.297277
Donnacha Kelliher	52.132559, -10.228300

Equipment Installed

Multitech LoRaWAN Gateways

- **MultiTechConduit®IP67 Base Station**
- **Gateway relays messages between sensors deployed on the farm and NetFeasa's central network server and data platform, EvenKeel.**
- **Backhauled using Eir sim's**
- **Four gateways deployed, covering the six farms**
- **Recommendation :**
- **Proved to be reliable, outages only observed due to power outages or loss of cellular coverage on farm or wider area.**
- **Good performance and coverage with minimal message loss**
- **For scaling this initiative across the 30 farms, it is recommended to use the IoT technology NB-IoT**



Equipment Installed

Libelium Smart Agri Node

Libelium Smart Agri sensor array allowing implementation of up to six sensors, with one rechargeable central control unit. Following probes attached :

- **WS-3000 Weather Station**
 - Wind Speed m/s
 - Wind Direction
 - Rainfall mm
- **BME280 node**
 - Air Temperature (°C)
 - Relative Humidity
 - Atmospheric Pressure (Pascal, kPa)
- **Soil Moisture, Watermark (2 depths 10cm & 20cm)**
- **PT-1000 Soil Temperature (°C) (Depth of 10cm)**
- **Solar Panel to recharge battery**
-

- Data validation carried out by Teagasc
- Improvements made to program to improve data collection and accuracy
- Number of node failures resulting in data gaps
- High failure rate of node (4 of 6 BME280 node replaced, 2 x weather station replaced)
- Data from this sensor can be used to produce a soil moisture deficit model and correlated to grass growth rates and milk production rates allowing a localised model for the farm to give predictive decision making matrix for the farmer.

Recommend use of sensor, but

- Float stock made available
- Five working day workaround, on breakdowns to ensure data continuity



Equipment Installed

Tekelek Ultrasonic LoRaWAN Tank Sensor

Sensor measuring distance from sensor to liquid in cm

Two installed per farm :

- Milk Tank reporting hourly
- Slurry Tank reporting every 6 hours

Recommendation & Findings

- Most successful and reliable sensor used in trial
- Suggested extra sensors per farm to attach to extra slurry tanks as necessary



Equipment Installed

Sensoterra Soil Moisture

- **Plug and Play device, inserted into the soil and give soil reading in %**
- **Transmitting hourly, depth of 15cm**

Recommendations and Findings

- Technology easy to use, sensors robust and portable
- Poor soil calibration curves, make sensor inaccurate and unreliable
- Sensor not recommended for further use, on the project, however suggest approach manufacture on a joint calibration trial with Teagasc for use on Irish soil.



Ongoing Project Work

Smart Agri Unit

- Several iteration of program during project
- Weather stations height adjusted 2meter

Soil Moisture probes

- Depths changed from 20cm / 50cm to 10cm / 20cm
- Method of installation improved for ease of install / removal

Tekelek (Milk Tank)

- Installation method improved, to ensure device fixed firmly to tank to prevent damage to sensor and for hygiene reasons

Site Visits

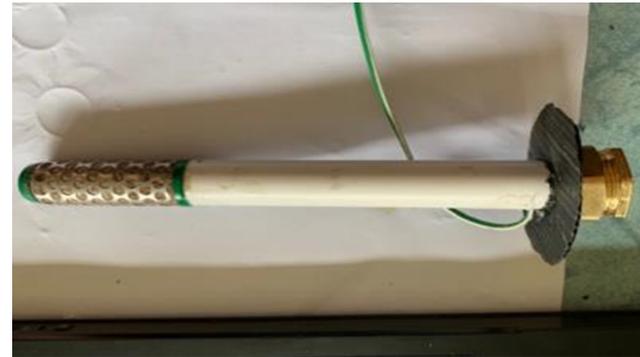
- Over 40 on-site visits by Net Feasa

Reports

- 54 reports delivered to farmers by Net Feasa and Teagasc.
- New format derived showing milk production / slurry production and summary weather data

Data Validation

- Initial validation done by Net Feasa and further verification and validation on data by Teagasc.



Weather data					
Rain		Value	Soil temperature		Value
Total mm		44.94	Daily average °C		8.01
Daily avg. mm/day		5.6175	Max °C	18/12/2020	9.26
Max mm	Multiple	6.42	Min °C	20/12/2020	7.19
Air Temp.			Atmospheric pressure		
Daily average °C		7.434356	Daily avg. hPa		979.054556
Max °C	18/12/2020	11.17	Max hPa	08/12/2020	992.1725
Min °C	20/12/2020	3.97	Min hPa	11/12/2020	961.2644
Humidity			Wind km/h		
Daily avg %		94.09472	Daily avg.km/h		No Data
Max %	Multiple	99.9	Max km/h	No Data	No Data
Min %	20/12/2020	72.92	Avg. wind direction		NE

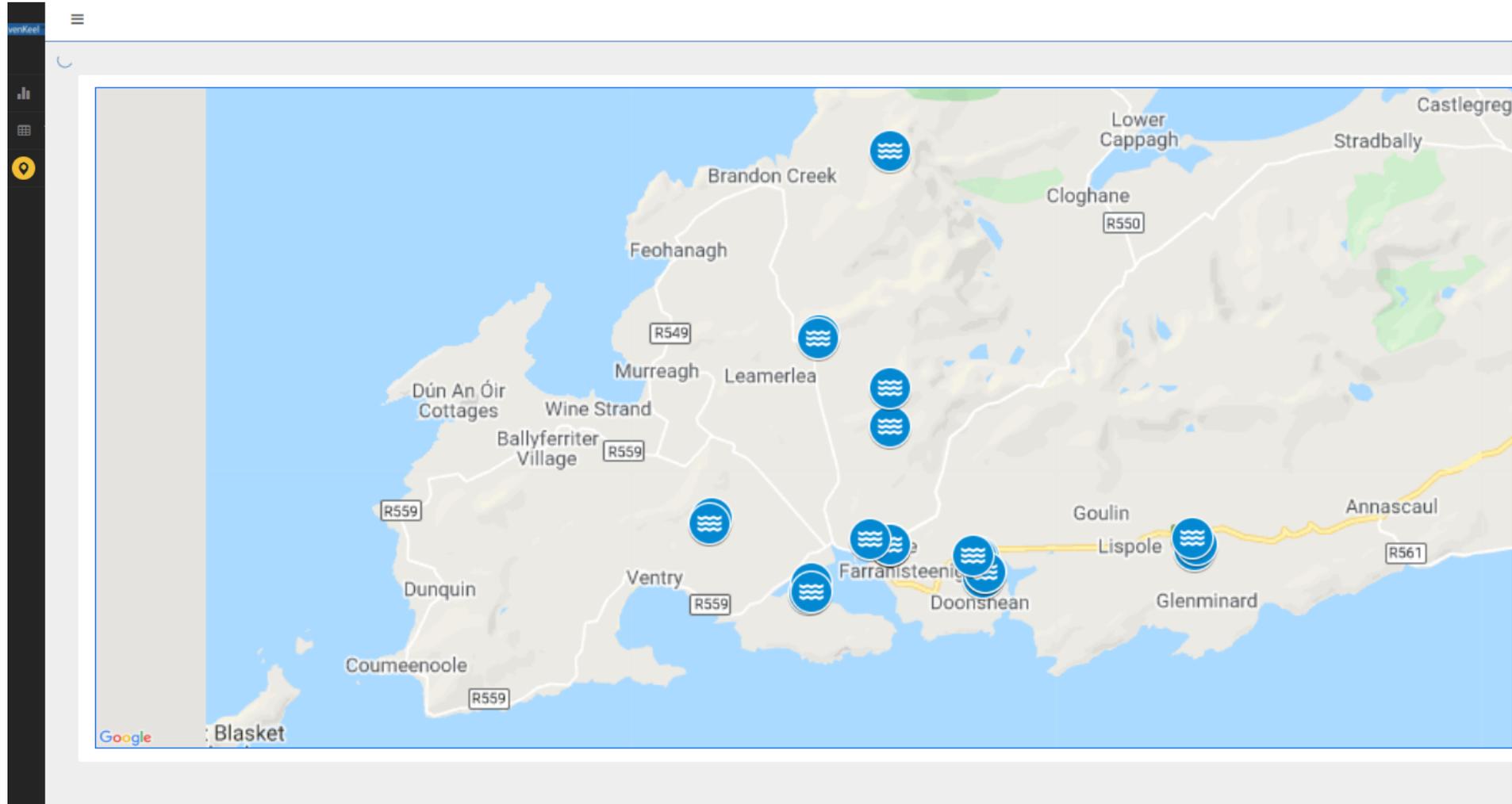
Difficulties / Issues during the Project

- **Sensor Issue**
 - No replacement units available resulting in large data gaps when sensor offline
 - Smart Agri Unit
 - Several iterations of the program to improve data collected eg(changing reporting interval, to improve rainfall readings)
 - Significant outages, requiring manual intervention to recover
 - Nodes returned to manufacture due to failure, significant delay with this due to pandemic
 - *4 / 6 of the temp/humidity/atmospheric pressure had to be replaced.*
- **Backend Issue**
 - EvenKeel Outage, some sensors auto-recovered, but other required manual intervention
 - **Access to the data**
 - Net Feasa produced weekly / monthly data presentations depicting graphical representations of the data collected.
 - No real-time access to the data for the end user

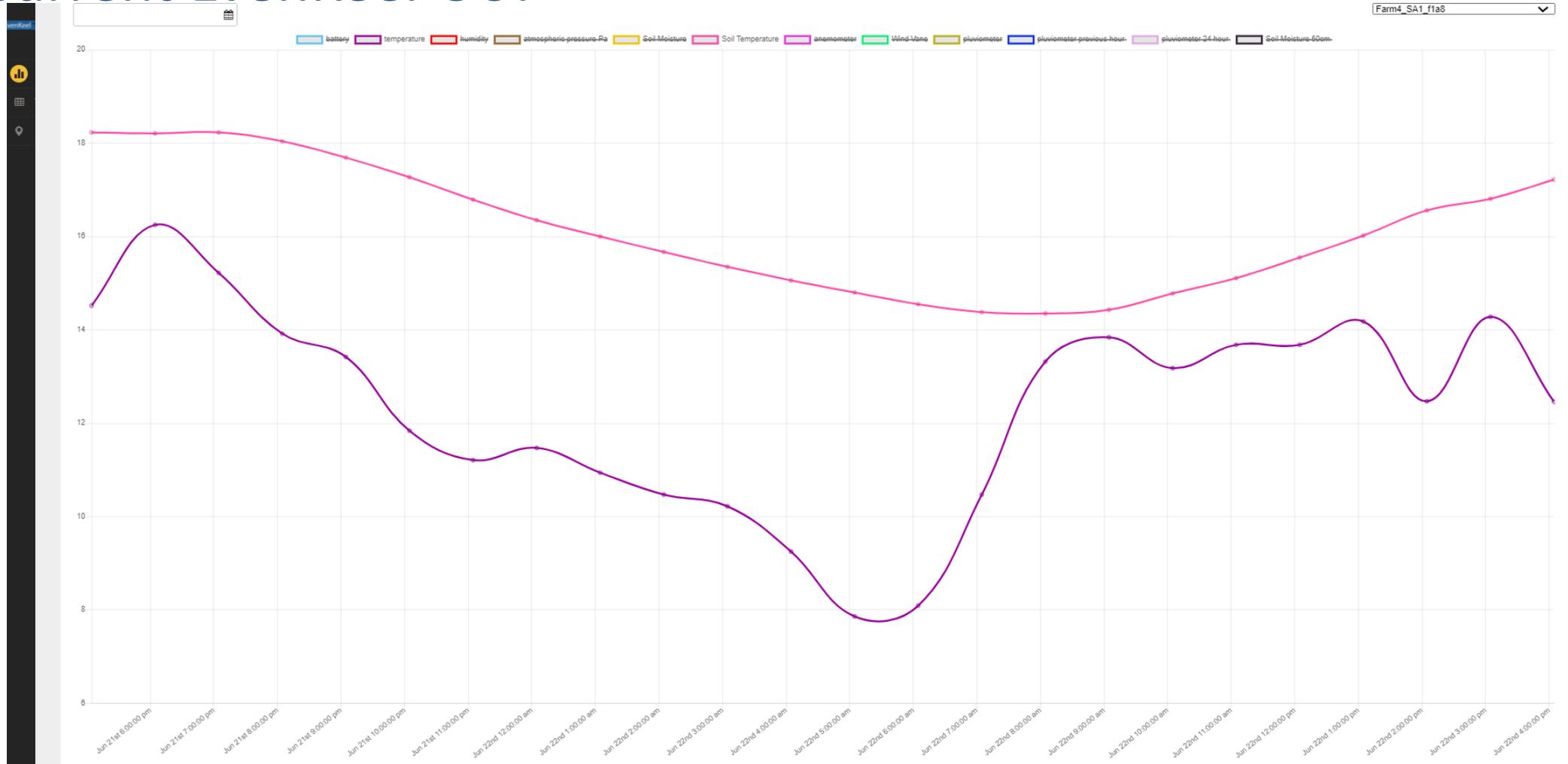
Lessons Learned

- **Uniform installation method on all sensors**
 - Weather stations all same height
 - Soil moisture / Soil temperature depths
- **Weather stations positioned away from ditches, trees, sheds etc to prevent shadow effect**
- **Strong mounting pole for Libelium**
- **Protection of sensors to prevent animal interference**
- **Protective covering on nodes**
- **Watermark placement important to ensure good contact with soil**
- **Milk Tank sensor firmly attached to tank to prevent damage**
- **Slurry Tank sensor firmly attached to prevent loss**
- **Replacement Stock in case of failures**
 - Recommended to have a float stock that would allow continuation of data in event of failures
- **Real-Time Access to the data**
 - Progressive Web App for display of end user data

Current EvenKeel GUI



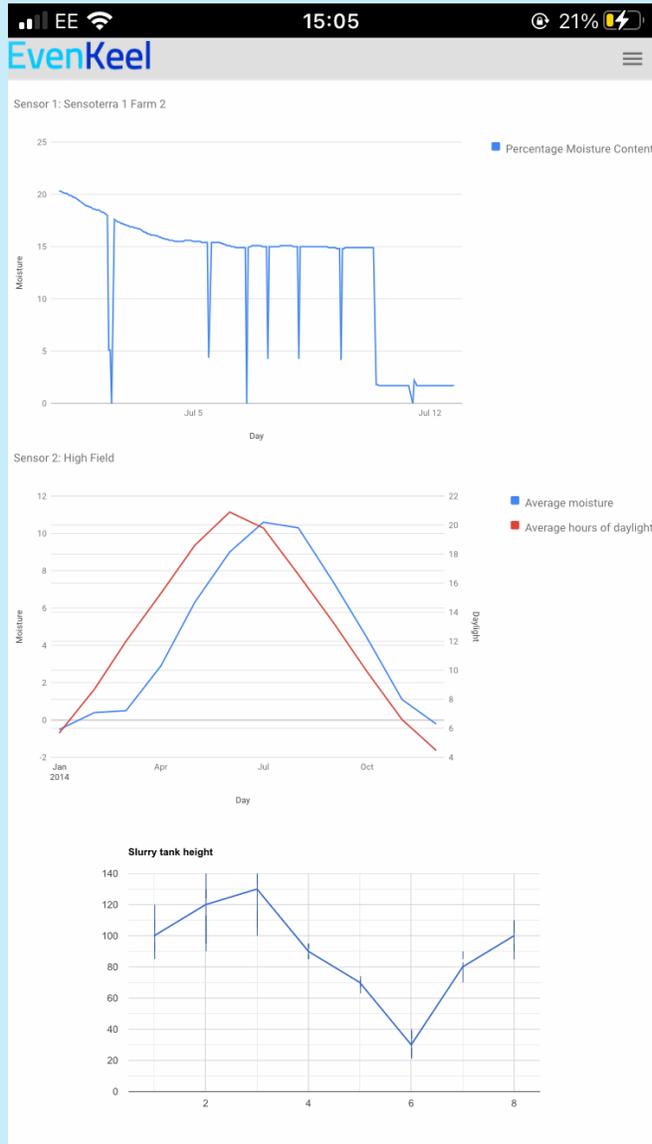
Current EvenKeel GUI



Current EvenKeel GUI

Farm6_SA1_1105

TIME	TEMPERATURE	HEIGHT	TIME	BATTERY	TEMPERATURE	HUMIDITY	ATMOSPHERIC PRESSURE PA	SOIL MOISTURE	SOIL TEMPERATURE	ANEMOMETER	WIND VANE	PLUVIOMETER	PLUVIOMETER PREVIOUS HOUR	PLUVIOMETER 24 HOUR	SOIL MOISTURE 50CM	TIME	BATTERY	TEMPERATURE
2021-06-22T14:59:11.260Z	14.35		2021-06-22T14:59:11.260Z	100	14.35	68.58	102697.20	3144.65	5680.05	9.60	WN	0.00	0.00	0.00	877.19	2021-06-22T14:59:11.260Z	100	14.35
2021-06-22T19:59:11.200Z	14.32		2021-06-22T19:59:11.200Z	100	14.32	72.53	102704.22	3030.30	5680.05	4.80	N	0.00	0.00	0.00	881.83	2021-06-22T19:59:11.200Z	100	14.32
2021-06-22T12:59:11.128Z	14.52		2021-06-22T12:59:11.128Z	100	14.52	63.59	102685.56	3086.41	5680.05	8.00	N	0.00	0.00	0.00	884.95	2021-06-22T12:59:11.128Z	100	14.52
2021-06-22T11:59:11.402Z	15.50		2021-06-22T11:59:11.402Z	100	15.30	62.77	102676.82	3105.59	5680.05	8.80	N	0.00	0.00	0.00	881.83	2021-06-22T11:59:11.402Z	100	15.30
2021-06-22T10:59:11.006Z	14.65		2021-06-22T10:59:11.006Z	100	14.65	67.34	102667.06	3125.00	5680.05	10.40	WN	0.00	0.00	0.00	883.39	2021-06-22T10:59:11.006Z	100	14.65
2021-06-22T09:59:10.940Z	14.06		2021-06-22T09:59:10.940Z	100	14.06	67.87	102656.12	3125.00	5680.05	8.80	N	0.00	0.00	0.00	883.39	2021-06-22T09:59:10.940Z	100	14.06
2021-06-22T08:59:11.226Z	13.80		2021-06-22T08:59:11.226Z	100	13.80	71.79	102634.92	3105.59	5680.05	4.80	N	0.00	0.00	0.00	880.28	2021-06-22T08:59:11.226Z	100	13.80
2021-06-22T07:59:10.824Z	12.77		2021-06-22T07:59:10.824Z	100	12.77	76.35	102628.88	3012.04	5680.05	13.60	N	0.00	0.00	0.00	881.83	2021-06-22T07:59:10.824Z	100	12.77
2021-06-22T06:59:11.103Z	10.52		2021-06-22T06:59:11.103Z	100	10.52	87.82	102600.94	3030.30	5680.05	0.00	WN	0.00	0.00	0.00	874.12	2021-06-22T06:59:11.103Z	100	10.52
2021-06-22T05:59:10.280Z	7.38		2021-06-22T05:59:10.280Z	100	7.38	100.00	102606.75	3030.30	5680.05	0.00	WN	0.00	0.00	0.00	3164.55	2021-06-22T05:59:10.280Z	100	7.38
2021-06-22T04:59:10.517Z	6.28		2021-06-22T04:59:10.517Z	100	6.28	99.71	102578.31	3067.48	5680.05	0.00	S	0.00	0.00	0.00	3184.71	2021-06-22T04:59:10.517Z	100	6.28
2021-06-22T03:59:10.421Z	6.55		2021-06-22T03:59:10.421Z	100	6.55	96.54	102527.10	3067.48	5680.05	0.00	S	0.00	0.00	0.00	3205.12	2021-06-22T03:59:10.421Z	100	6.55
2021-06-22T02:59:10.325Z	5.15		2021-06-22T02:59:10.325Z	100	5.15	97.25	102518.55	3105.59	5680.05	3.20	SW	0.00	0.00	0.27	3225.80	2021-06-22T02:59:10.325Z	100	5.15
2021-06-22T01:59:09.895Z	6.26		2021-06-22T01:59:09.895Z	100	6.26	94.90	102526.80	3086.41	5680.05	3.20	S	0.00	0.00	0.27	3225.80	2021-06-22T01:59:09.895Z	100	6.26
2021-06-22T00:59:09.817Z	8.72		2021-06-22T00:59:09.817Z	100	8.72	91.83	102529.00	3030.30	5680.05	4.80	NNE	0.00	0.00	0.27	3225.80	2021-06-22T00:59:09.817Z	100	8.72
2021-06-21T23:59:09.733Z	9.05		2021-06-21T23:59:09.733Z	100	9.05	92.04	102526.39	3012.04	5680.05	7.20	NNE	0.00	0.00	0.27	3246.75	2021-06-21T23:59:09.733Z	100	9.05
2021-06-21T22:59:09.623Z	9.19		2021-06-21T22:59:09.623Z	100	9.19	88.81	102503.98	3012.04	5680.05	6.40	N	0.00	0.00	0.27	3246.75	2021-06-21T22:59:09.623Z	100	9.19
2021-06-21T21:59:09.881Z	9.22		2021-06-21T21:59:09.881Z	100	9.22	87.31	102469.50	3030.30	5680.05	6.40	WN	0.00	0.00	0.27	3246.75	2021-06-21T21:59:09.881Z	100	9.22



EvenKeel

REGION 1 REGION 2 REGION 3

Date ↑	Event	Links
Mon Sep 09 2019	Temperature 14C, Moisture 5mm	
Tue Sep 10 2019	Temperature 14C, Moisture 5mm	
Wed Sep 11 2019	Temperature 14C, Moisture 5mm	
Thu Sep 12 2019	Temperature 14C, Moisture 5mm	
Fri Sep 13 2019	Temperature 14C, Moisture 5mm	
Mon Sep 30 2019	Temperature 14C, Moisture 5mm	
Sat Sep 14 2019	Temperature 14C, Moisture 5mm	
Mon Sep 30 2019	Temperature 14C, Moisture 5mm	
Sun Sep 15 2019	Temperature 14C,	





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Intelligent Connectivity