POSITIVE OUTCOME AREAS

- [x] SOIL
- [ ] CARBON
- [x] WATER
- [ ] BIODIVERSITY
- [ ] ANIMAL HEALTH & WELFARE
- [ ] SOCIAL

TECHNICAL GUIDE

Crop and Irrigation Monitoring

What is crop and irrigation monitoring?

Crop and irrigation monitoring involves measuring soil moisture, weather conditions, and crop performance to make informed decisions about water use and crop management. It is relevant across arable, horticultural, and mixed farming systems. Soil moisture monitoring tells us how effectively crops are accessing water and can be combined with weather data to provide additional context for crop growth, disease risk, and irrigation need.

Why should I be doing this?

Rather than applying water on a fixed schedule, you can respond to actual crop demand and soil moisture levels. This improves water use efficiency (whether broadcast or drip), reduces costs, and protects water resources. It also helps avoid overwatering, which can lead to nutrient leaching, shallow rooting, and increased disease risk.

Better water management supports more even crop growth, improving yield, quality, and shelf life - particularly important in horticultural systems. Soil moisture monitoring may give insight into hidden problematic rooting conditions such as soil pans at certain depths.

As weather patterns become more variable, monitoring real-time data across rainfall, temperature, humidity, wind speed, light level and leaf wetness, will be crucial in anticipating uncertainty and for instance when irrigation requirements may conflict with fungal disease risk. Over time, this data can be used to compare seasons, track indicators such as growing degree days or chill units, and improve planning.

What the science says about it

Research shows that irrigation scheduling based on soil moisture and crop demand can significantly improve water use efficiency compared to fixed schedules. Targeted irrigation can reduce water use by 20–40% while maintaining or improving yields, depending on crop type and system. Over-irrigation increases nutrient leaching, reduces oxygen availability and may stunt root development. Intermittent watering may see the plant regularly undergo periods of stress stunting growth and absorption of nutrients.

Soil moisture monitoring helps optimise plant water availability, which supports nutrient uptake, strengthens plant tissue, and can reduce susceptibility to pests and diseases. Studies in horticultural systems show that consistent soil moisture management improves crop quality, storage performance, and shelf life - key factors in market returns. Weather-based monitoring systems can also support disease prediction models, allowing more timely and targeted interventions.

Overall, the evidence shows that monitoring leads to more efficient use of water and inputs, improved crop performance, and reduced environmental impact.

Whole farm system

Crop and irrigation monitoring go hand in hand with soil health. Soil structure and organic matter are both key indicators of good soil health and help to retain water, reducing irrigation demands. While most common in horticulture, monitoring is increasingly relevant in arable and mixed farms. Monitoring provides insight into how soil, crops, and weather interact across the farm. It can highlight differences between fields, soil types, and management zones, supporting more targeted decision-making. It could help to inform crop choice, when to cultivate and identify drainage issues. As part of a whole farm system, it helps optimise resource use, reduce inputs, and improve resilience to weather variability.

10% of the area could be used to get the same yield if irrigated effectively.

It is important to consider how the people on farm will interact with the data collected. Daily data collection can easily be overlooked during busy periods so training may be required on data analysis so that the irrigation team and farm workers are better informed. Decisions will likely be funnelled through the farm manager but advances in AI-optimised interfaces could de-centralise decision making, better integrating the farm workers into making informed and immediate responses as required.

How do I make sure it will work for me?

Successful monitoring starts with good setup and clear objectives.

- **Know your soil:** place probes in representative areas, avoiding tramlines, compacted zones, or field edges
- **Install correctly:** ensure good soil contact - air gaps will allow water to run down the sides of the probe giving false readings. Tapered probes require tapered holes.
- **Match tools to need:** simple systems can still deliver useful insights

Use monitoring to answer key questions:

- When should I irrigate? How much water is needed? How deep are roots accessing moisture?

Consider combining other forms of data such as satellite imagery. The Normalized Difference Vegetation Index (NDVI) can be useful for large, field-scale operations. Difference in colour makes early signs of drought and disease easy to spot. NDVI may also help to spot how representative the probe data is of the monitored area.

Avoid common pitfalls:

- Over-reliance on data without field checks
- Poor probe placement
- Lack of training in data reading

Irrigation checklist – rain gun pressure, nozzle size in relation to pressure, irrigation run widths, diversify irrigation runs to avoid repeatedly missing certain areas

Measuring and monitoring

Monitoring should combine data and field observation.

Key measures include:

- **Infiltration and water uptake:** availability and movement of water through the profile. Different depths can be measured concurrently (10cm, 20cm, 30cm, 40cm, 50cm) to give a full infiltration picture.
- **Rooting depth:** how effectively crops access water and whether or not certain watering patterns encourage or discourage deep root growth. Early watering of certain crops such as broccoli may inhibit root growth.
- **Crop condition:** visual checks for stress or variability. Significant rainfall events may only provide brief irrigation if the soil profile has not been to capacity.
- **Weather data:** rainfall, temperature, humidity, wind. Soil probes could be useful in highlighting local rain variation where drastic differences can occur within as little as 10 miles

Tracking crop performance through harvest, storage, and sale can also show the impact of improved water management. Recording and comparing data year on year helps refine decisions and improve outcomes.

Timescales

Monitoring provides both immediate and long-term benefits.

Short-term:

- Real-time irrigation decisions
- Reduced risk of over- or under-watering

Medium-term:

- Improved crop performance and consistency
- Better understanding of soil variability

Long-term:

- Improved soil management and structure
- Increased resilience to weather variability

Data can be collected immediately after installation and built into long-term records.

Impact

Water usage: Targeted and efficient preserving harvested rainwater supplies and local water reserves.

Ecosystem conservation: Nutrient leaching from over watering is reduced, preserving local and regional watercourses.

Resilient Crops: Improved yield, quality and shelf life. Optimal root growth and plant health through moisture monitoring.

Less is more: Intelligent use of limiting water to prevent splitting, encourage deep rooting and bring crops on.

Soil Health: Soil benefits from improved infiltration, structure, organic matter levels, water retention and reduction of soil erosion.

Trial insight: Nuanced insight into conflicting trial aims. For instance testing the impacts of shallow rooting living mulches on water infiltration depth.

Climate adaptability: Risks associated with both drought and excessive rainfall reduced.

Rainfall

Measures how much water has been received naturally. This helps avoid unnecessary irrigation and improves timing of applications. Tracking rainfall over time also supports planning and comparison between seasons, particularly in dry or variable years.

Temperature and relative humidity (RH)

Temperature drives crop growth and development, while relative humidity affects plant stress and disease risk. Together, they can be used to calculate growing degree days and assess conditions for frost risk, crop development, and disease pressure.

Wind speed

High winds increase evaporation and crop water demand, meaning irrigation may need to be adjusted. Wind also affects the efficiency of irrigation systems (especially overhead) and is important when planning field operations such as spraying.

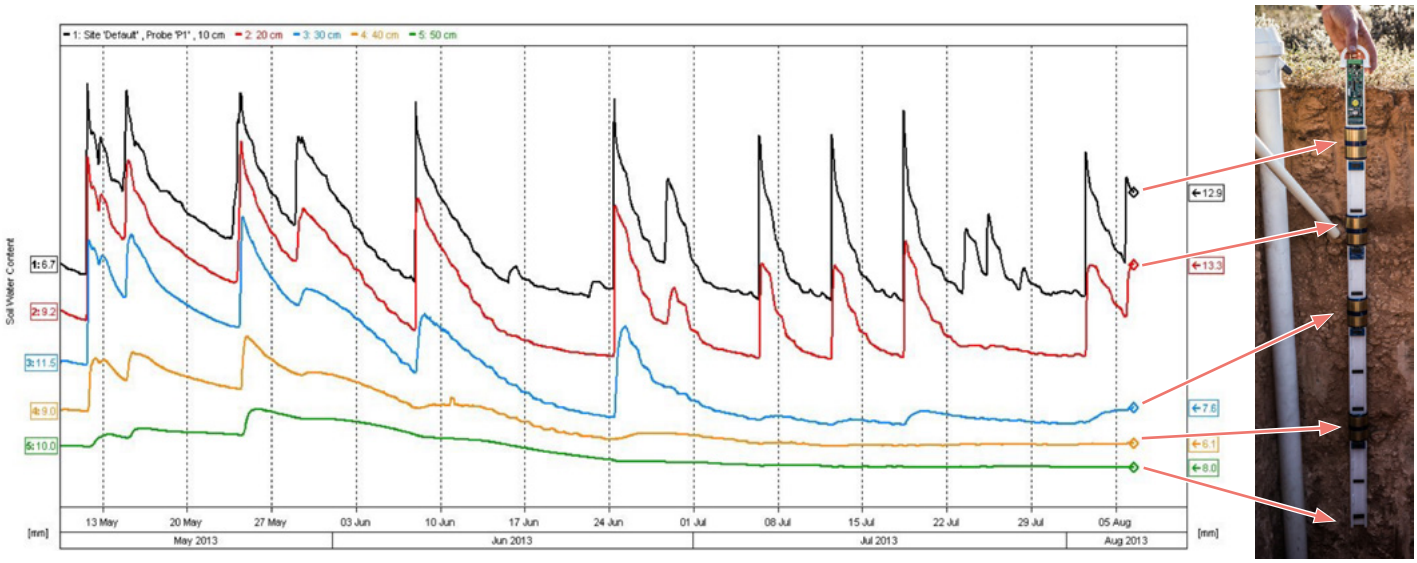
Light (solar radiation)

Light levels influence photosynthesis and crop growth. Monitoring light helps explain variations in crop performance and supports the use of growth models, particularly in horticulture and protected cropping.

Leaf wetness

Indicates how long leaves remain wet from rain, dew, or irrigation. This is a key factor in the development of many fungal diseases. Monitoring leaf wetness can support disease prediction models and help target interventions more effectively.

Soil water content at different depths: 10, 20, 30, 40, 50cm



Sentek Probe data capture. Image courtesy of Peter White, founder of Soil Moisture Sense

Case study – Boxford Fruit Farms

At Boxford Fruit Farms in Suffolk, farm manager Robert England has integrated crop and irrigation monitoring to improve water use efficiency and fruit quality across a large-scale apple and soft fruit enterprise.

Operating in a region with increasing pressure on water resources, the farm uses soil moisture probes and weather data to guide irrigation decisions. This allows irrigation to be applied only when needed, based on crop demand and soil moisture availability, rather than fixed schedules.

Monitoring has helped the farm better understand rooting depth and soil variability across fields, enabling more precise water application. This reduces the risk of over- or under-watering, both of which can affect fruit quality, taste profile, storage performance, and disease risk. The approach has supported more consistent crop quality and improved shelf life - critical in fresh produce markets.

By combining real-time data with field knowledge, the farm has improved water efficiency while maintaining productivity.

Costs, savings and improvements

There is a wide range of monitoring systems available, from simple soil moisture probes to fully integrated systems combining weather stations and remote data access. Costs vary depending on complexity, but entry-level systems can provide useful insights without significant investment.

Some suppliers offer subscription or rental models, reducing upfront costs and allowing systems to be tested before full adoption. The main costs include equipment, installation, and time spent interpreting data. However, these are often offset by savings and improved performance.

More precise irrigation can reduce water use, energy costs, and labour associated with irrigation. It also reduces the risk of overwatering, which can lead to nutrient loss and reduced crop quality.

Improved water management supports better rooting and nutrient uptake, which can reduce input requirements and improve yield consistency. In horticultural systems, improvements in quality and shelf life can have a significant impact on returns.

Monitoring can also highlight inefficiencies or problem areas, allowing targeted action rather than blanket approaches. Over time, the system supports more consistent production, improved resource efficiency, and reduced risk—particularly under increasingly variable weather conditions.

In-field economics:

Potato yields range from lowest 38t/ha to highest 72t/ha with a growing cost of £7,200/ha.

Valuing potatoes at £200 per ton: 38 tons = £7,600 so gives £400 profit. 72 tons = £14,400 giving a profit of £7,200. Take away observation: you could get more profit from 10% of the area if irrigated and monitored efficiently.

While benefits will vary between farms, monitoring provides a practical tool for improving both economic and environmental performance.

Contacts

Soil Association advice and support

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