SENSOTERRA

we make sense of water

WHITE PAPER
PRECISION AGRICULTURE

Precision irrigation for optimum yield & crop health

Growers are under increasing pressure, because buyers want lower prices and higher quality, and governments want more influence and oversight. At the same time, fuel/energy, inputs, and labor are becoming more expensive and natural resources are dwindling. It is also a fact that agriculture and horticulture count for 70% of the global use of freshwater, and up to 40% of that water is wasted by over-irrigation or leakages.

Under-irrigation (drought) is a well-known issue. One of the biggest drought-related issues is if the soil becomes hydrophobic – it becomes so dry, that it cannot absorb and retain water anymore. A lesser known but equally relevant issue for freshwater use is over-irrigation. Besides wasting resources, over-irrigation leads to nutrients and pesticides washing out, depleting the soil, increasing the investment in inputs, and eventually threatening freshwater supplies from chemical pollution.

Wireless soil moisture sensors help increase yields and save water (and fuel/energy, man-hours and inputs).

"We never know the worth of water, till the well is dry "

Thomas Fuller

Sensoterra sensors are used for irrigation optimization whether automated or manual, for monitoring water infiltration in soil moisture profiles and dynamic plant interactions, and for monitoring the soil condition in general.

Current measurement methods and models hardly include local variations in soil types and moisture levels, while these differences can vary greatly from one field to the next.

Healthy soil contains a good balance of soil moisture. Different values for ideal volumetric moisture percentages apply to every soil type, such as the wilting point, irrigation point and field capacity. For example, the irrigation point will be different in clay soil, which holds water much longer, than that of sandy soil.

Soil isn't homogeneous, and the soil composition and characteristics (clay, sand, loam, silt) can vary from field to field, and even within fields. Water holding capacity is dependent on many factors such as porosity, organic matter concentration, compaction, and other variables. It's important to take the soil texture requirements into consideration when managing irrigation.

TOO DRY SOIL

Lower yields of crops in agriculture & horticulture

Low quality nature and green spaces do not help to reduce heat stress

Rainwater runs off because soil becomes hydrophobic

HEALTHY SOIL MOISTURE CONTENT

Crops in agriculture & horticulture provide the highest yields

Nature & green spaces are of high quality and reduce heat stress

Rainwater is better absorbed by the soil

TOO WET SOIL

Reduced yields of crops in agriculture & horticulture

Nature and greenery can suffer root damage due to lack of oxygen

Extreme rainfall is no longer absorbed by the soil

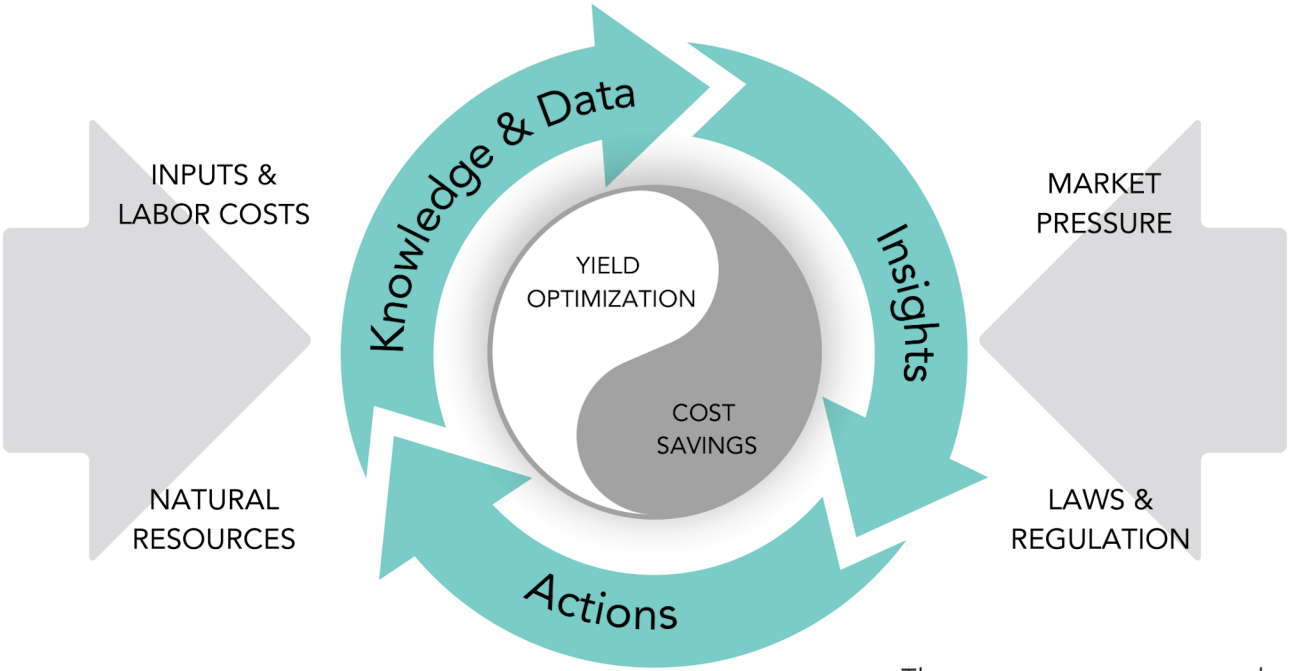
Plant available water has a direct relation to the growth and health of plants and soil functionality. Too much water and plants undergo hypoxic stress, are waterlogged, and unable to uptake air and nutrients. Too little water and plants are susceptible to wilting (stress) and permanent wilting (death).

Growers use their years of field knowledge and expertise to identify the water related stressors to their crops. Keeping plant available water in the 'healthy zone' within these stress related thresholds is key for plant health and yield. Sensors can help to validate and fine tune these experience-based practices.

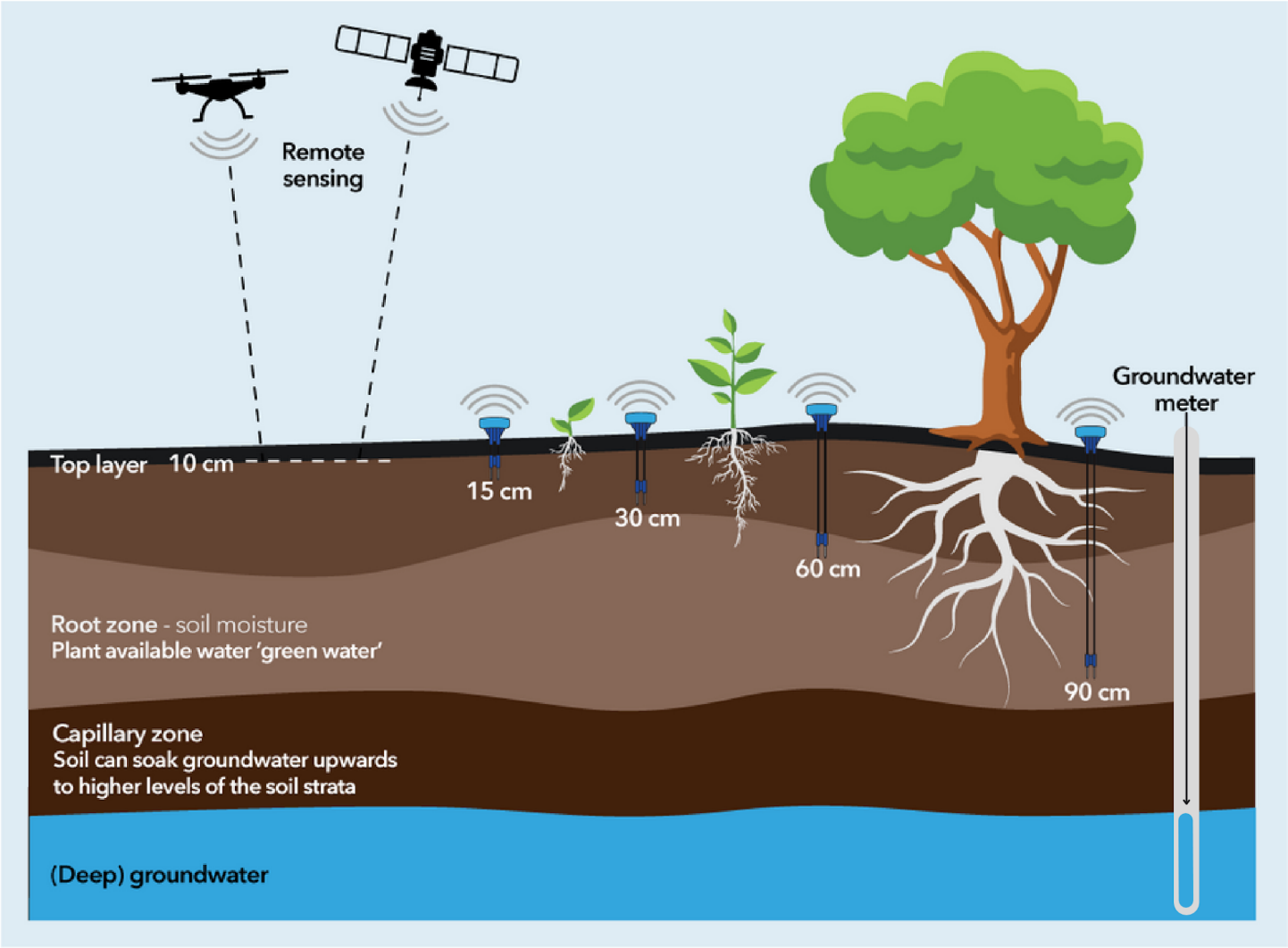
Satellite and drone imaging is often used to get snapshots of the state of the top 10 cm of soil at one point in time.

These systems offer a good indication of the changes in water availability over time, and can be used to review seasonal data, but they are not practical for daily water management practices.

To optimize irrigation, soil moisture data must be taken with real-time in-situ measurements, at the rootzone of plants to help substantiate what the grower knows – when to irrigate, and when to stop irrigation for crop health and cost saving.



The water management cycle



Key elements of a monitoring system

There are many sensors on the market. Technology is crucial for a monitoring system, but just installing soil moisture sensors is not enough. Different crops and farming practices require different data, so it's essential to combine data from different sensor types and online data sources in a clever way so the data is truly supporting the decision making and day-to-day management.

Monitoring platform
In the monitoring platform, everything comes together. Multiple data sensor types and additional data sources should be configurable. It contains specific domain knowledge for setting thresholds and other settings. It also provides clear dashboards, with at-a-glance information like a map, decision making support, automation, extensive analysis and data export capabilities.

Sensors
The number of sensors, and sensor placement is based on domain knowledge about the terrain/fields, crops, irrigation zones and/or by using satellite imagery with soil moisture data. The platform has pre-configured settings for different situations and crop types. Fine-tuning thresholds is possible by adjusting these manually based on local parameters and experience.

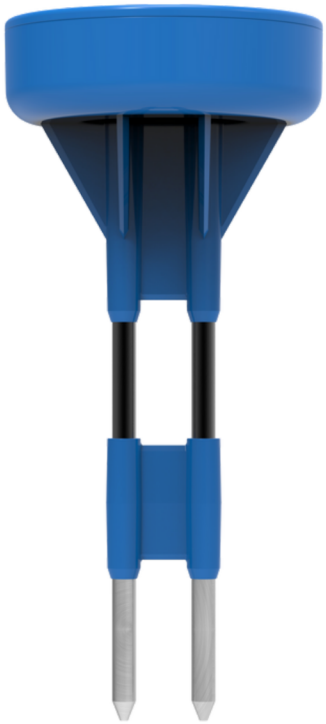
Regarding the sensors it is important that these can be easily installed and relocated, that they are 'farm tough' and do not require any maintenance. The sensors should operate stand-alone, and the batteries need to provide energy for extended periods of time (6 to 10 years with hourly measurements) without having to be replaced. The sensors communicate wirelessly over LoRaWAN. This makes it possible to use a single sensor in multiple locations, over many years.

Flexible placement
Measuring green water necessitates positioning sensors within the root zone of plants, trees, or crops. Various sensor lengths are available, including a Multi Depth version to cater to different needs. Hiding sensors can be done by using drainpipe covers, mulch, coco mats, or wooden covers, and will work as long as the sensors are not obstructed by metal objects.

Considering the rapid hardware advancements and the multitude of suppliers in the market, managing different dashboards for each sensor type can become cumbersome. Thus, it is crucial for a monitoring system to be hardware agnostic, allowing for easy integration of devices without being tied to a specific platform. This approach enhances flexibility, enabling the system to adapt to different scenarios by combining various sensor types, thereby maximizing its capabilities.

Integrated data provides value add to stakeholders - supporting actionable water management decisions

Sensoterra soil moisture sensors
Sensoterra's wireless soil moisture sensors are designed to set up a high density network of soil moisture measurements:



- Very fast installation (<1 minute) and relocation
- Easy to hide, theft free, mower friendly Maintenance free for 6 to 10 years, with one measurement per hour
- Multiple depths available (Single Depth) and Multi Depth for 6 depths at once
- Super high accuracy with more than 45 standard calibrations
- Low TCO (Total Cost of Ownership) per sensor
- Long range, cost efficient wireless connectivity via LoRaWAN
- Built to integrate (API-first philosophy)

To learn more, visit www.sensoterra.com or contact us at sales@sensoterra.com.

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