

How can we measure this water level of those plants?

Measuring water levels for plants involves assessing soil moisture or water table levels to ensure optimal irrigation. Here are common methods and devices used for this purpose:

1. Soil Moisture Measurement Methods

- **Gravimetric Method:** Involves collecting a soil sample, drying it in an oven, and calculating water content by weight difference. This method is precise but time-consuming and not practical for real-time irrigation^{[1] [2]}.
- **Tensiometers:** Measure soil water potential and are effective for shallow-rooted crops. They are affordable, easy to use, and suitable for irrigation scheduling^{[1] [2]}.
- **Time Domain Reflectometry (TDR):** Uses electromagnetic pulses to measure soil moisture. It is accurate and reliable but expensive, making it more suitable for large-scale operations^{[1] [2]}.
- **Neutron Probes:** Provide volumetric water content at different depths with high accuracy but require specialized licensing and equipment^[1].

2. Remote Sensing Techniques

- **Vegetation Indices (e.g., NDWI, NDVI):** Use satellite or drone-based spectral data to assess plant water stress by analyzing canopy reflectance. These methods are non-invasive but require expertise in image analysis^{[1] [3]}.
- **Energy Balance Models:** Estimate evapotranspiration (ET) using surface energy balance equations through remote sensing data. These methods are useful for large areas but require high-resolution thermal imaging^[1].

3. IoT-Based Sensors

- **Low-Cost Sensors:** Devices like SKU: SEN0193 measure volumetric soil moisture and can be integrated with IoT systems for real-time monitoring. Machine learning algorithms can improve their calibration and accuracy^[3].
- **Water Table Sensors:** Measure groundwater levels to manage irrigation in areas dependent on subsurface water. These are often combined with IoT for automation^[3].

4. Lysimeters

- Lysimeters directly measure crop water use by monitoring water loss from a controlled soil volume. They are highly accurate but expensive and labor-intensive, making them suitable for research purposes^[4].

5. Choosing the Right Method

The choice of method depends on:

- **Budget:** Gravimetric methods and tensiometers are cost-effective; TDRs and neutron probes are expensive.
- **Crop Type:** Shallow-rooted crops benefit from tensiometers, while deep-rooted crops may require neutron probes.
- **Scale:** Remote sensing is ideal for large farms, while IoT-based sensors suit precision agriculture.

By selecting appropriate tools based on crop needs, soil type, and available resources, farmers can optimize irrigation schedules and maximize yields.

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1. <https://www.mdpi.com/2673-4931/25/1/20>
2. <https://content.ces.ncsu.edu/measuring-soil-water-for-irrigation-scheduling>
3. <https://pmc.ncbi.nlm.nih.gov/articles/PMC9500614/>
4. <https://www.mdpi.com/2673-4931/25/1/101>