Mapping small-scale irrigation for climate adaptation

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The case for irrigation in sub-Saharan Africa

- Irrigation can bring:
  - Improved yields, income, and food security
  - Improved resilience to drought and climate change
- Only 6% of cropland in sub-Saharan Africa is equipped for irrigation despite available water
- A lack of data constrains adaptation policy and water management, especially for small-scale irrigation

Mapping all dry season irrigation across Zambia from 2016-2025

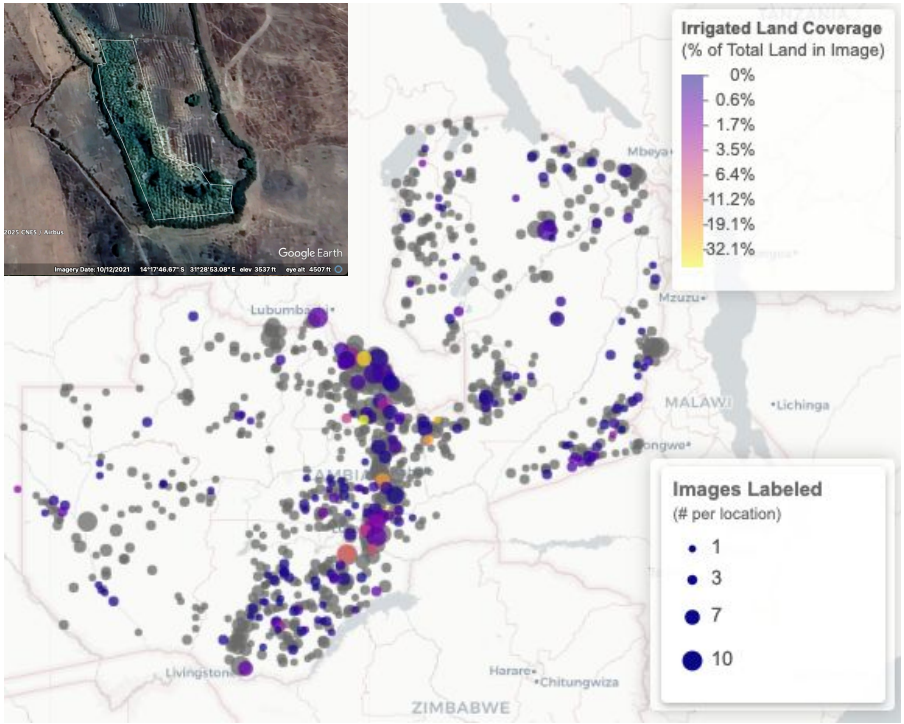
a. Label irrigated areas in very high resolution satellite imagery

b. Train a machine learning model to automatically detect irrigation from Sentinel-2 image time-series

c. Apply model to generate the continuous maps

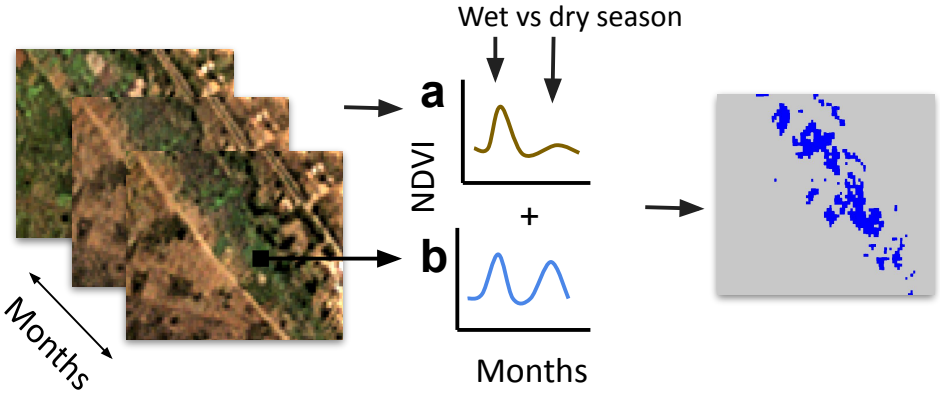
Manually identifying dry season irrigation from satellite data

- **Approach:**
  - Access very high resolution (VHR) using Google Earth Pro
  - Randomly sample 1km areas in agricultural regions
  - Label dry season images 2016+
- **Dataset:** 936 locations (2674 Images)
  - **¼** of images have some irrigation
  - **⅓** of irrigated area is small-scale irrigation



Modeling approach

- Constraints:
  - Leverages temporal information to capture seasonal changes
  - Ideally also uses spatial information
  - Functions with limited labels
- Proposed models
  - Tree-based models
  - Lightweight transformer models (e.g. PRESTO)
  - Heavyweight geospatial foundation models (e.g. TerraMind)
  - Pre-computed earth embeddings (e.g. AlphaEarth)



Applications of mapping and broader impacts

Scientific research

Monitoring and evaluation

Investment targeting

Water management