A photograph of a person in a boat pulling a large white fishing net from the water. The net is draped over the side of the boat and is being pulled towards the person. The background is a bright, hazy sky over the water.

# Ethiopia study on Landsat 8 satellite imagery and drones for estimating crop residue retention on soils



Independent  
Science and  
Partnership  
Council

# Background

- Crop residue cover is a key element of conservation agriculture
- A minimum level of 30% residue cover is recommended
- Estimating adoption is complex - generally based on self-reported farmer's perceptions in agricultural surveys
- Aerial-based methods could represent an improvement over survey-based methods



## Objectives:

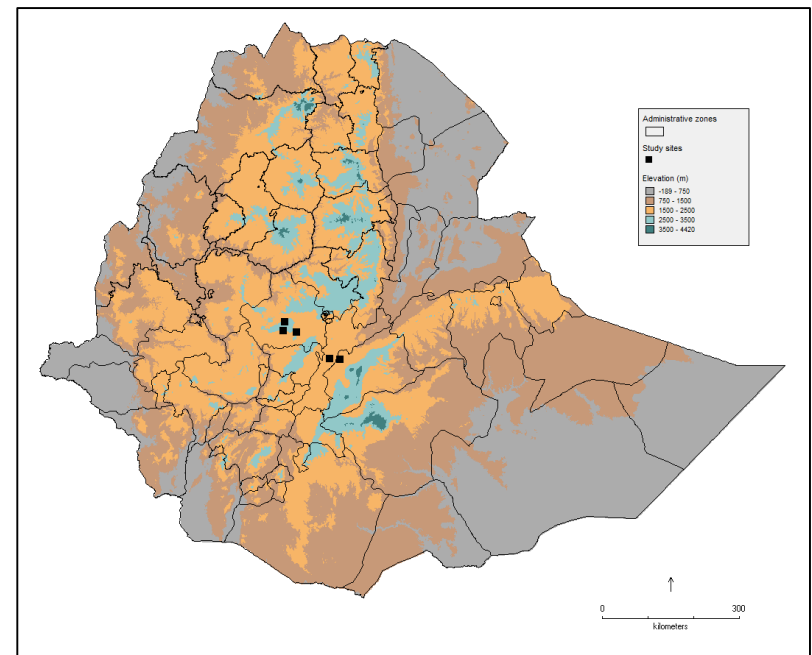
- 1) Identify low-cost, reliable methods for measuring crop residue coverage
- 2) Estimate the measurement errors associated with each method

## Collaboration:

SPIA / World Bank LSMS-ISA / Central Statistical Agency of Ethiopia

## Sampling:

A total sample of 197 households and 314 plots were surveyed in 12/2015 and 02/2016.



Six measurement methods are used on each plot and data are compared to a line-transect reference method

## Method 1 and 2

### **Method 1: Interviewee (away from field)**

In the meantime, what percentage of [FIELD] is covered with crop residues?

### **Method 2: Enumerator (looking at the field)**

In the meantime, what percentage of [FIELD] is covered with crop residues?

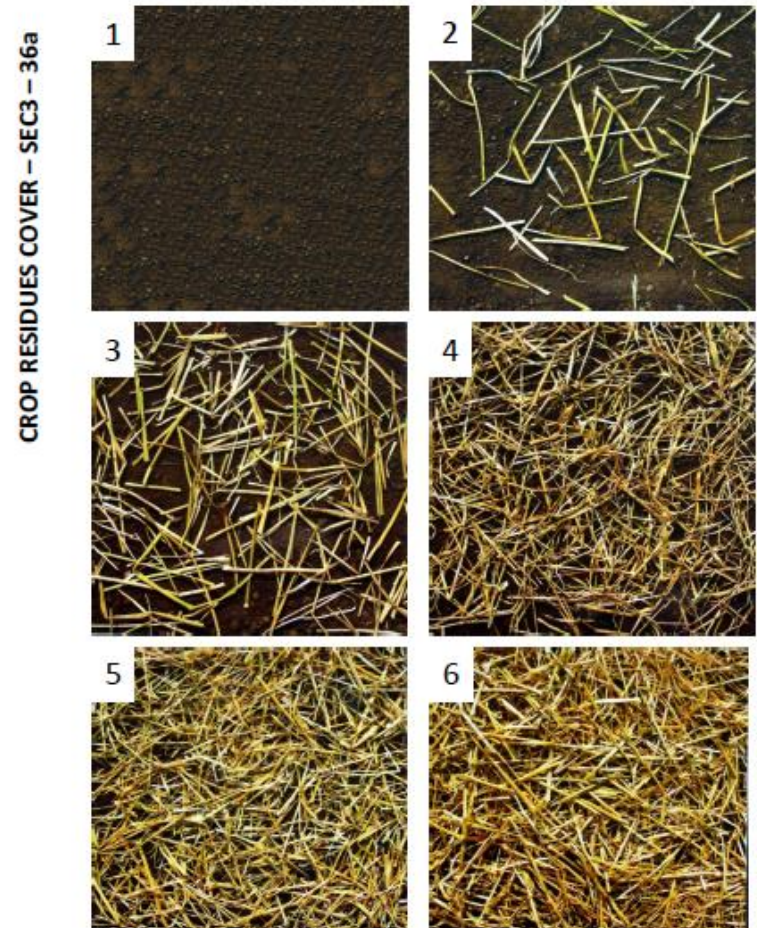
# Method 3 and 4

## Method 3: Interviewee (away from field)

In the meantime, what does the [FIELD] look like?

## Method 4: Enumerator (looking at the field)

In the meantime, what does the [FIELD] look like?





## Method 5 - drone

- Field pictures taken by a drone at a 25 feet altitude (0.27 cm/pixel resolution)
- Image processing methods used to segment RGB components and assess the % residue cover



## M5 – data collection



- Drone positioned at the field's center
- Camera oriented at the ground
- Pictures taken at 5, 15, 25, 50 and 75 feet
- n=182 plots



# M5 – analysis

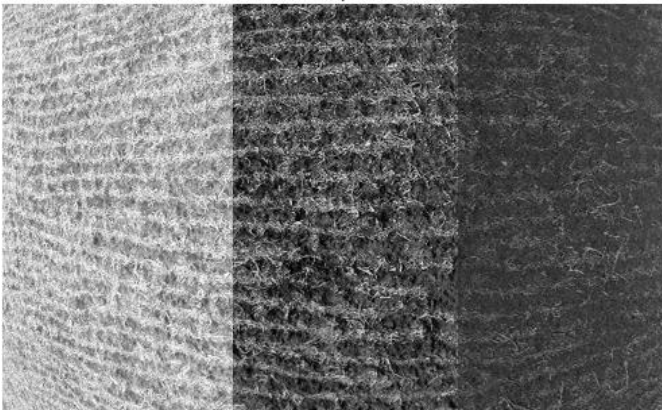
a)



b)



c)



d)





# Method 6 – remote sensing

- After survey completion, two archived full scenes of Landsat 8 TM satellite imagery were acquired
- We used Landsat 8 Thematic Mapper (TM) satellites because the images are freely available
- A Normalized Different Tillage Index (NDTI) was computed
- The index was not calibrated

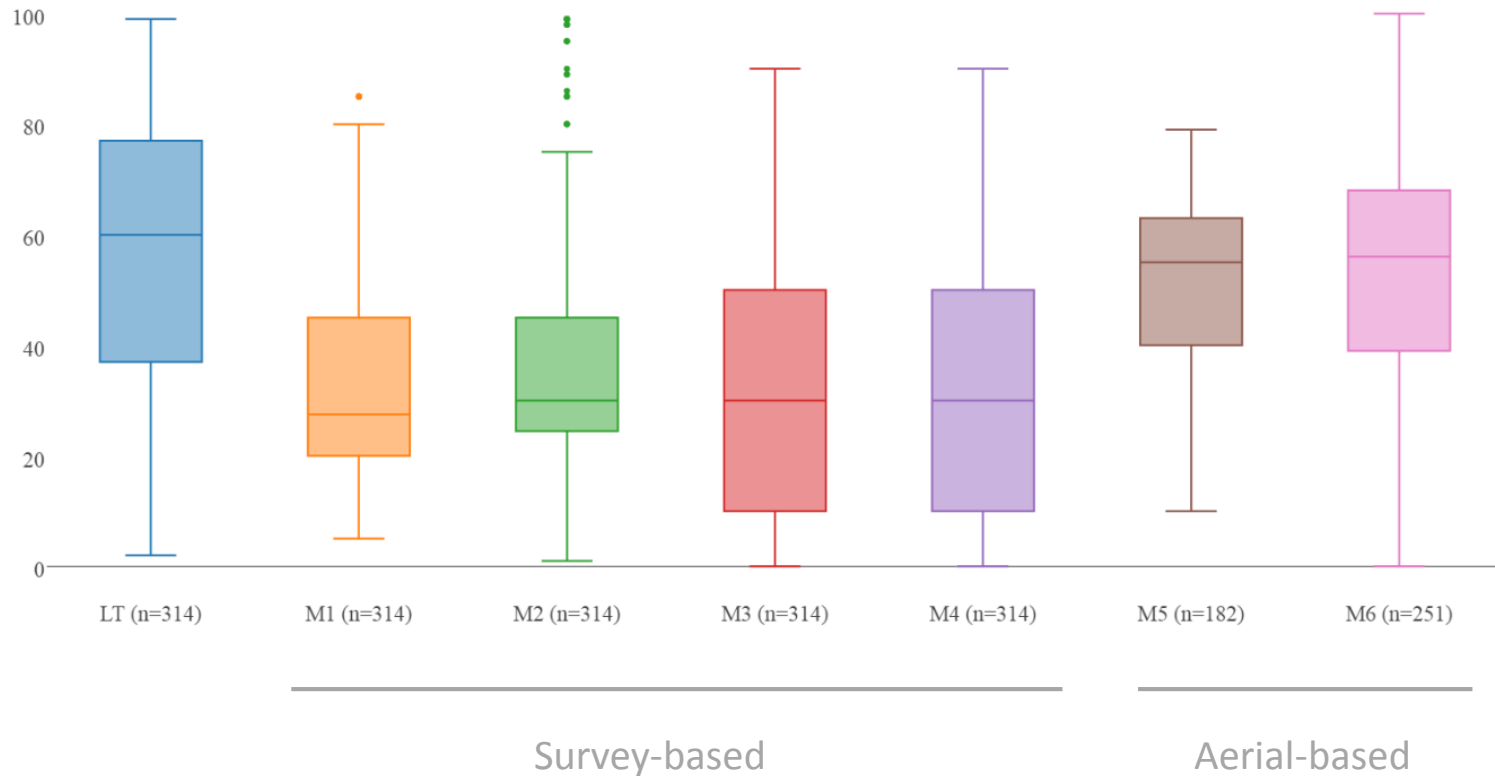
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# Benchmark – Line-transect

- A rope with 30 nodes is stretched at the four corners of the field
- The 120 counted measures are then averaged
- Validity tested on same plots at a 2-months interval

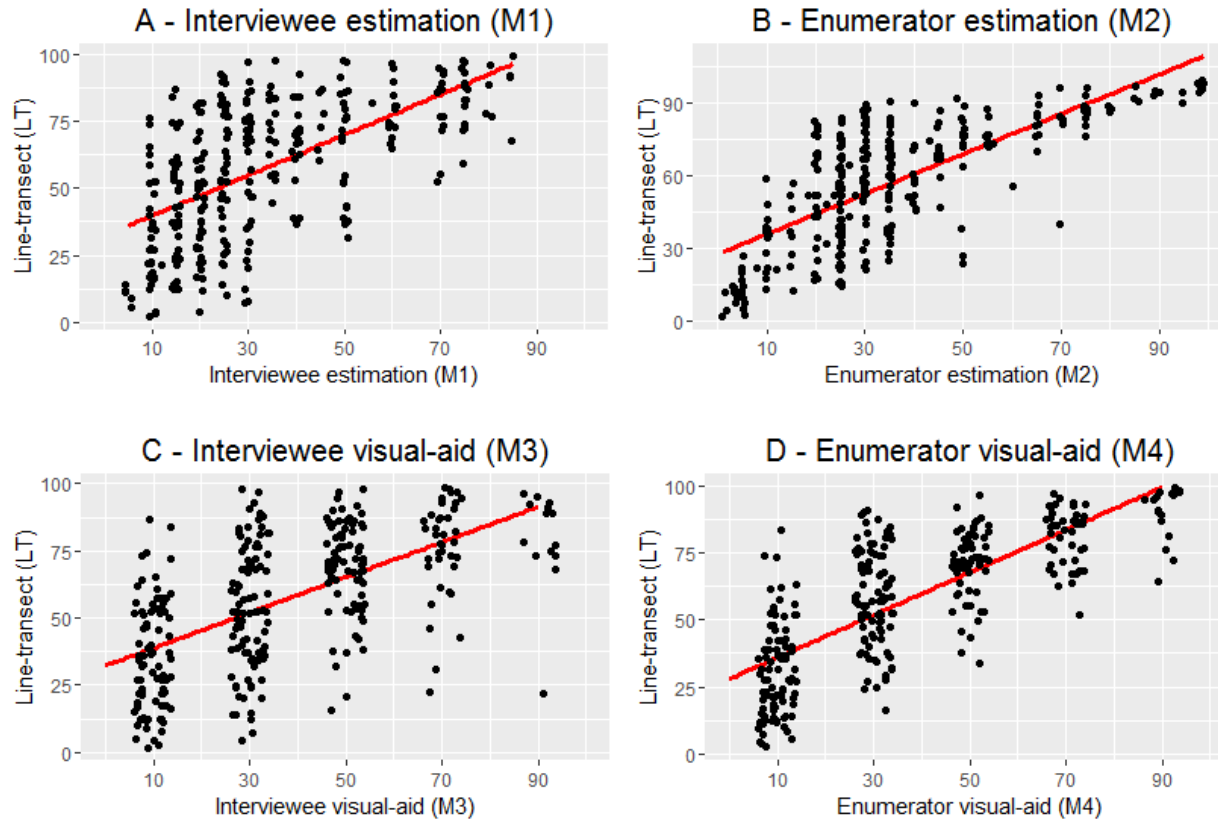


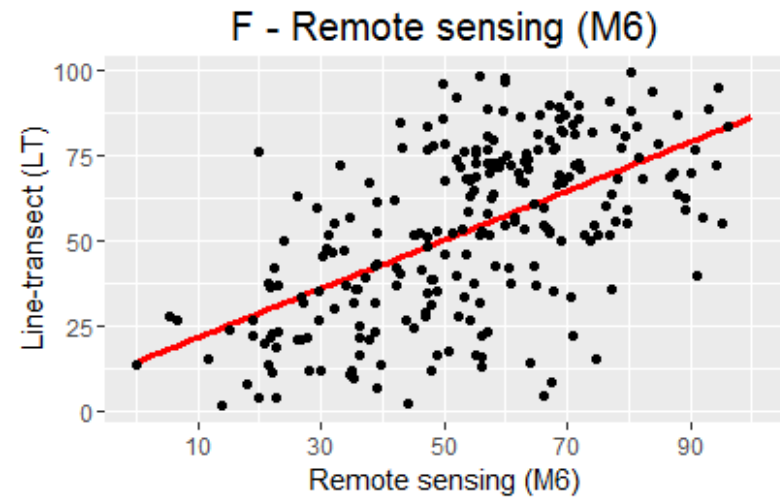
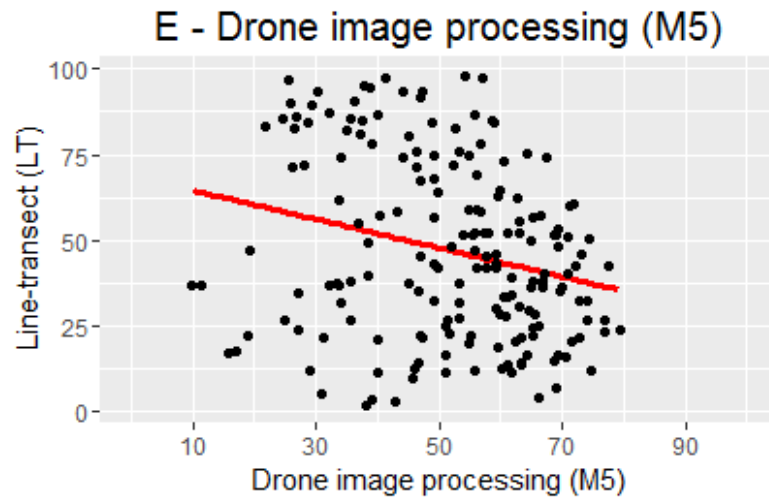
# Distribution of measurement methods



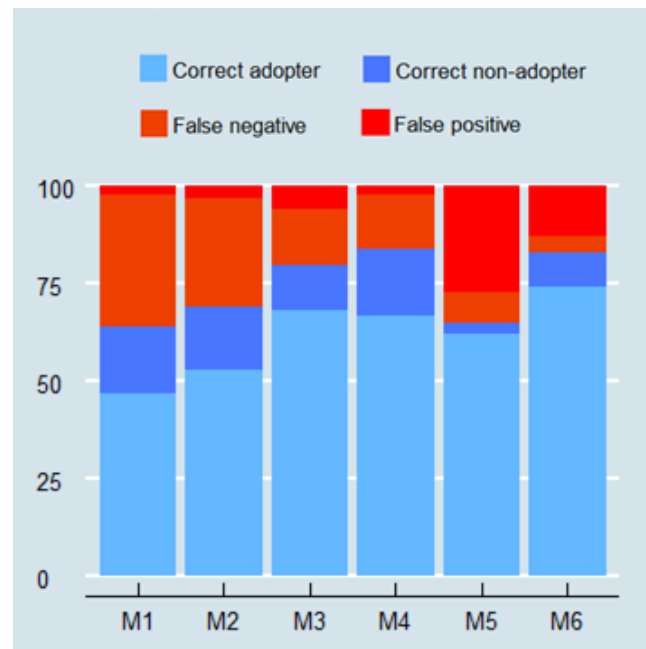


# How well did the measures correlate?



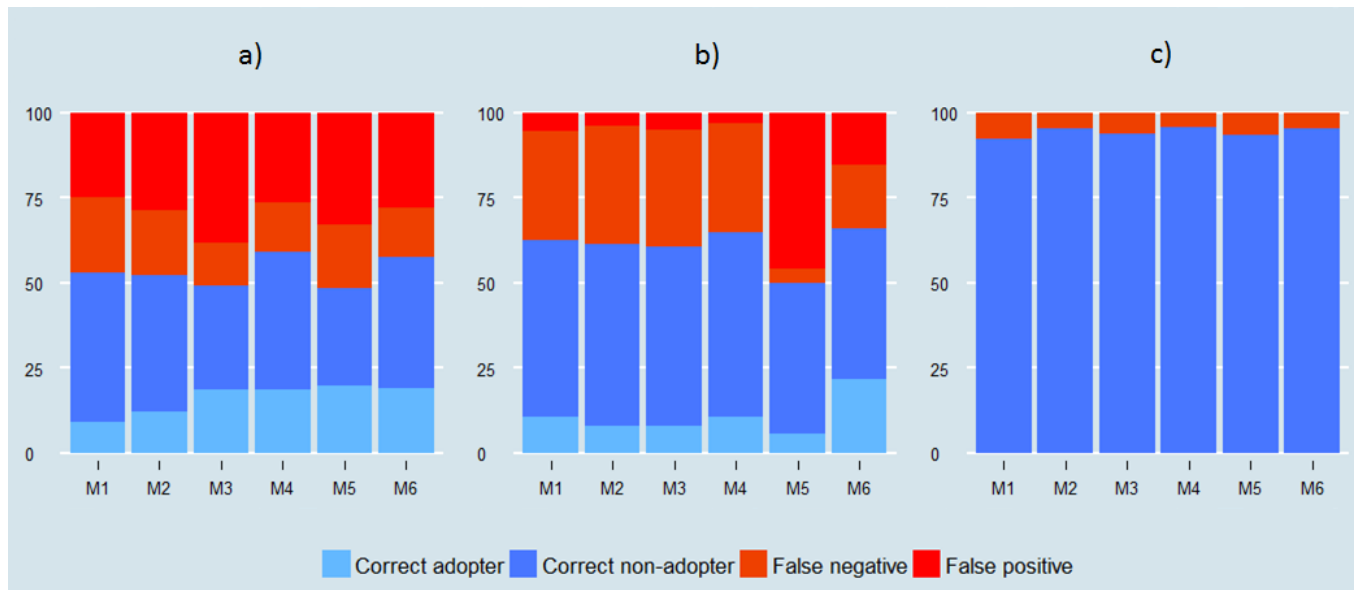


# Adoption false reporting of a minimum 30% crop residue cover





**Adoption false reporting of a) 30-60% crop residue cover, b) 60-90% crop residue cover and c) >90% crop residue cover by method of data collection**



# Conclusion

- Survey-based methods (M1-M4) tend to underestimate crop residue coverage
- In continuous analysis, best estimates came from the visual-aid protocols
- In categorical analysis, visual-aid protocols and remote sensing performed equally well (> 80% accuracy)
- **Drone method** : sensitivity of camera sensors to lightning conditions may be responsible for poor measurement
- **Remote sensing** : encouraging results given the coarse resolution (30m) and the fact that we did not calibrate the index



**Thank  
You!**