



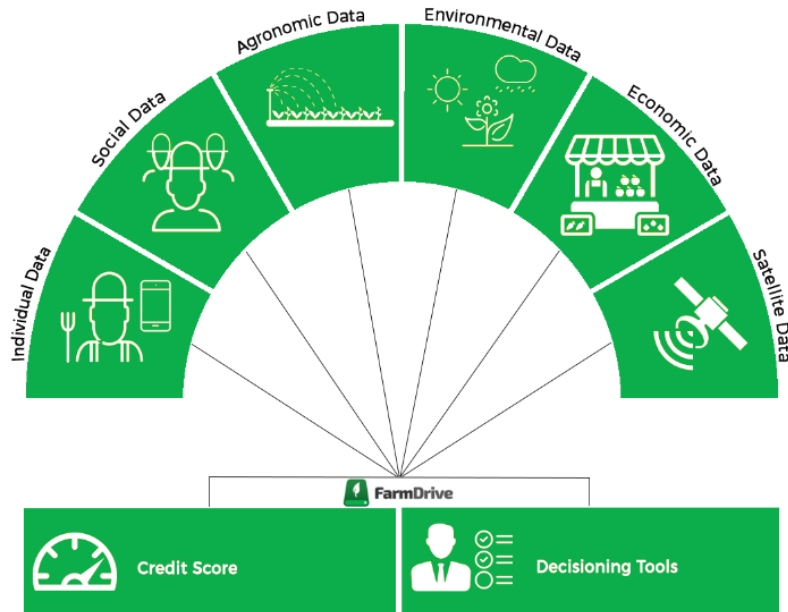
CGI




food security

tep

Service Pilot - Improved access to credits for smallholder farms in Kenya



- Support Kenyan company Farmdrive, who provide micro redits to farmers
- Integrate EO data into methods for objective assessment of credit risk
- Minimize operational costs while increasing the efficiency and operational capacity of financial services providers to support meeting the demand for credit by farmers



Relevant crops & parameters to be delivered

Sorghum

- Scientific name: Sorghum bicolor
- Other names: great millet, durra, jowari, milo
- First planting season: April-August (Long rains)
- Second planting season: September – December (short rains)

Maize

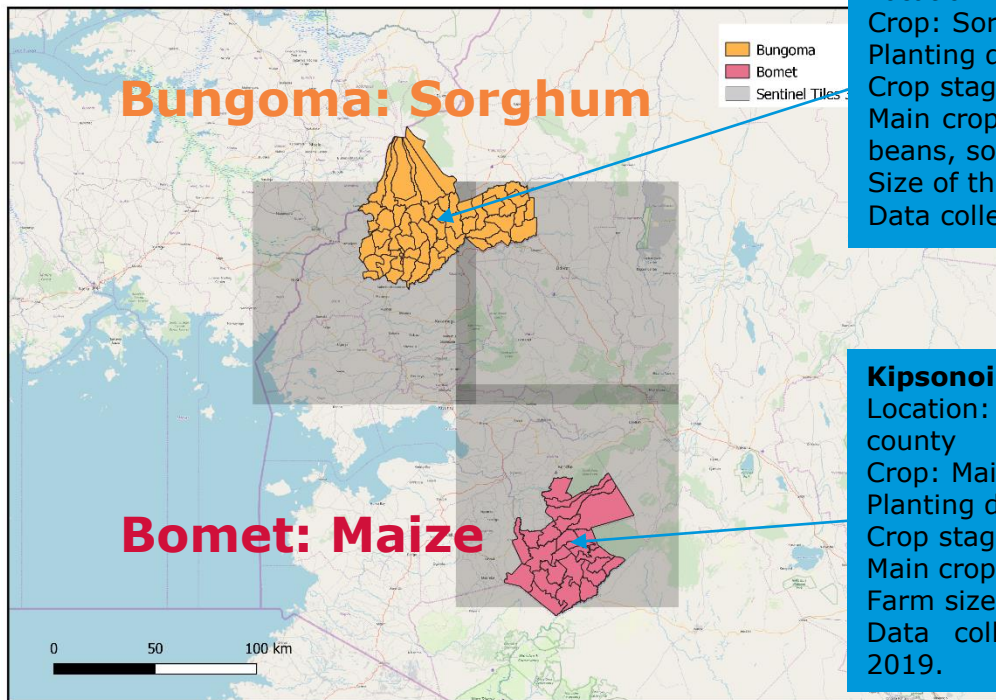
- Scientific name: Zea mays
- Other name: Corn
- Planting seasons: 1. Late October, November, December and January – Right season. 2. June – August- wrong season, intercropping of both maize and beans.

Three different EO variables were delivered to FarmDrive in Kenya:

- **SMOS Soil Moisture Products**
- **LAI time-series derived from Sentinel-2**
- **Yield estimates for the two chosen counties**

For all variables, a time-frame of November 2018 to November 2019 was considered.

Relevant Counties and Available In-Situ Data



Sample farm_1 - Sorghum

Location: Siboti ward, Bungoma county
Crop: Sorghum
Planting date: 3rd October 2019
Crop stage: Weeding
Main crops: Maize, groundnuts, Tobacco, beans, sorghum
Size of the farm: 0.5 Acres
Data collection date: 28th October 2019.

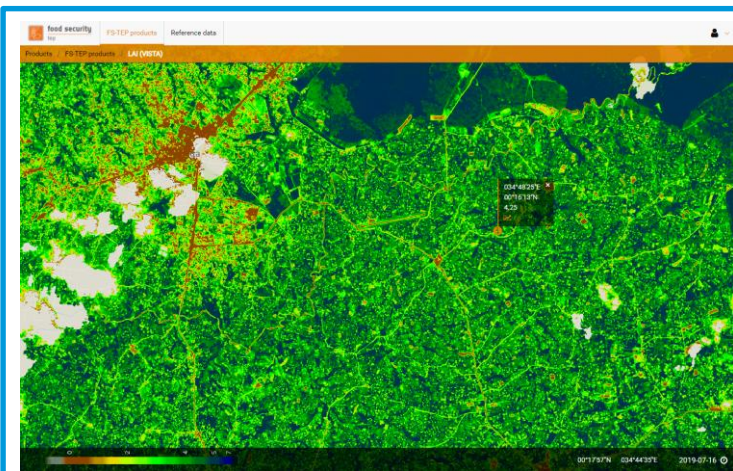


Kipsonoi ward sample farm_1

Location: Kipsonoi ward, Bomet county
Crop: Maize
Planting date: 14th October 2019
Crop stage: Weeding
Main crops: Maize, beans
Farm size: 1 Acre
Data collection date: 30th October 2019.



Crop Parameters to be delivered

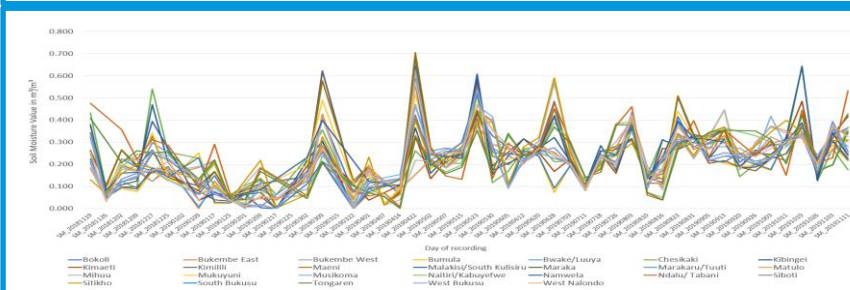


Leaf Area Index for whole counties and past year
Example: 16/07/19

Yield Estimates for maize (Bomet) and sorghum (Bungoma)

Challenges for yield estimation:

- Very small fields
- Crop types of fields not known
- Only very coarse information available on planting / harvesting dates
- Very few in-situ data for calibration / validation



SMOS Soil Moisture time series for whole counties and past year

From Sentinel-2 Data to equidistant LAI time series without prior land use information

Step 1:

Random selection of pixels on masked remote sensing image stacks (agricultural land only)

Step 2:

Detection of plant phenological parameters

- Vegetation onset
- Vegetation maximum
- Vegetation offset

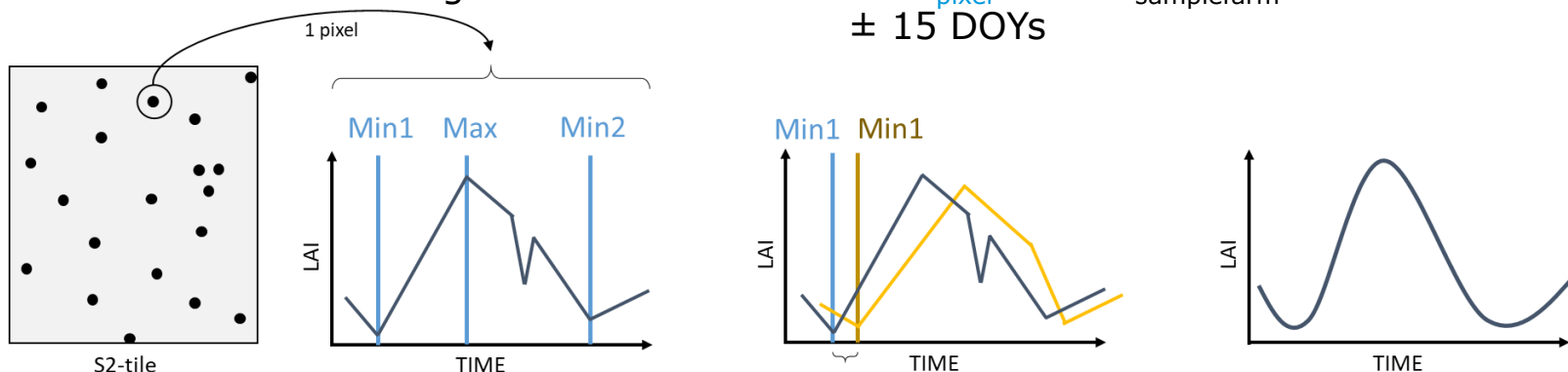
Step 3:

Selection of LAI time series matching the following criteria:

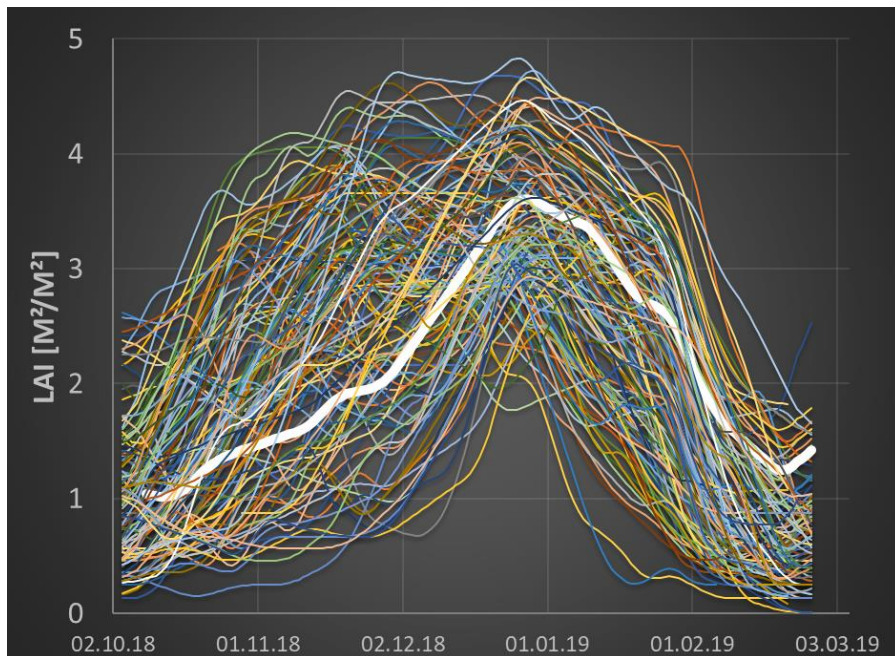
- All parameters have been derived (no missing value)
- $\text{Min1}_{\text{pixel}} = \text{Min1}_{\text{samplefarm}} \pm 15 \text{ DOYS}$

Step 4:

Outlier removal, linear interpolation, moving window smoothing



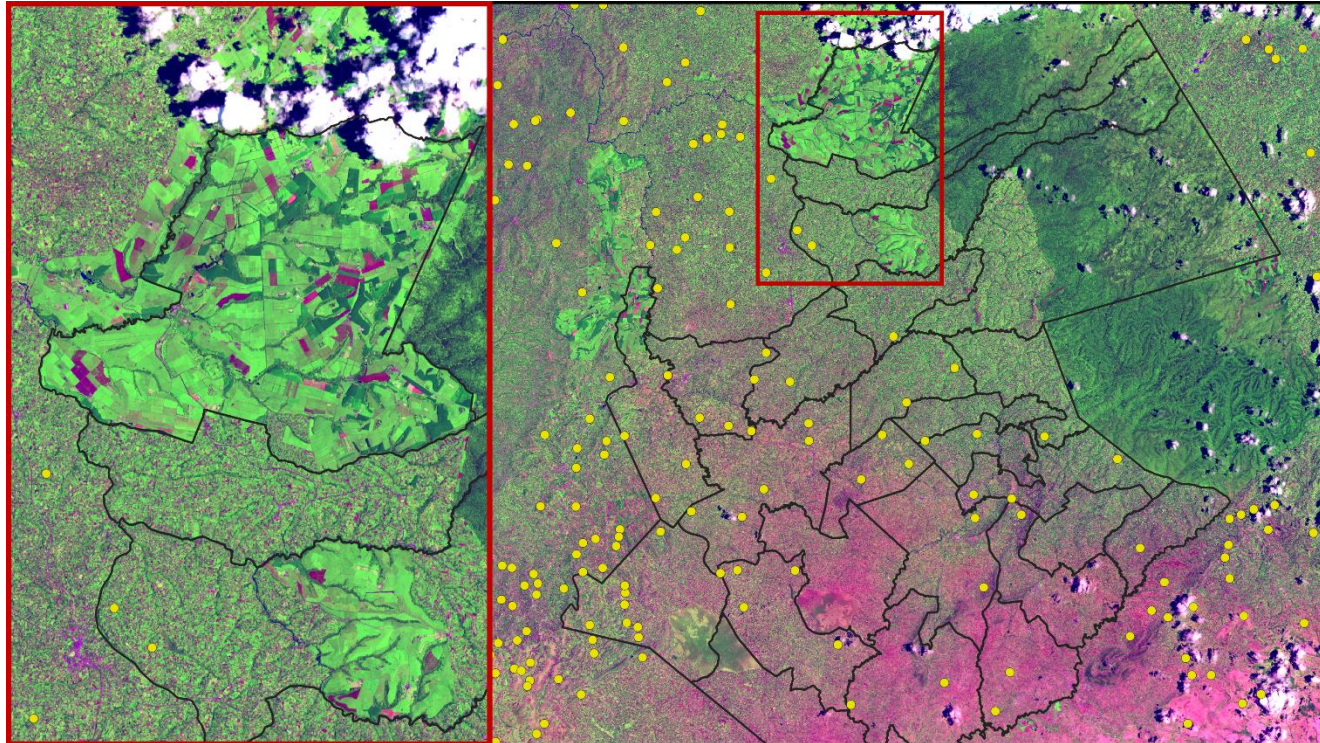
Example for resulting LAI time series as input into crop growth model



Interpolated and smoothed LAI time series of maize pixels in Kenya

Time range: October 2018- February 2019

Pixel selection for maize in Bungoma

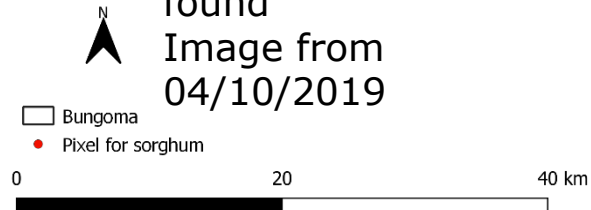


- Only few commercial farms with large fields in county
- Selected pixels are all on smallholder fields
- Image from 04/10/2019:
Second harvest phase of sorghum,
planting phase for maize

Pixel selection for sorghum in Bomet

- Only few commercial farms with large fields in county
- Selected pixels are all but one on smallholder fields
- One S2 tile (East) had better data availability, so more pixels could be found

Image from
04/10/2019



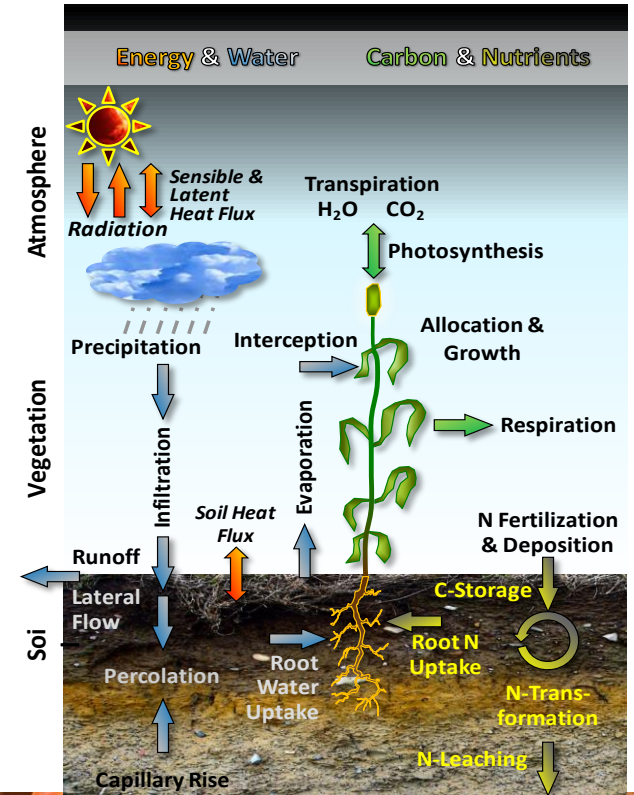
Crop Growth Model PROMET

Simulation of plant growth and water, carbon and nutrient household

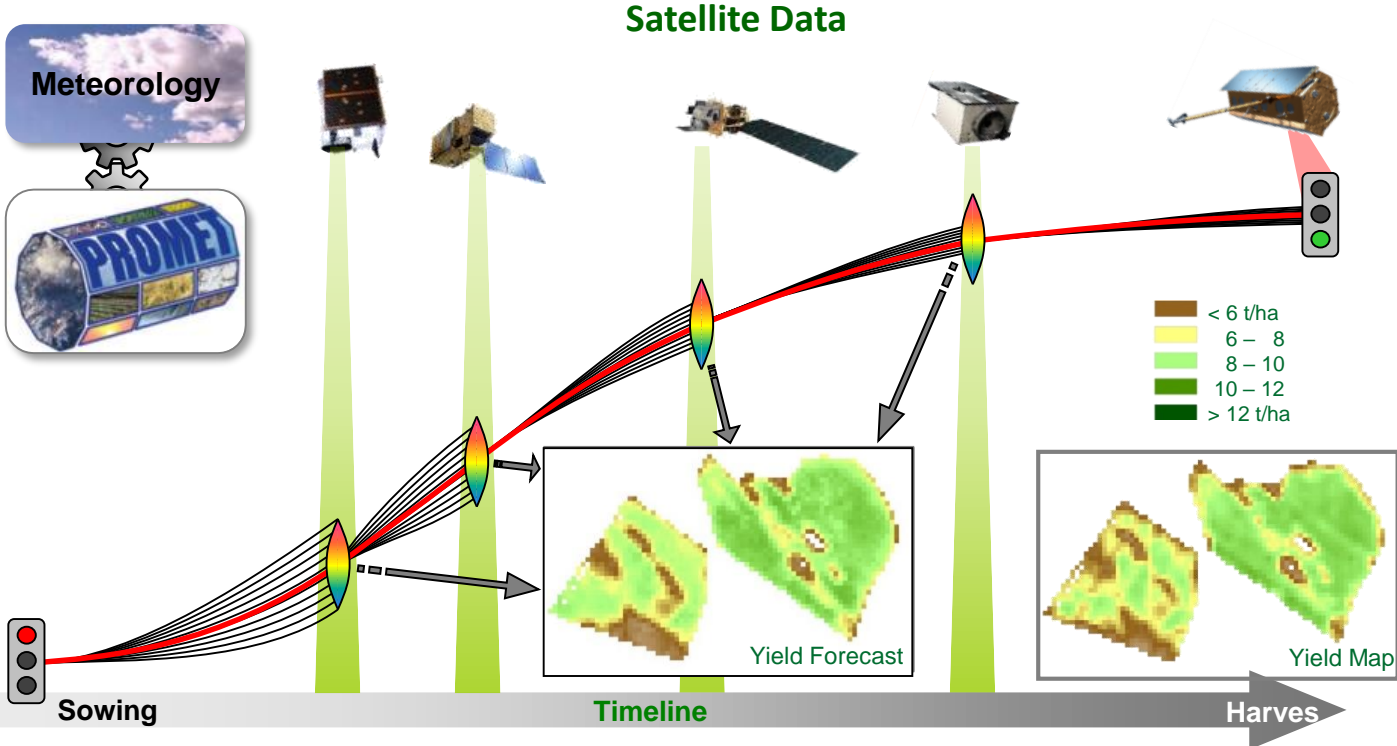


PROMET attributes:

- physically based
- spatially distributed
- raster based (10m – 1km)
- hourly calculations



Assimilation of Satellite Data into Crop Growth Model

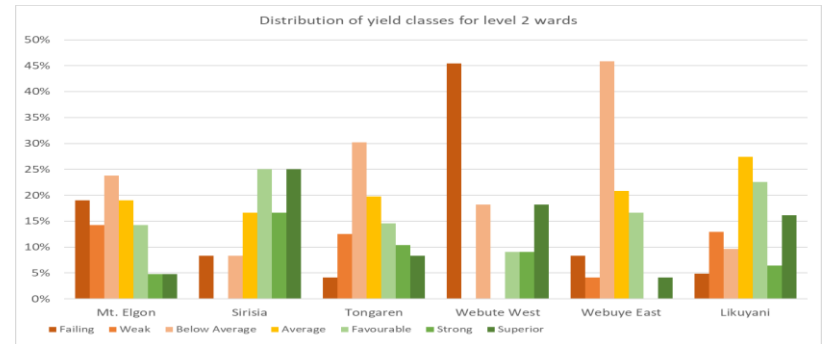
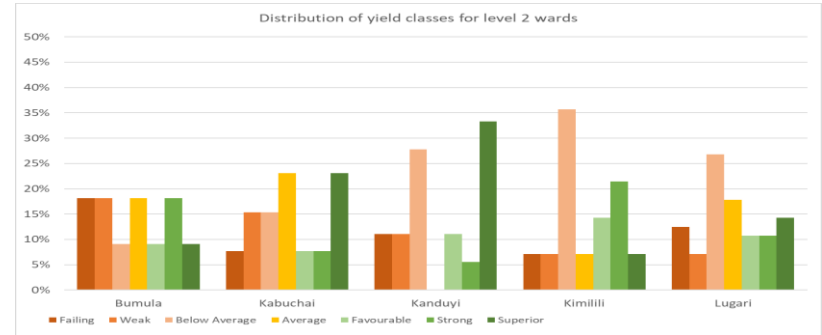


Sorghum Yields - Bungoma

Yield results
in t/ha



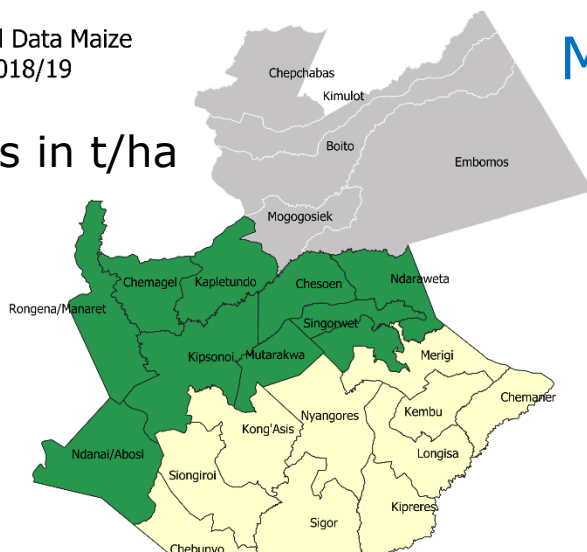
Yield class	Flag	Average t/ha	Minimum t/ha	Maximum t/ha
Failing	1	0.13	0.00	0.30
Weak	2	0.47	0.30	0.65
Below Average	3	0.82	0.65	1.00
Average	4	1.17	1.00	1.34
Favourable	5	1.52	1.34	1.69
Strong	6	1.87	1.69	2.04
Superior	7	2.21	2.04	2.39



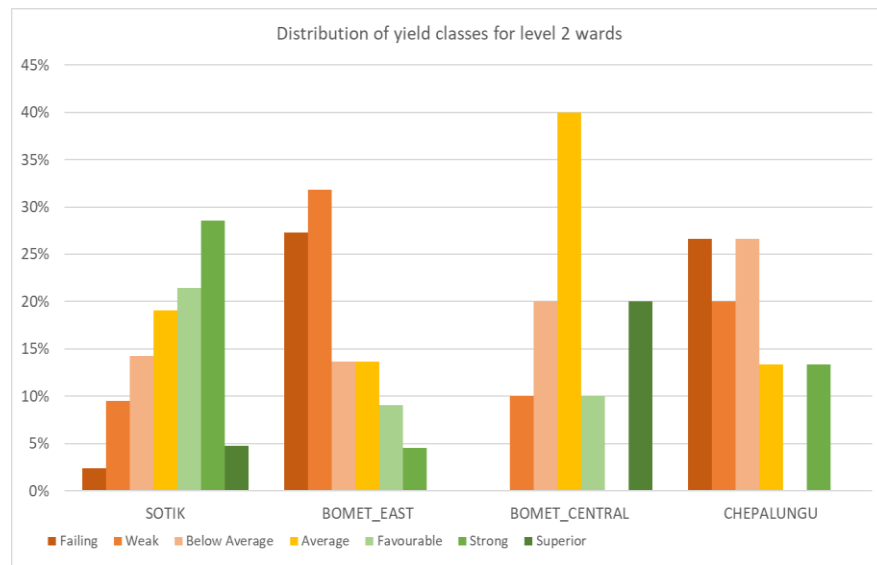
Distribution of simulated sorghum yield classes in 11 different Constituencies in Bungoma County, Kenya



Yield results in t/ha



Yield class	Flag	Average t/ha	Minimum t/ha	Maximum t/ha
Failing	1	1.36	1.25	1.46
Weak	2	1.56	1.46	1.66
Below Average	3	1.76	1.66	1.86
Average	4	1.96	1.86	2.07
Favourable	5	2.17	2.07	2.27
Strong	6	2.37	2.27	2.47
Superior	7	2.57	2.47	2.68



Distribution of simulated maize yields in four Constituencies in Bomet county, Kenya