7TH ale AGRIFIN LEARNING EVENT

7th & 8th November
Nairobi, Kenya

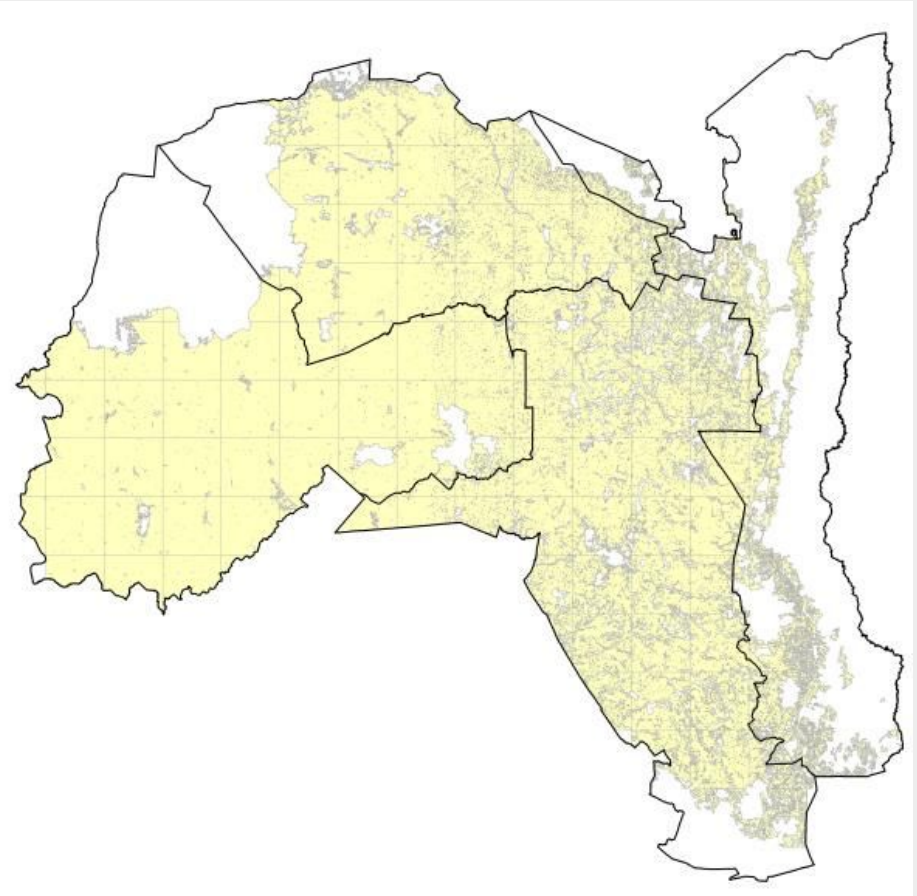
Soil Mapping and analysis with input recommendations for four counties in Kenya

#ALE2023 #AgriFinALE2023

Chapter 1: INTRODUCTION & APPROACH

INTRODUCTION

- Collection of georeferenced topsoil samples in Bungoma, Trans-Nzoia, Uasin Gishu and Elgeyo Marakwet
- Laboratory analysis of Samples to determine fertility levels and generate recommendations for fertilizer and lime application to boost yields in those areas.



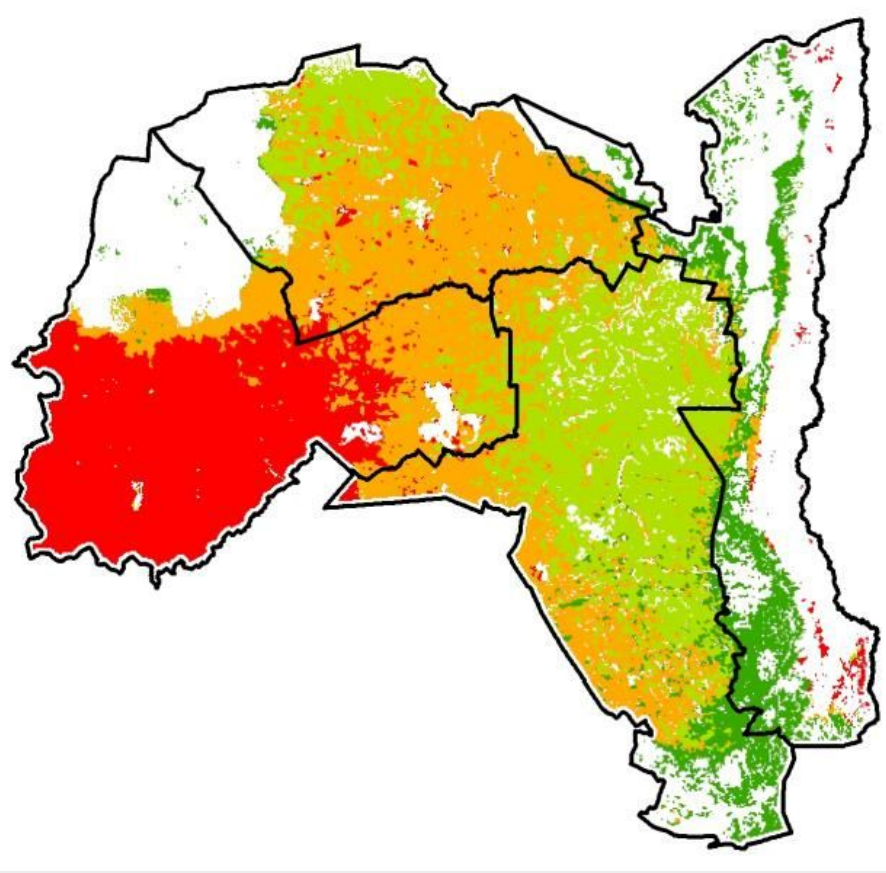
CONTENTS - APPROACH

1. Identification of the sampling sites through the generation of fertility zones using covariate analysis. A total of 1140 Apollo farms to sample, spread across the delineated zones.
2. Navigation and collection of topsoil samples on the selected sites (5 teams)
3. Lab analysis of all soil samples: 100% using spectral MIR technology and 20% using wet chemistry for the validation of the results
4. Geostatistical data analysis and validation with refinement of the fertility zones and development of fertilizer plan per fertility zone.

Chapter 2: SAMPLE COLLECTION AND LAB ANALYSIS

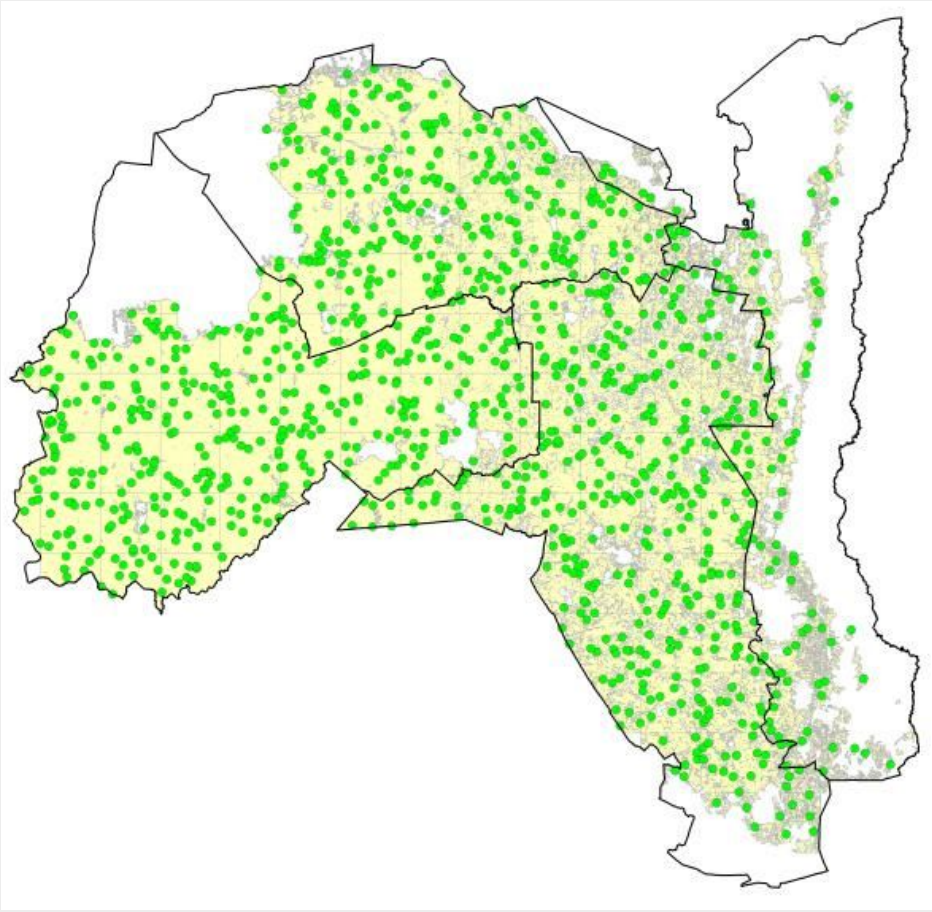
SAMPLING DESIGN

- Zoning: six different covariates: AOI; County boundaries; Land use/Land cover; DEM; long-term annual T°C & ppt; NDVI.
- The covariate analysis was run within the AOI determined by the distribution of Apollo farmers.
- Optimal number of zones across the AOI was found to be **four**, increasing the number of zones provided no significant increment in zone diversity



COLLECTION OF SAMPLES

- 5 Teams collected samples between Nov-Dec
- Subsamples were collected across the field (W-sampling) = 1 composite sample per farm
- Samples sent to lab weekly for analysis



LABORATORY ANALYSIS

- All samples were logged into the lab and analysed for the following parameters:
  - MIR on 100% of samples: pH, P (class), K, Ca, Mg, OM, Total N, Exchangeable Acidity (and Acid Saturation, %)
  - Wet Chemistry on 20% of samples: pH, CEC, P (ppm), K (ppm), Ca (ppm), Mg (ppm), S (ppm), Na (ppm), OM (%), Total N (%), Fe (ppm), Mn (ppm), Cu (ppm), B (ppm), Zn (ppm), C:N ratio and Ca:Mg ratio.

Chapter 3: RESULTS

ZONE REFINEMENT & CHARACTERIZATION

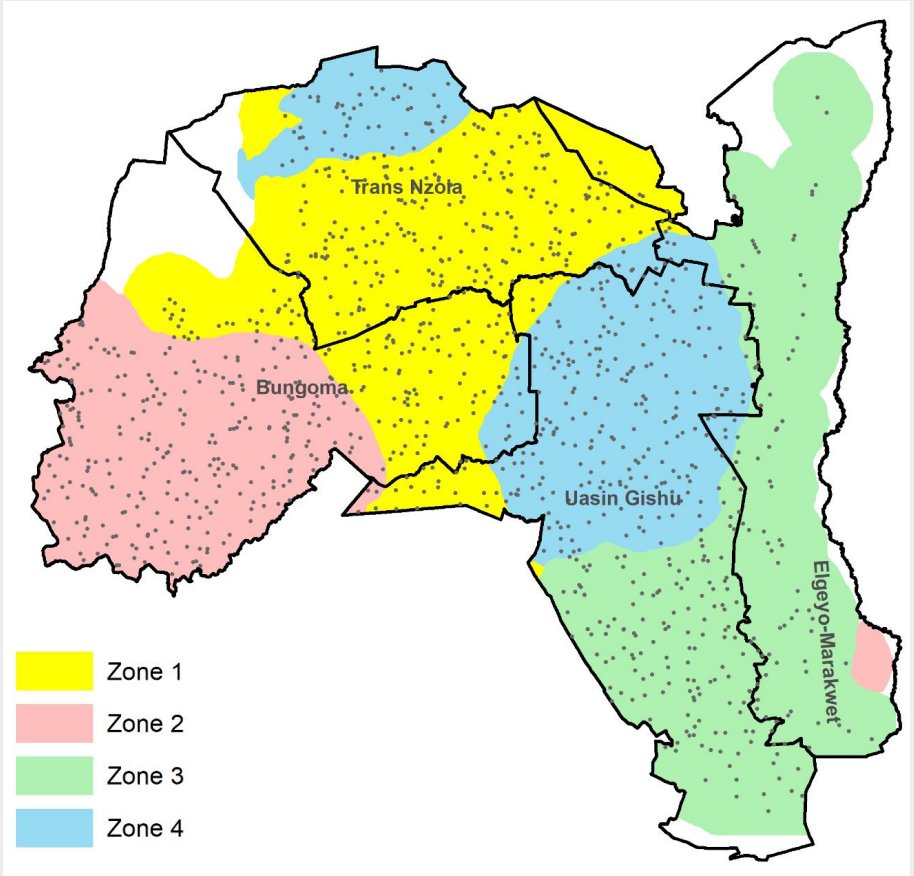
- Zones were refined using the original zones and the data from the lab

Zone 01	Temp	Elevation
	°C	m
min	15	1600
1st Quartile	18	1800
median	18	1800
mean	18	1900
3rd Quartile	19	1900
max	20	2400
sd	0.79	150

Zone 02	Temp	Elevation
	°C	m
min	18	1300
1st Quartile	20	1400
median	21	1500
mean	21	1500
3rd Quartile	21	1600
max	22	2100
sd	0.85	140

Zone 03	Temp	Elevation
	°C	m
min	13	1400
1st Quartile	15	2200
median	16	2300
mean	16	2300
3rd Quartile	17	2500
max	22	2800
sd	1.1	190

Zone 04	Temp	Elevation
	°C	m
min	16	1800
1st Quartile	17	1900
median	18	2000
mean	17	2000
3rd Quartile	18	2100
max	19	2300
sd	0.65	120



SOIL DATA

KEY	Very Low	Low	Optimal	High	Very High

Zone	pH	P	K	Ca	Mg	Na	S	OM	N	CEC	Fe	B	Cu	Zn	Exch_Ac
		Class	ppm					%		meq/100g	ppm				meq/100g
1	5.50	Very Low	220	1100	210	18	11	3.44	0.16	13.0	140	0.42	2.8	3.8	0.25
2	5.50	Very Low	130	840	150	17	7.8	2.58	0.12	8.9	140	0.32	2.0	3.8	0.16
3	5.20	Very Low	500	1200	270	18	16	4.64	0.19	18.0	130	0.47	2.2	5.4	0.54
4	5.40	Very Low	440	1100	260	18	13	3.27	0.16	15.0	120	0.43	2.5	4.0	0.37

ZONE 01	pH	OM	N	K	Ca	Mg	Na	CEC	B	Cu	Fe	Zn	Exch_Ac	OC	S
		%		ppm				meq/100g	ppm				%		
min	4.4	1.32	0.07	40	130	48	1.4	3.7	0.019	0.2	53	0.79	-0.07	0.77	0.39
1st Quartile	5.2	2.75	0.14	160	750	150	13	9.4	0.29	2.1	120	3.1	0.14	1.6	8.5
median	5.5	3.44	0.16	220	1100	210	18	13	0.42	2.8	140	3.8	0.25	2	11
mean	5.5	3.78	0.18	310	1500	280	21	16	0.49	5.4	150	4.5	0.34	2.2	12
3rd Quartile	5.8	4.64	0.20	380	2000	340	24	21	0.59	4.3	170	4.9	0.47	2.7	14
max	7.4	9.29	0.62	2500	6200	1500	100	53	2.2	61	500	35	1.40	5.4	50
sd	0.45	1.43	0.07	240	1100	210	11	9	0.31	7.6	53	2.8	0.28	0.83	5.7

ZONE 02	pH	OM	N	K	Ca	Mg	Na	CEC	B	Cu	Fe	Zn	Exch_Ac	OC	S
		%		ppm				meq/100g	ppm				%		
min	4.1	0.74	0.04	19	130	17	2.7	2.1	0.03	0.19	35	0.78	-0.09	0.43	0.01
1st Quartile	5.3	2.06	0.10	98	600	100	12	6.9	0.25	1.4	120	2.9	0.05	1.2	6.5
median	5.5	2.58	0.12	130	840	150	17	8.9	0.32	2	140	3.8	0.16	1.5	7.8
mean	5.7	2.58	0.13	170	1200	200	20	12	0.41	2.7	160	4.7	0.26	1.5	8.7
3rd Quartile	6	3.10	0.15	190	1300	220	24	12	0.48	2.8	170	4.8	0.32	1.8	9.9
max	8.5	8.94	0.48	1400	8400	1300	94	51	3.4	28	640	100	1.20	5.2	28
sd	0.62	1.14	0.05	140	1200	180	11	8.6	0.32	3.2	67	6.8	0.29	0.66	4.1

ZONE 03	pH	OM	N	K	Ca	Mg	Na	CEC	B	Cu	Fe	Zn	Exch_Ac	OC	S
		%		ppm				meq/100g	ppm				%		
min	4.3	1.00	0.08	81	110	25	-2	3.3	0.097	0.25	58	1.8	-0.08	0.58	1.90
1st Quartile	5	3.61	0.18	410	810	190	14	14	0.38	1.5	110	4.2	0.20	2.1	13
median	5.2	4.64	0.19	500	1200	270	18	18	0.47	2.2	130	5.4	0.54	2.7	16
mean	5.3	4.82	0.21	540	1600	300	21	19	0.62	4.7	130	6.4	0.59	2.8	18
3rd Quartile	5.6	5.50	0.23	620	2100	380	26	22	0.73	3.4	150	7.2	0.88	3.2	21
max	7.6	9.63	0.74	1800	5000	860	110	41	2.3	100	320	28	1.90	5.6	45
sd	0.53	1.38	0.08	230	1100	150	12	6.9	0.41	11	38	3.6	0.43	0.8	6.5

ZONE 04	pH	OM	N	K	Ca	Mg	Na	CEC	B	Cu	Fe	Zn	Exch_Ac	OC	S
		%		ppm				meq/100g	ppm				%		
min	4.8	1.51	0.07	75	250	54	-0.93	3.3	0.088	0.67	73	1.5	-0.04	0.88	5.90
1st Quartile	5.2	2.92	0.15	330	910	210	14	13	0.35	1.9	110	3.3	0.17	1.7	10
median	5.4	3.27	0.16	440	1100	260	18	15	0.43	2.5	120	4	0.37	1.9	13
mean	5.5	3.44	0.17	430	1500	310	23	17	0.49	3.8	140	4.5	0.42	2	13
3rd Quartile	5.6	3.78	0.18	530	1600	340	26	18	0.56	3.2	150	5.1	0.60	2.2	16
max	7.6	6.36	0.39	920	6500	1400	250	49	2.1	54	410	16	1.30	3.7	29
sd	0.4	0.86	0.03	170	970	180	22	7.2	0.24	5.6	40	1.9	0.29	0.5	3.9

YIELD DATA

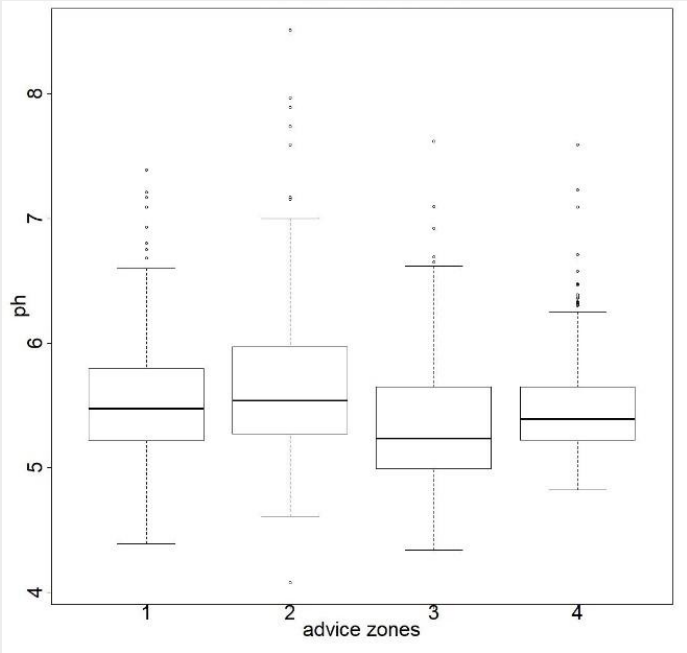
- Average Yield in Kenya = 1 ton/ha (4.5 bags/acre)
- Ideal yield Targets per Zone:

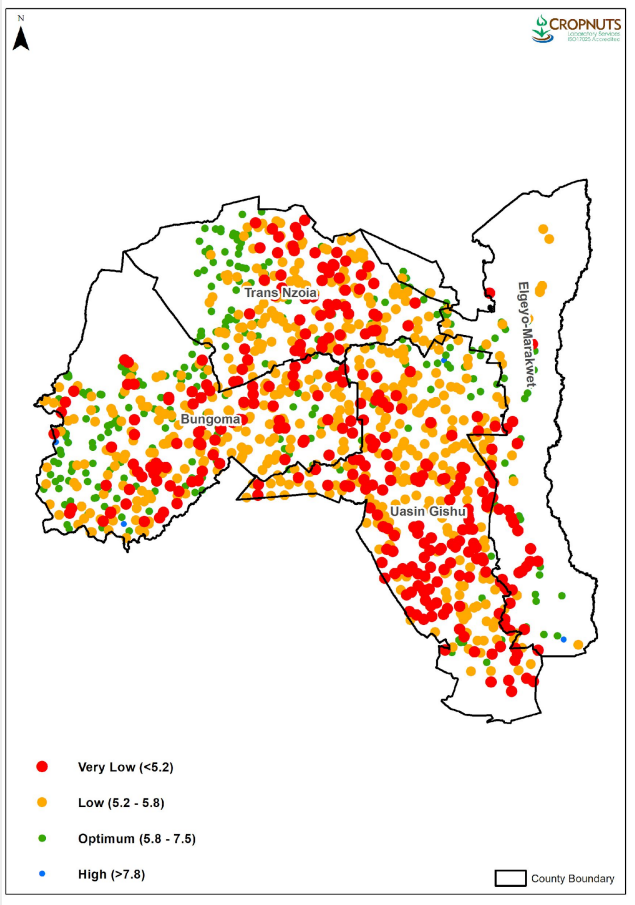
Zone	Elevation (m a.s.l.)	Temp (°C)	Yield Target (ton/ha)	Yield Target (bags/acre)
01	1800	18	4.5	20.2
02	1500	21	4.0	18.0
03	2300	16	5.5	24.7
04	2000	18	5.0	22.5

SOIL CORRECTION

- Lime applications, Calcitic Lime (pH < 5.2 and Calcium % <50%)

ZONE	% OF FARMS PER EACH ZONE				
BAGS/ACRE	4	4-8	8-12	12-16	>16
01	77.1	0.6	6.9	7.4	8.0
02	79.7	1.9	7.7	5.0	5.8
03	53.3	0.0	1.3	0.9	44.6
04	76.4	0.4	1.1	3.5	18.7





- Manure applications (Organic Matter < 2.5%)

ZONE	% OF FARMS REQUIRING MANURE
01	13.5
02	47.5
03	2.2
04	7.0

FERTILIZER PROGRAM

Basal Fert.	Yield Target (bags/acre)					PRODUCT	MICROS
Yield Target (bags/acre)	10	15	20	25	30		
Zone 01	0.50	0.75	1.00	1.25	1.25	DAP	B, Zn
Zone 02	0.75	1.25	1.75	2.25	2.75	NPK	B, Zn
Zone 03	0.50	0.75	1.00	1.25	1.25	DAP	B
Zone 04	0.50	0.75	1.00	1.25	1.25	DAP	B, Zn

Top Dressing Fert.	Yield Target (bags/acre)					PRODUCT
Yield Target (bags/acre)	10	15	20	25	30	
Zone 01	0.00	0.25	0.75	1.25	2.00	40N 6S
Zone 02	0.25	0.50	1.00	1.50	2.00	40N 6S
Zone 03	0.00	0.00	0.25	0.75	1.50	40N 6S
Zone 04	0.00	0.25	0.75	1.25	2.00	40N 6S

Chapter 4: DISCUSSION

DISCUSSION

- Basal fertilizer driven by P rate and yield potential
- Type of basal fertilizer driven by levels of K (DAP vs NPK)
- Top-dress Nitrogen driven by levels of OM and yield potential
- Manure required on 47% of farms in Zone 02; not recommended in zonal recs due to median value being above the OM threshold
- pH variable within same zones;
  - Lime recommendations not well suited to zoning
  - Site specific soil testing for accurate lime recommendations
- Value Cost Ratio – higher for DAP rather than NPK

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Thank You!