Soils and Management Practices in Malawi. A case study in Potato Fields of the Central Highlands of Malawi

What effect has soil management had on soil fertility?

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Food Security and Soil Fertility Constraints

Sub-Saharan Africa

- Persistent food insecurity

- Out of 950 million people: 218 million are undernourished

(OECD/FAO, 2016)

Malawi

- Maize occupies 75 % of cultivated land; yield ≤ 2 t/ha vs 12 t/ha

- Potato occupies 2.8 % of agric. land; Yield 17 t/ha vs 40 t/ha

FAO, 2017

Soil fertility and acidity: potential yield limiting factors

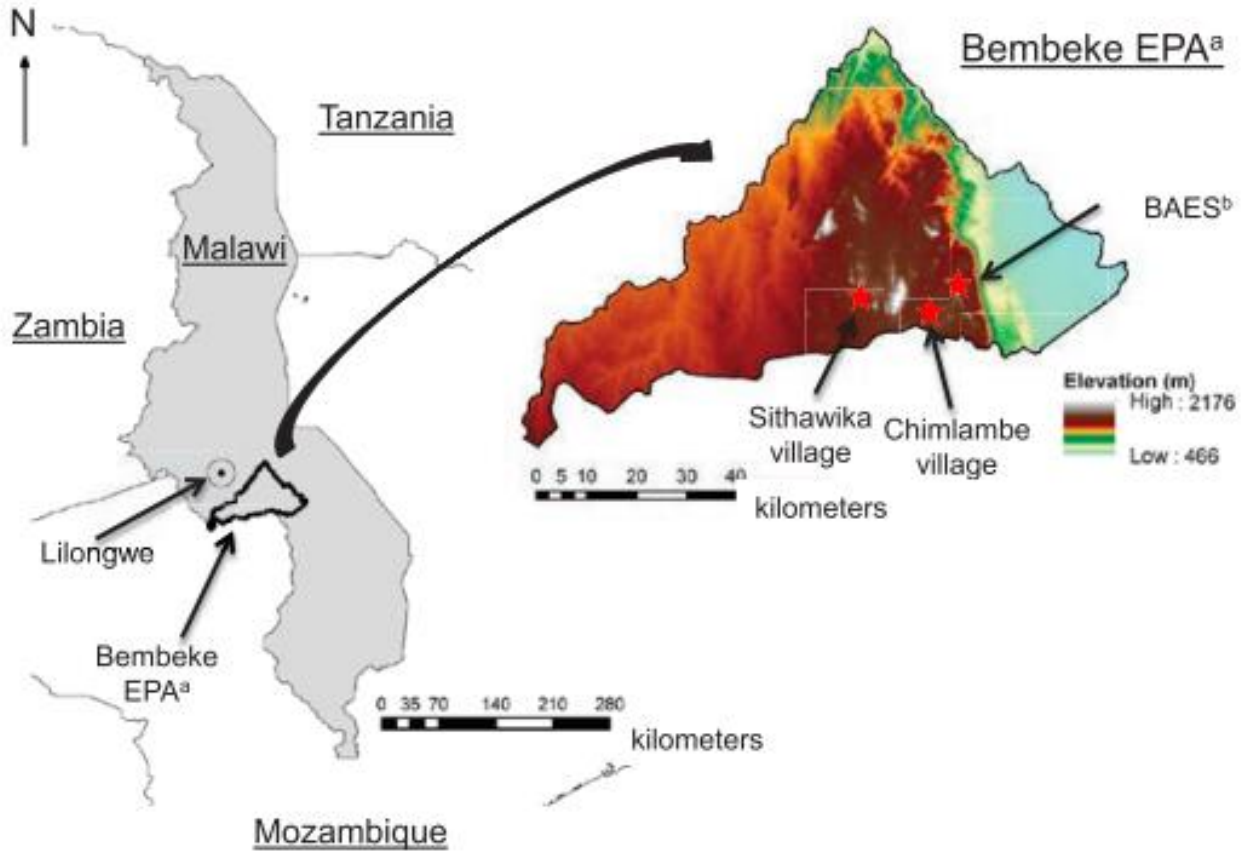
Common Soil Management Practices in Malawi

Objectives of the study

- Evaluate **major soil types** found in the area through soil profile assessment as well as mineralogical and physico-chemical testing

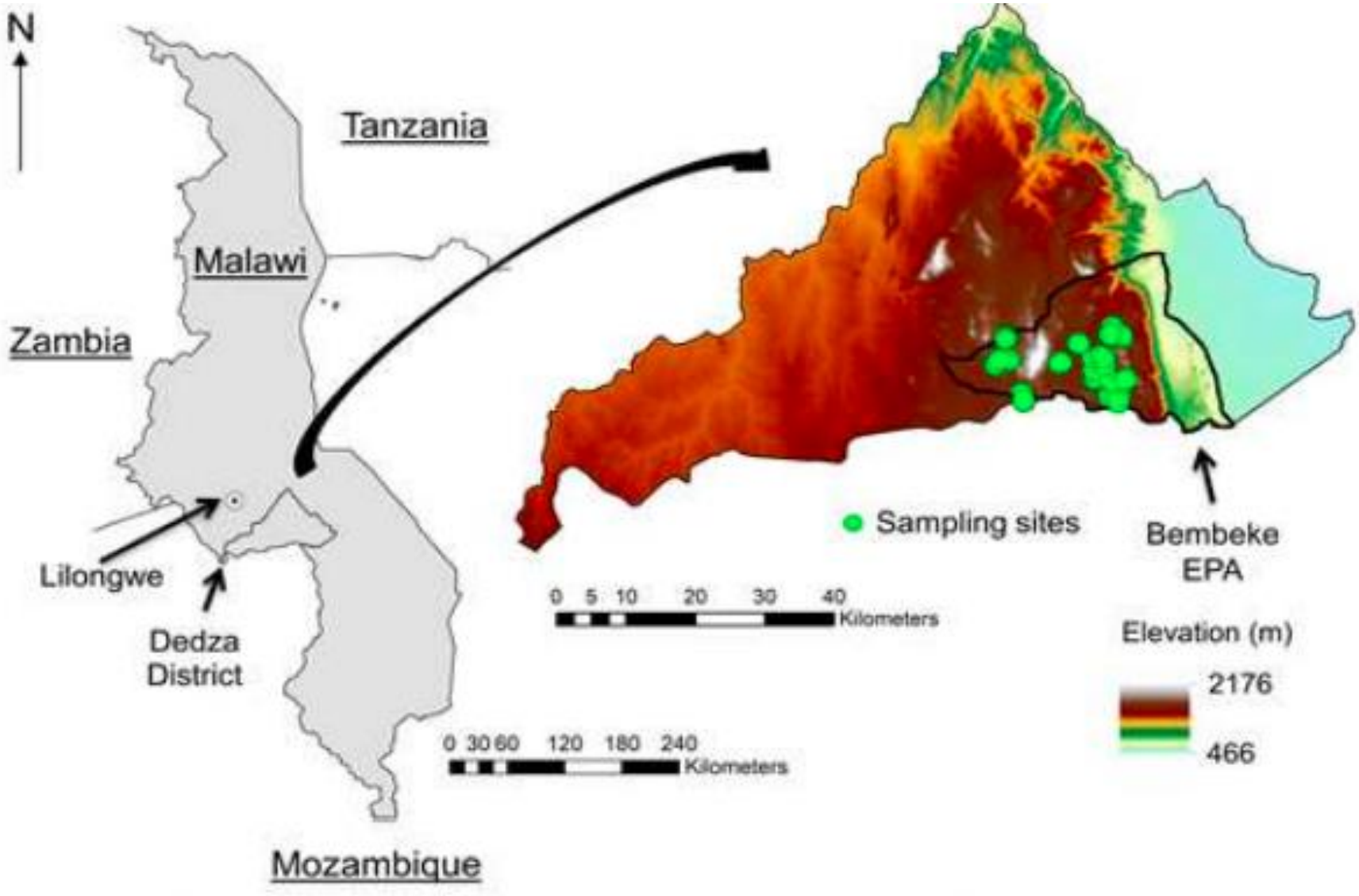
- Investigate the **current soil nutrient status** of multiple potato fields and determine factors affecting the nutrient status

SOIL PROFILING



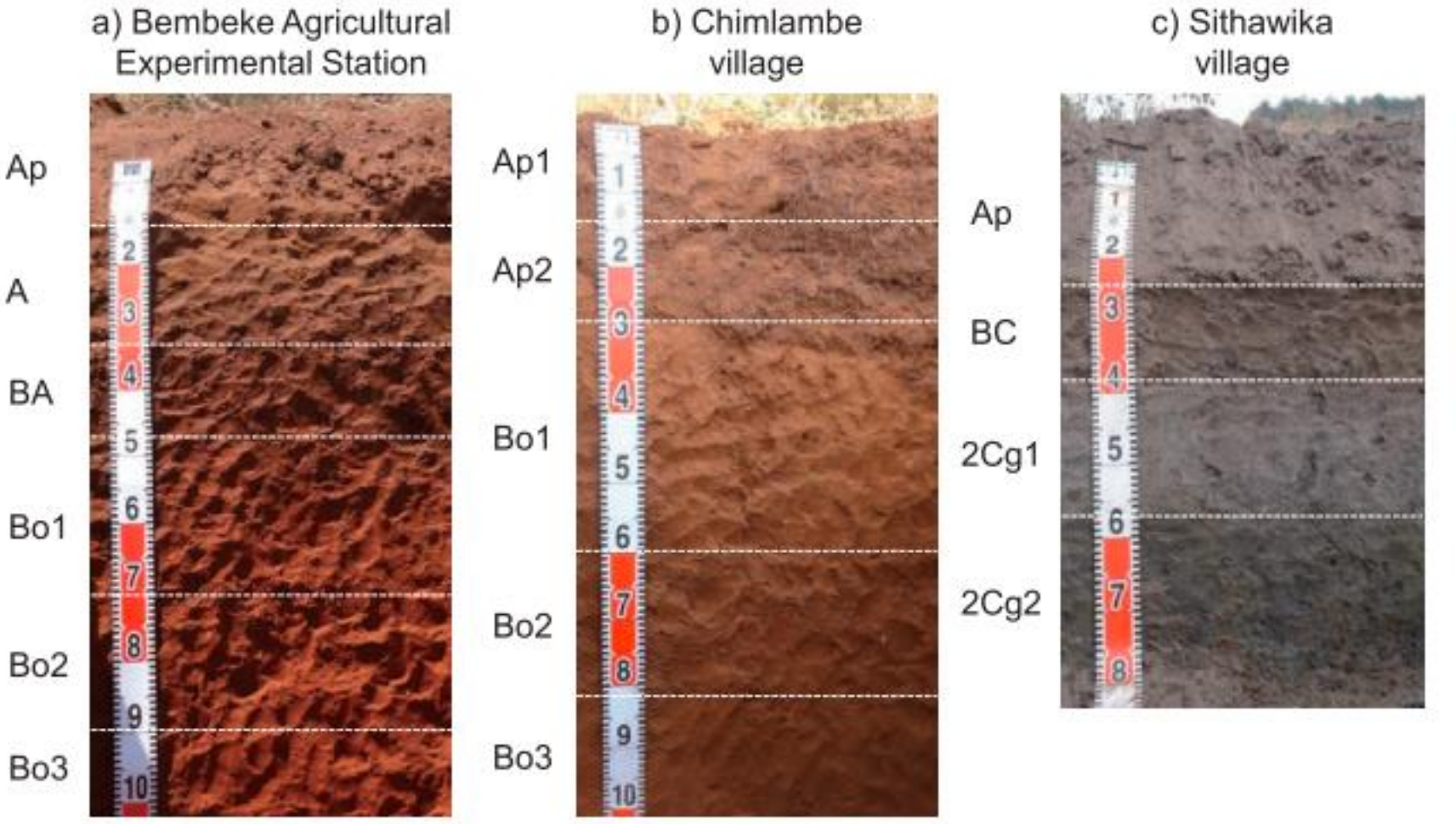
SOIL NUTRIENT STATUS ASSESSMENT

26 farms across the area

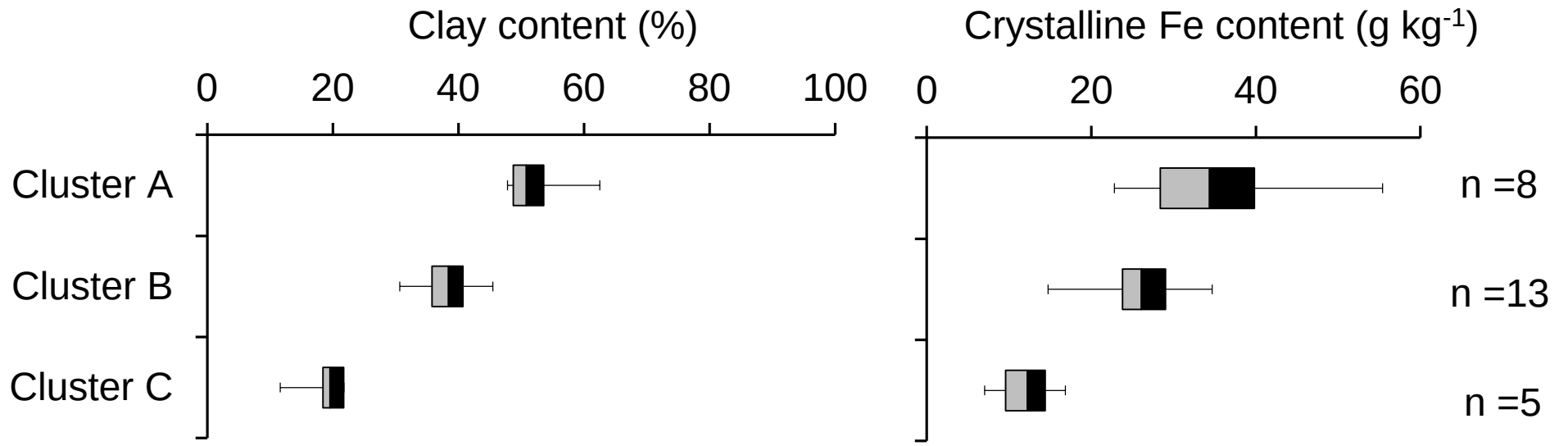


SOIL TYPES

Rhodic Haplustoxs Typic Haplustoxs Oxyaquic Ustorthents



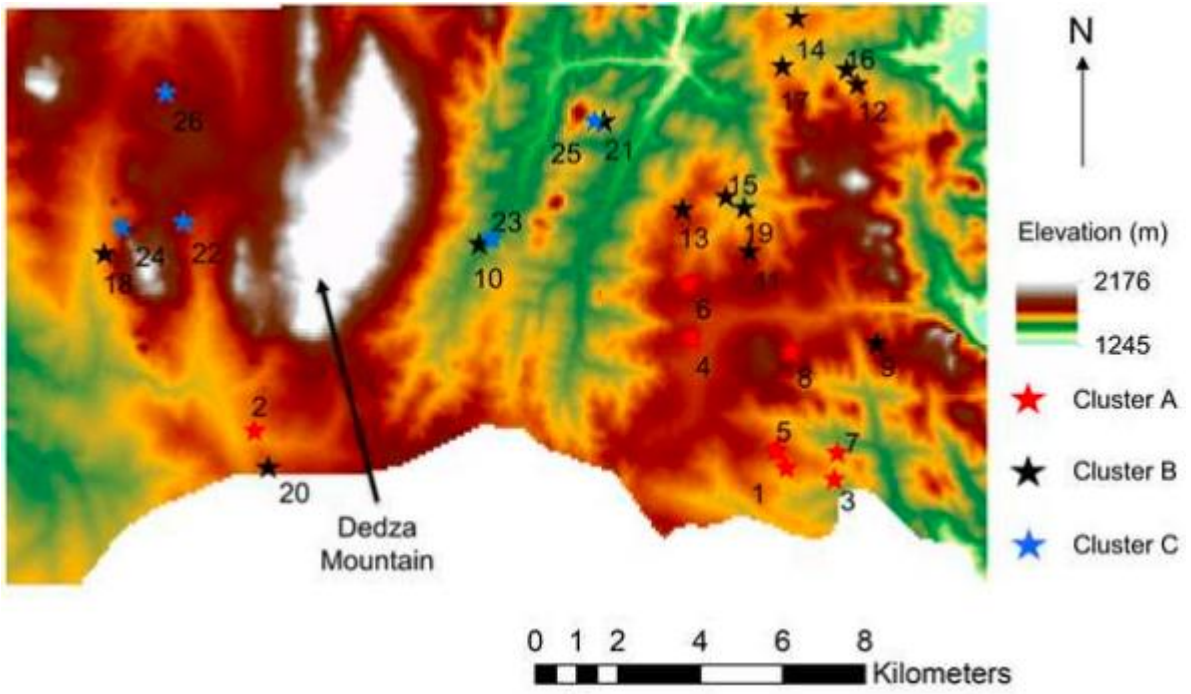
SOIL CLUSTERS IN POTATO FIELDS



Cluster A: Oxisols

Cluster B: Oxisols

Cluster B: Entisols



SOIL ACIDITY AND Al TOXICITY STATUS

Soil properties		Cluster A (n =8)	Cluster B (n = 15)	Cluster C (n = 5)
pH (H_2O)	-	5. 3±0.2	5.2±0.4	5.3±0.2
pH (KCl)	-	4.5±0.1	4.5±0.3	4.5±0.2
Exchangeable acidity (Y_1)	-	2.8±0.8	3.7±1.5	1.7±0.7
Exchangeable Al	($cmol_c\ kg^{-1}$)	0.196±0.102	0.305±0.240	0.104±0.114

Presented as mean ± standard deviation.

- Soils generally acidic
- Majority soils exchangeable acidity <6 = low
- Majority soils exchangeable Al <0.7 $cmol_c\ kg^{-1}$ = low

No worries for Al toxicity in the area

SOIL INORGANIC N STATUS

- Cluster A: 17.7 to 55.2 mg kg^{-1}
- Cluster B: 28.0 to 69.5 mg kg^{-1}
- Cluster C: 12.0 to 62.0 mg kg^{-1}

If we consider among other factors;

- 40 t/ha of potato = 102 kg N ha^{-1}
- Farmer application of 69 kg ha^{-1} of N fertilizer

Relatively high N levels

SOIL P, K, Mg STATUS

	Range	Cluster A (n = 8)	Cluster B (n = 13)	Cluster C (n = 5)
	mg kg^{-1}	Available phosphate (P_2O_5)		
Deficient	0-50	1	5	1
Slightly deficient	50-100	5	6	1
Optimum	100-300	2		3
Slightly excessive	300-600		2	
Excessive	>600			
	$cmol_c$ kg^{-1}	Exchangeable K		
Deficient	0-0.17	1	1	2
Slightly deficient	0.17-0.32	3	7	1
Optimum	0.32-0.64	4	5	2
Slightly excessive	0.64-1.1			
Excessive	1.1-1.5			
Highly excessive	>1.5			
	$cmol_c$ kg^{-1}	Exchangeable Mg		
Deficient	0-0.50	2	4	2
Slightly deficient	0.50-1.2	6	9	2
Optimum	1.2-2.2			1
Excessive	>2.2			

P, K and Mg could be serious constraints

SOIL CALCIUM STATUS

- 23 out of 26 farm fields below the recommended exchangeable Ca range of 3.6 to 6.1 $cmol_c\ kg^{-1}$ for potato production

Ca could be a serious constraint

Soil Doctor in Malawi

- Soil pH

- Soil organic matter

FAO, 2022