“Potassium is sufficient in soils of Kenya”

A long held misconception

A REVIEW OF THE POTASSIUM STATUS OF SOILS IN KENYA

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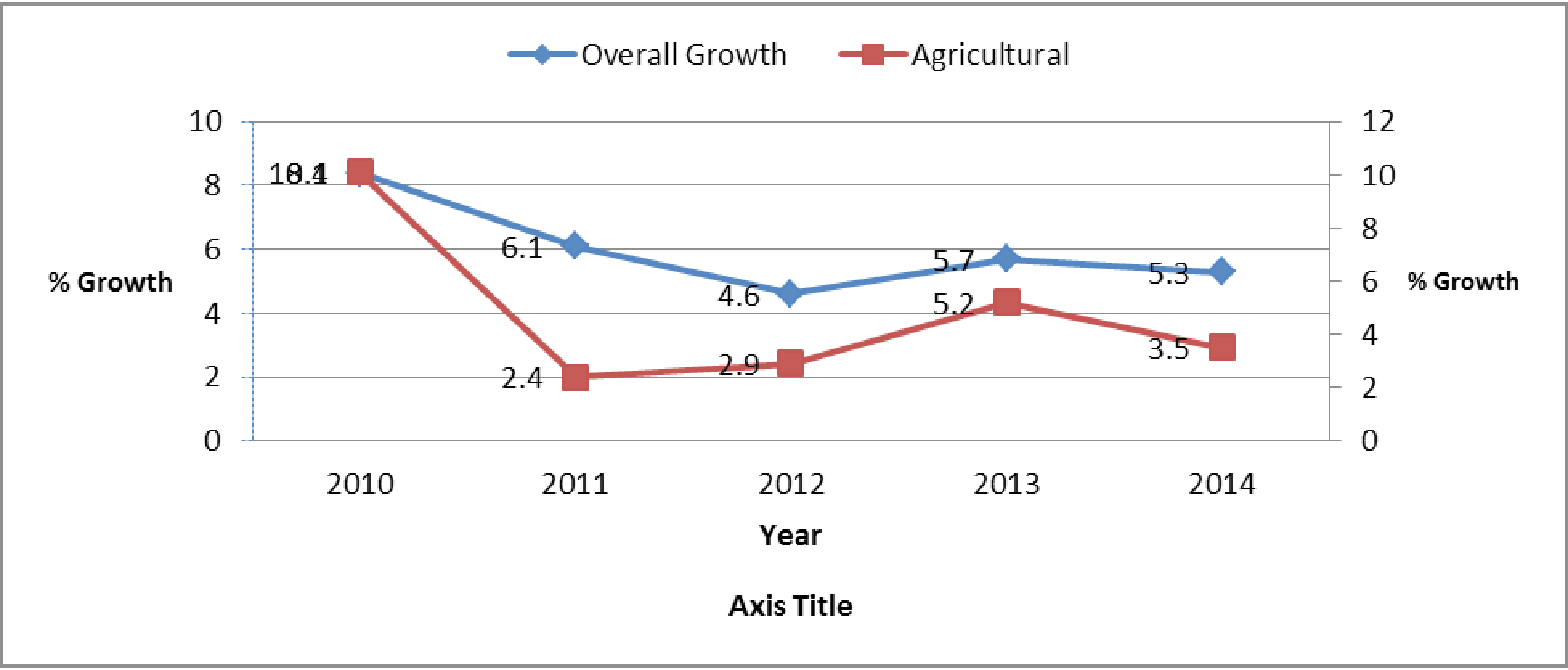
OUTLINE

- Introduction: Agriculture in Kenya
- Historical perspective of K fertilization
- Research highlights on soil analysis K status in Kenya
- Addressing the gaps
- Conclusions

INTRODUCTION

Agriculture and GDP trend 2010-2012



Market Size

– Agriculture 30% of Kenya's GDP ($4.5B), 75% of its labor force

Exports

– ~$2B pa agricultural exports, mainly tea, coffee, vegetables, and flowers

Farm profiles

– 75 % small holder and 25% medium and commercial large scale farms

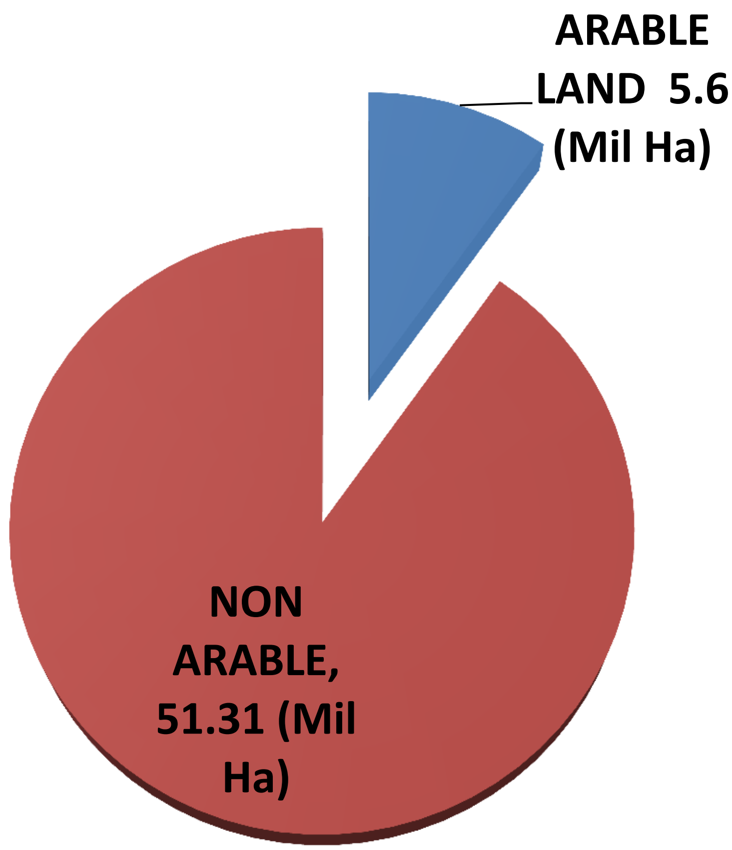
– Most small holders do mixed farming: mixed cropping , poultry and livestock

Major crops

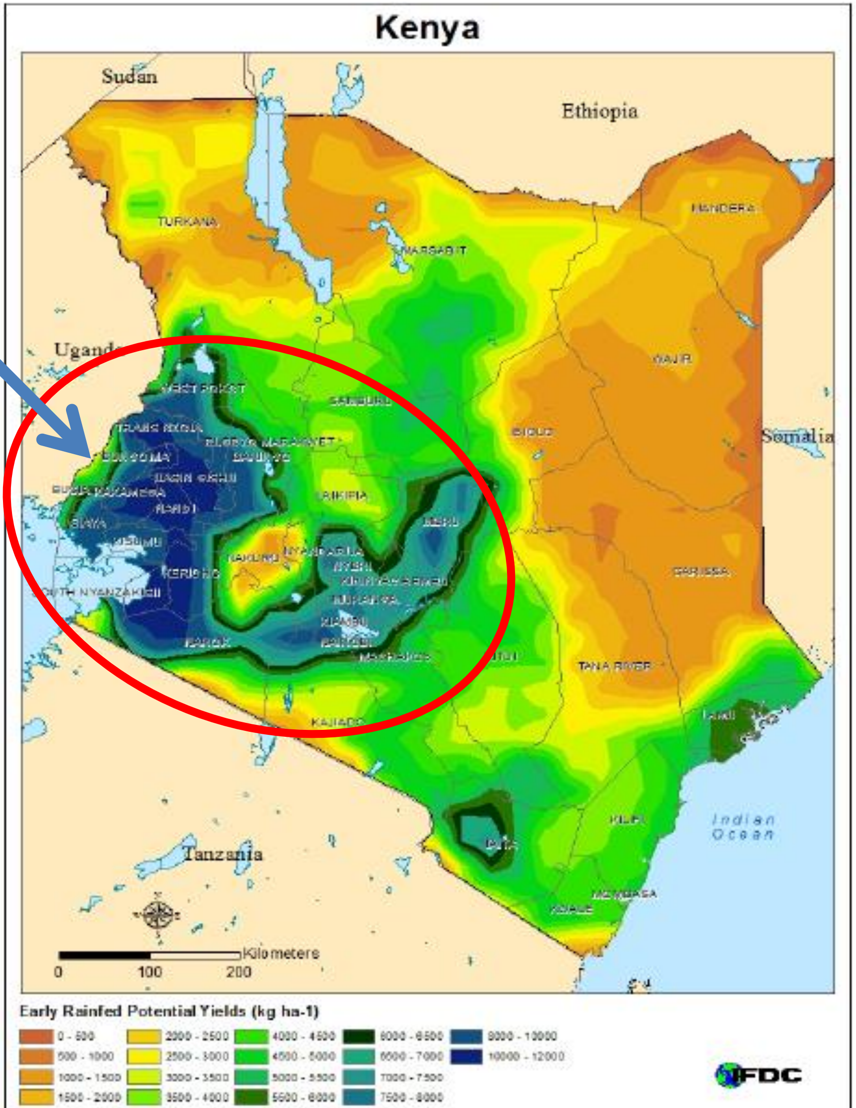
– Food crops: Maize, rice, beans, Irish potatoes

– Cash crops: Tea, coffee, pyrethrum, sisal, tobacco and horticulture

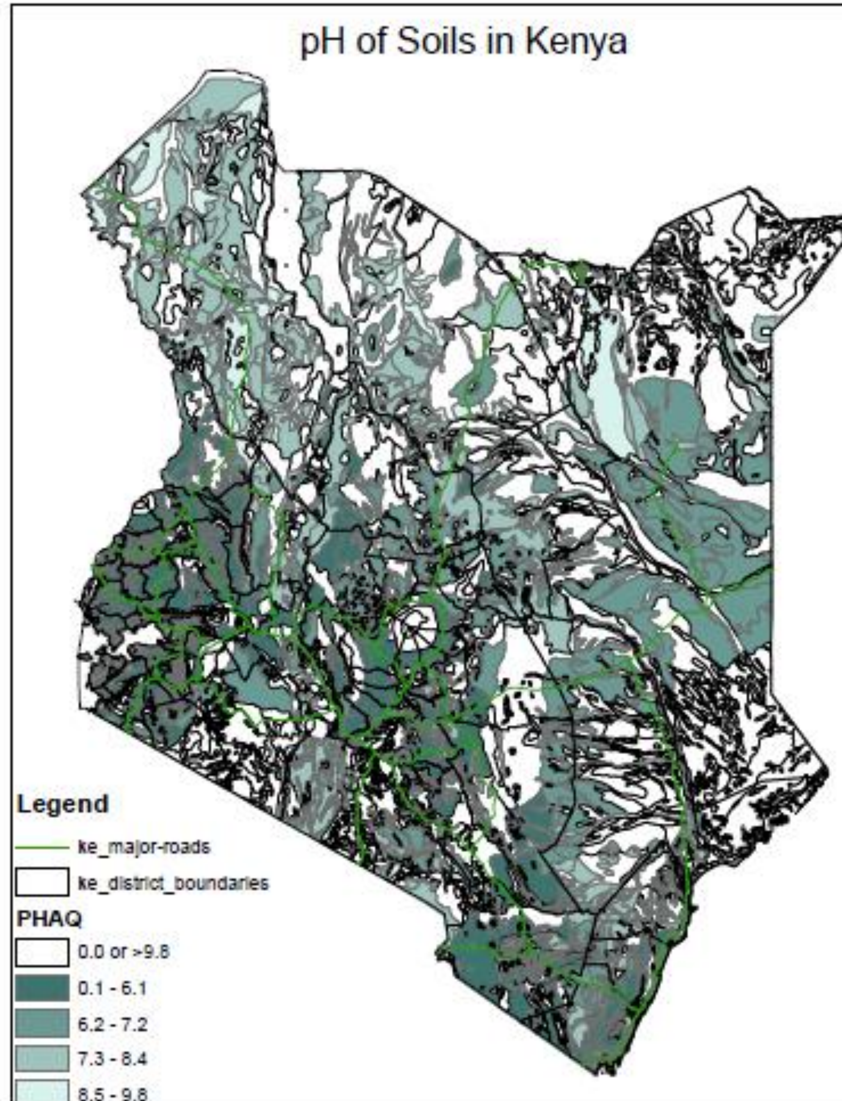
Source: MOALF, 2015



Arable land 10-15% of total land area

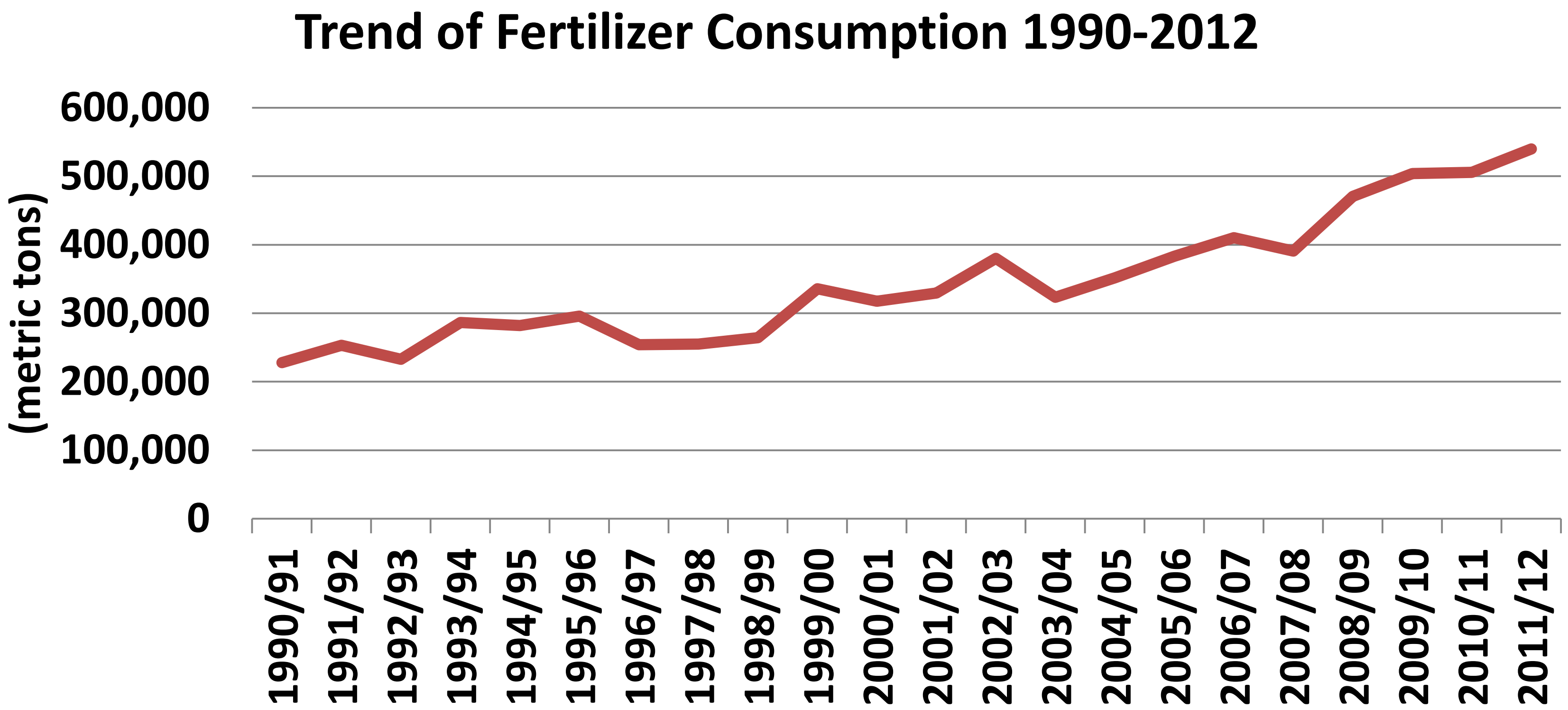


Crop productivity within the country



Most soils are acidic

Fertilizer Usage in Kenya



- Use estimated to be at an average of 24kg/ha of arable crop land
- Major types of Fertilizer: DAP, CAN, TSP, NP’s, UREA, some NPK’s
- Small holder (40%); Commercial estates/large scale (60 %)
- Only 7% out of the total fertilizer usage is K based and limited to specialty crops

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Estimated Average Fertilizer Use by Crop Category (2008/09-2010/11)

Crop Group	Metric Tons	As % of Total Use
Cereals	365,357	74.7%
Tea	63,023	12.9%
Coffee	26,902	5.5%
Tobacco	542	0.1%
Horticulture	32,979	6.7%
Total	488,803	100.00%

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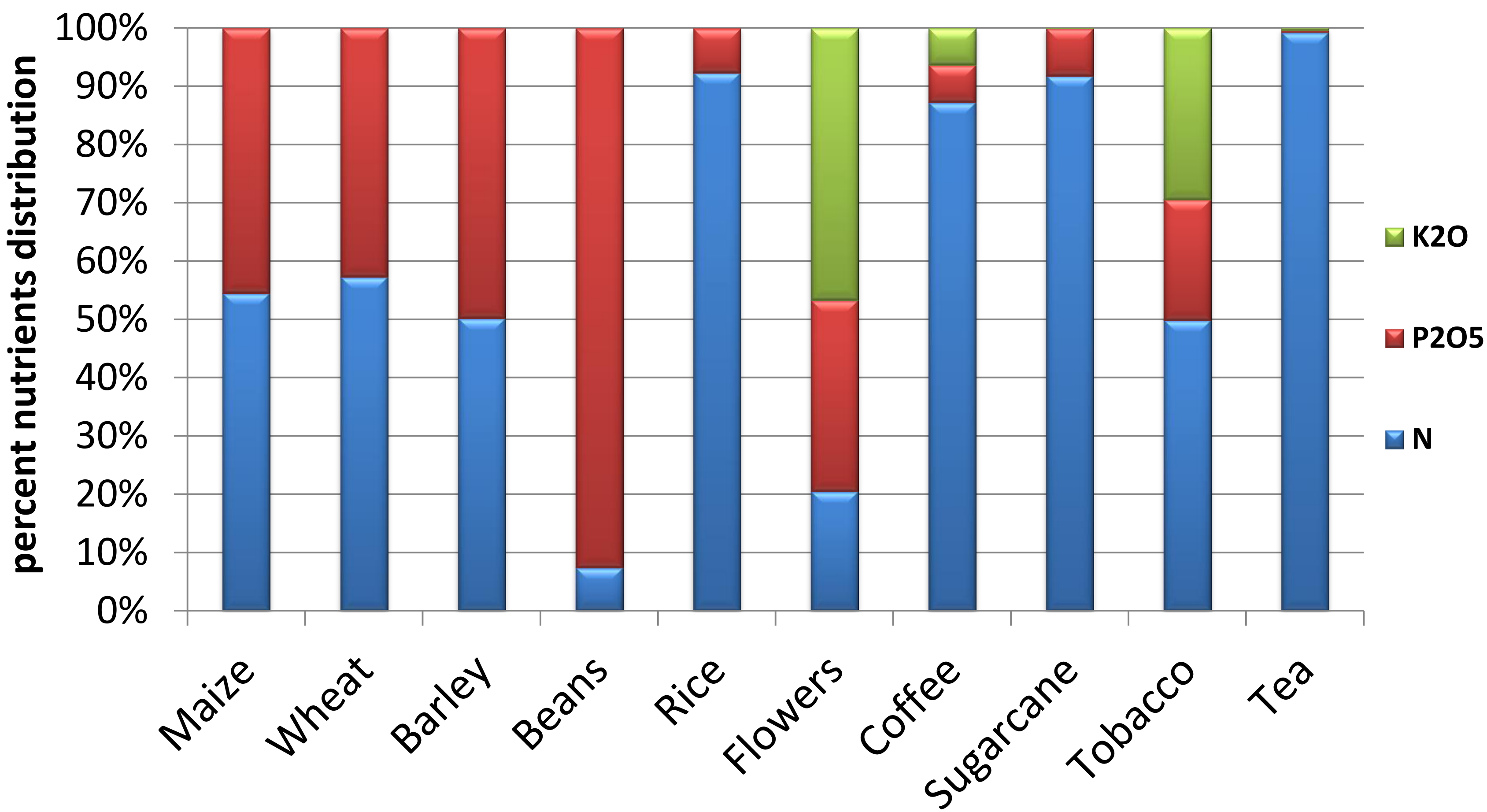
Source IFDC report 2012, 2014

Distribution of nutrient usage per crop



Source: MOALF, 2015

‘Crop productivity in Kenya on a gradual decline’

(ICRAF, 1997)

Causes of declining crop productivity

Net negative balance between nutrient losses and gains-Nutrient mining

- Intensified continuous cultivation without adequate nutrient replenishment
- Losses through leaching and erosion
- Sole continuous use of N and P based fertilizers
- Depletion of key nutrients like K, Ca and Mg without replenishment

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Potassium in soils of Kenya

Historical perspective

- 1960-70's:
  - none, low or negative responses to addition of K Fertilizers (MOA, 1969, 1970, 1975)
  - No benefit from K fertilization (Hinga and Foum, 1972)
  - Kenya fertilizer recommendations to date dominated by N and P

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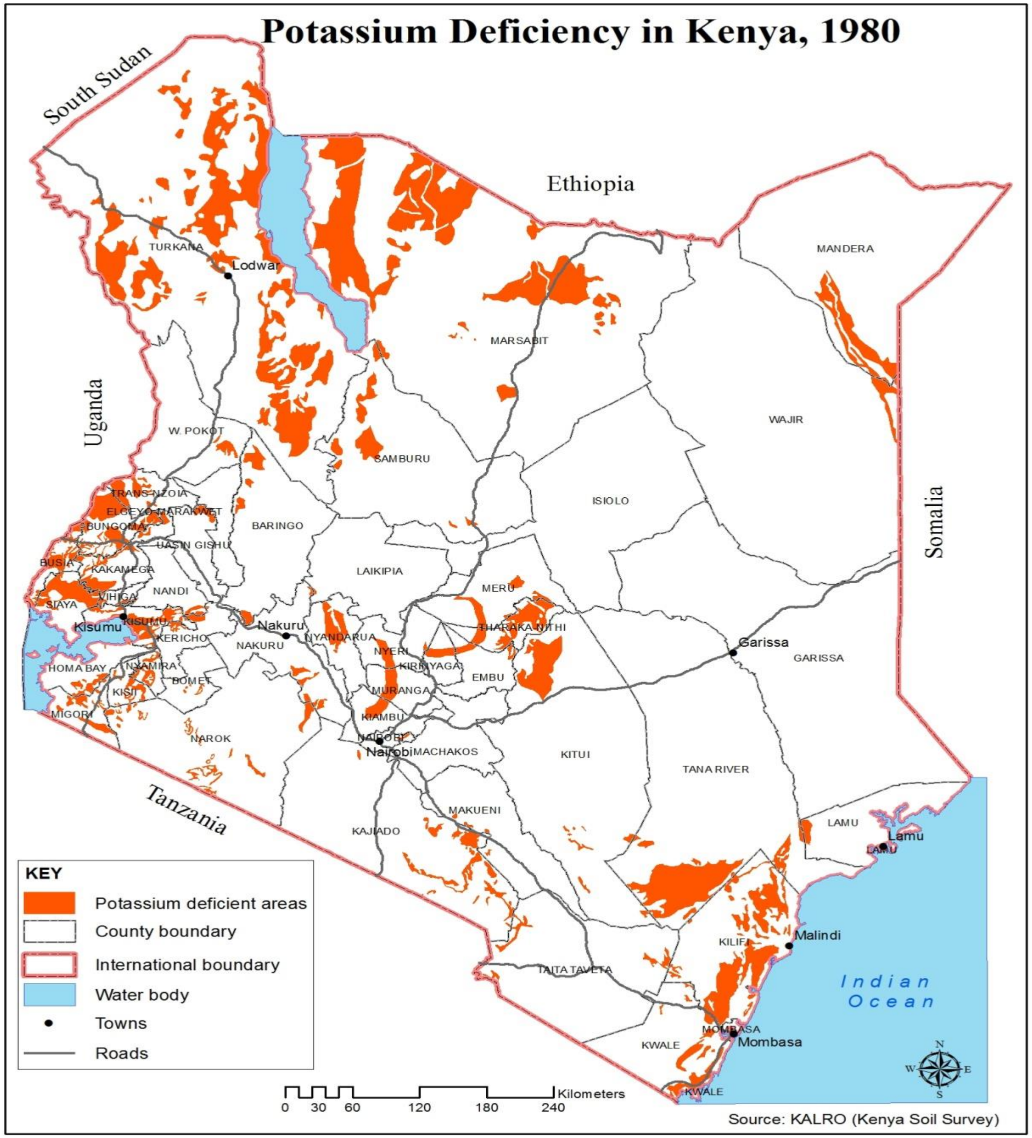
- 1980-90's:
  - Soil analysis data showing K deficient zones in Kenya
  - Research highlighting K declining status and crop responses (Nandawa, 1988; Mochoge, 1991; ICRAF 1995; Kanyanjua, 1999)

70 kg ha-1yr -1

K-depletion rate

Source: (Smaling et al., 1993)



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RESEARCH HIGHLIGHTS ON SOIL ANALYSIS K STATUS IN KENYA

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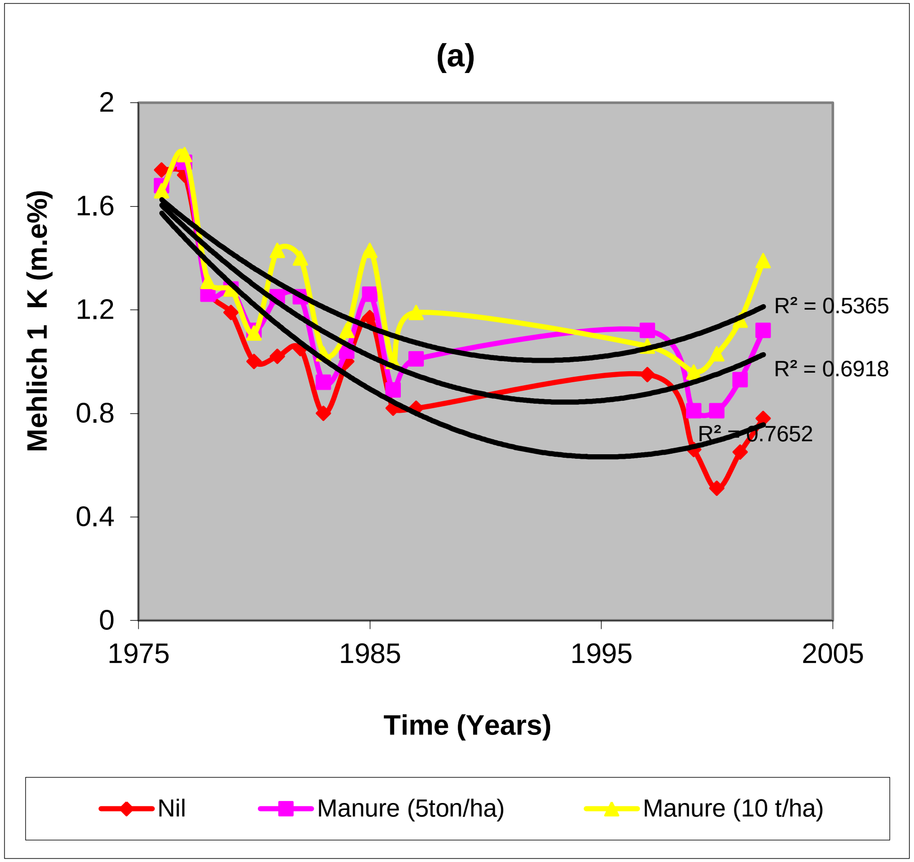
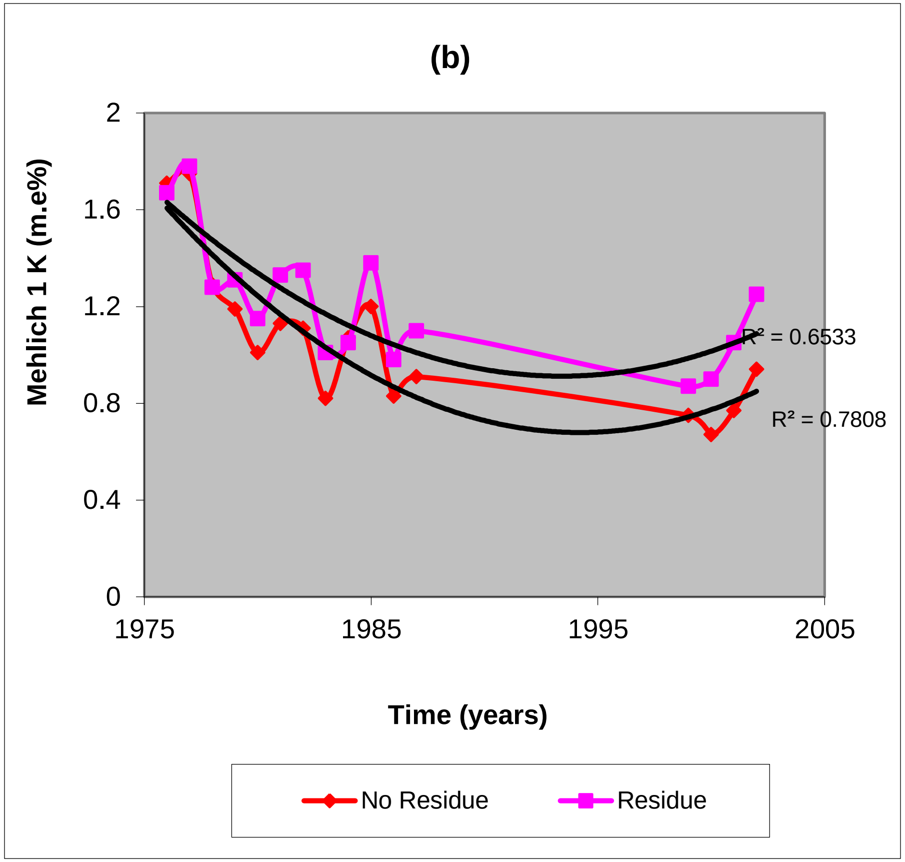
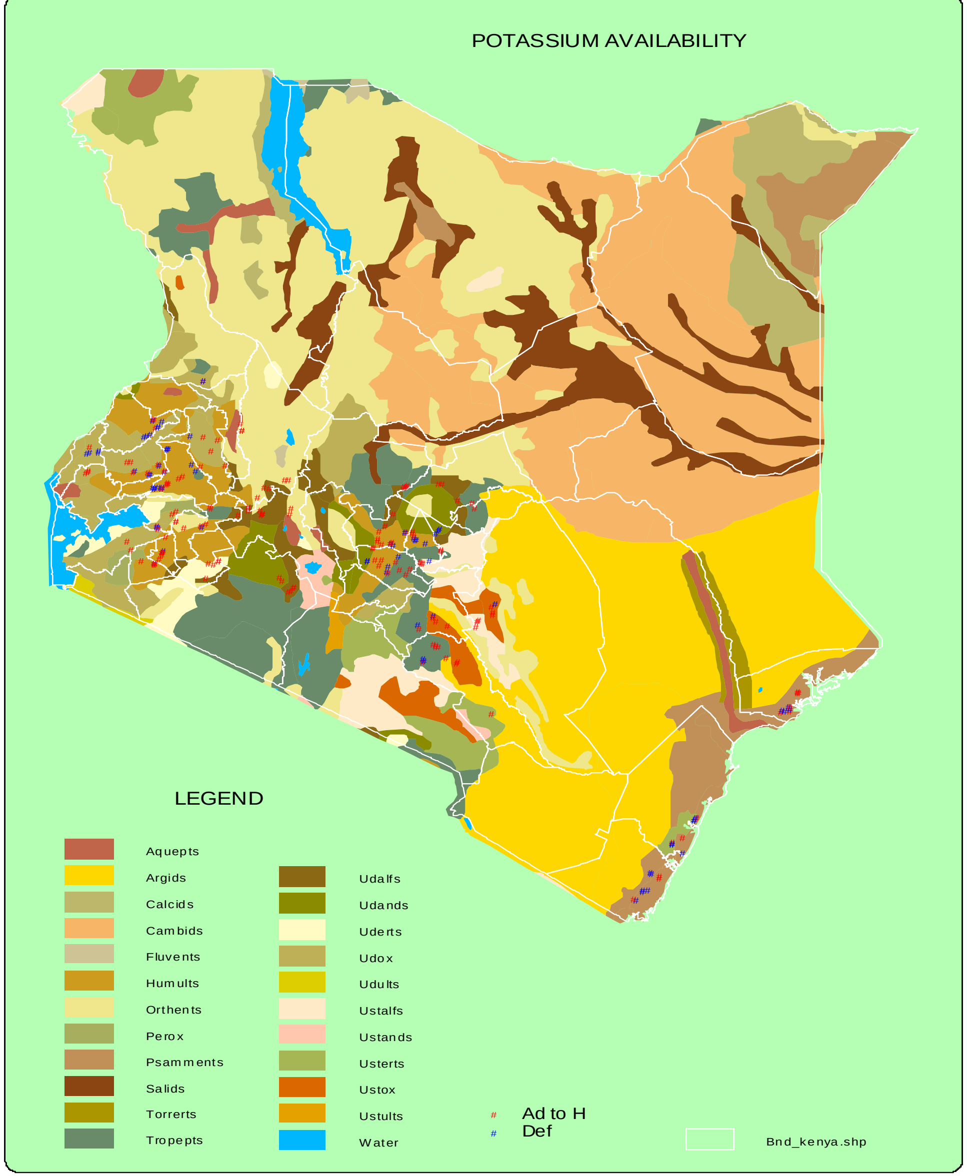


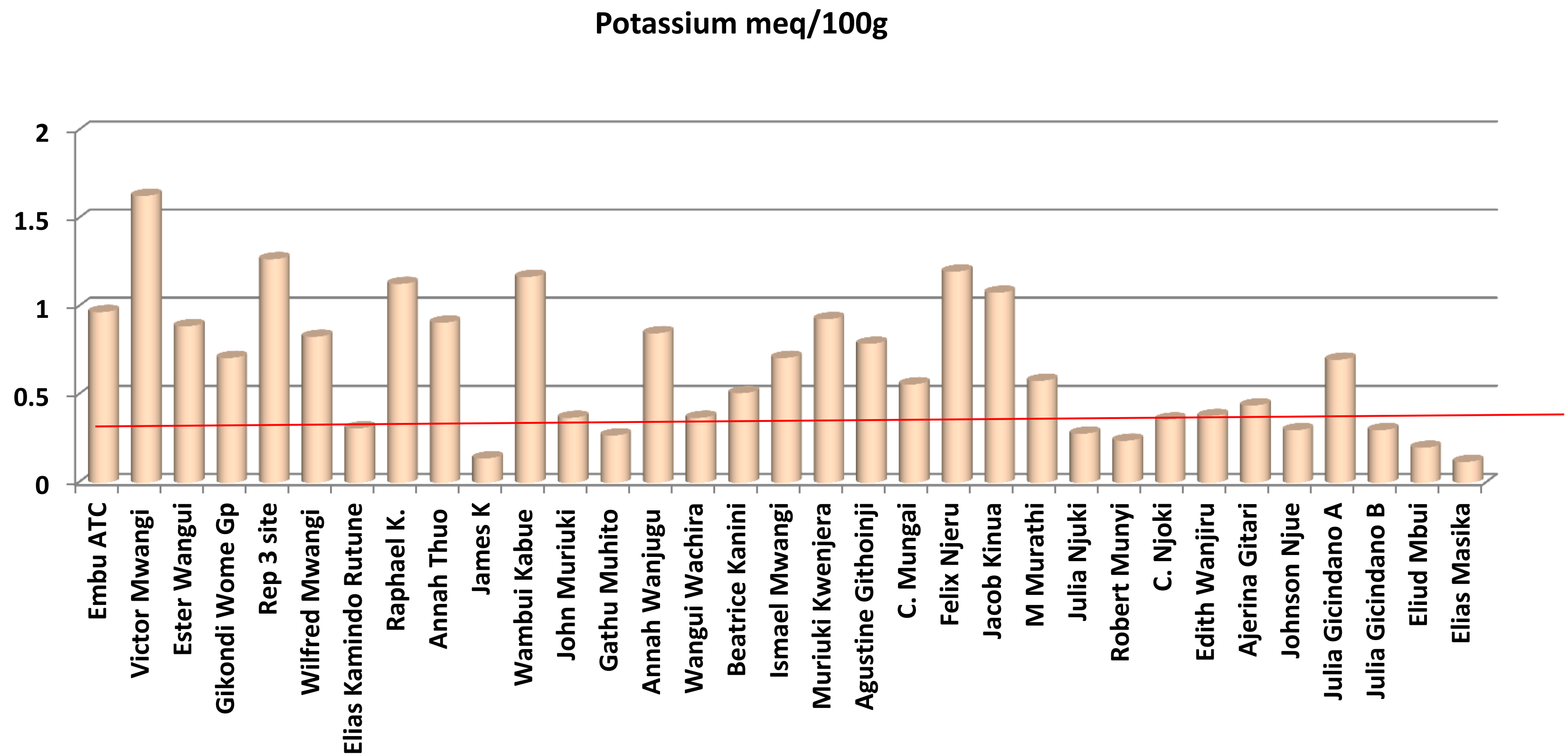


The trend of Exchangeable potassium levels based on long-term maize continuous study at the KARLO-Kabete Research station (1976-2005). (Kibunja, 2015, unpublished data)



2002: Map showing K adequate and deficient regions in high and medium potential zones of Kenya (30% sites with K deficiency)

(Gikonyo et al., 2002)



2002: efficient nutrient utilization in central Kenya

30% sites were K deficient

(Gikonyo et al., 2015)

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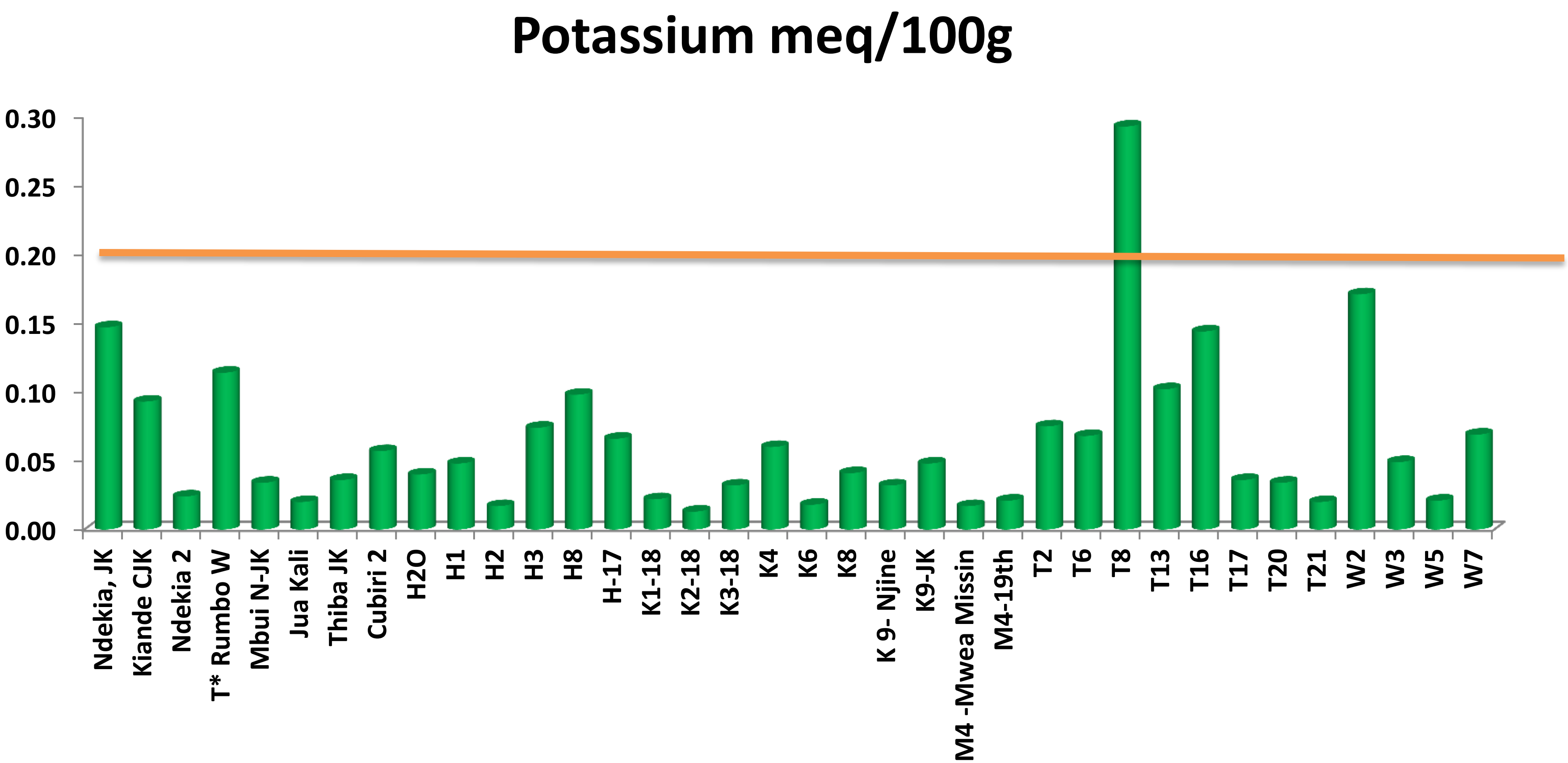

2002: Situational analysis of rice production in Mwea irrigation scheme

– Almost 100% K deficiency (<0.2 meq/100g soil)

(Gikonyo et al., 2012)

- 2006: Study on mapping of K deficient zones and relationship between the geochemical and mineralogical properties of parent rocks, bases exchangeable Ca^{2+}, Mg^{2+} and K^{+} in soils, and K distribution in the soil phases at different sites
  - Identified two zones under different geochemical mineralogical properties for K response study

(Kanyanjua et al., 2006)

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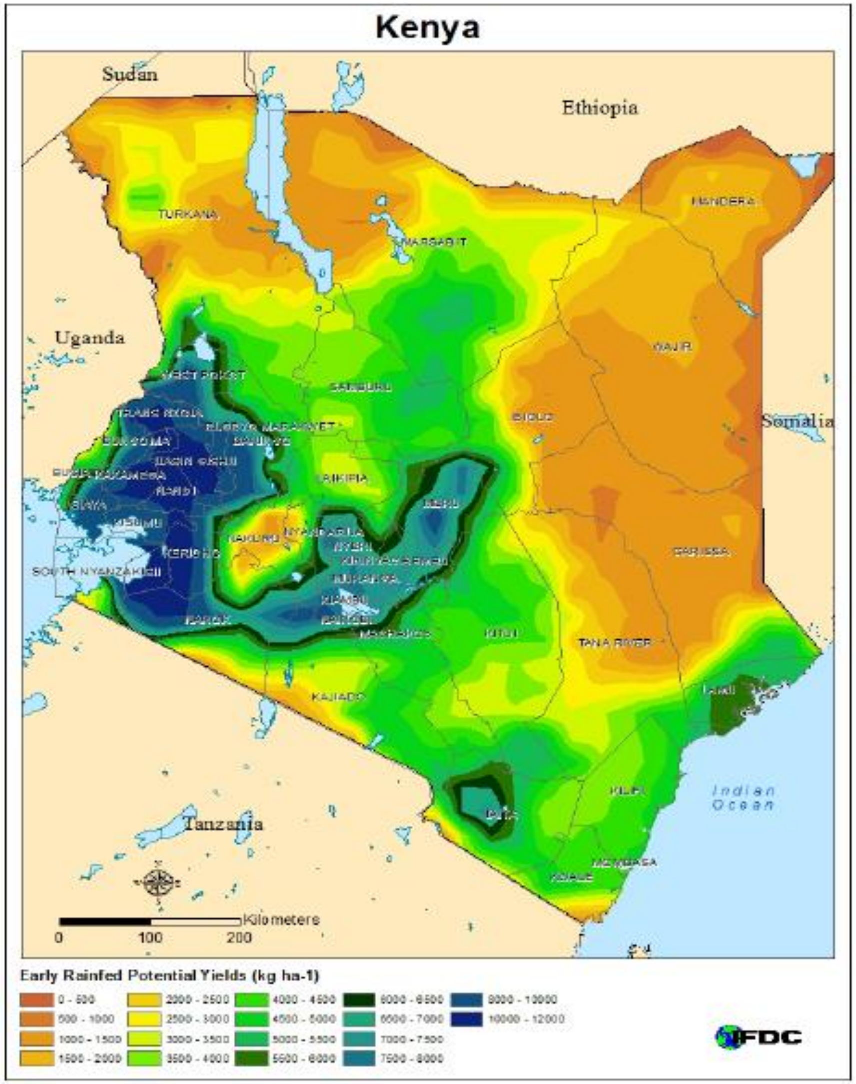

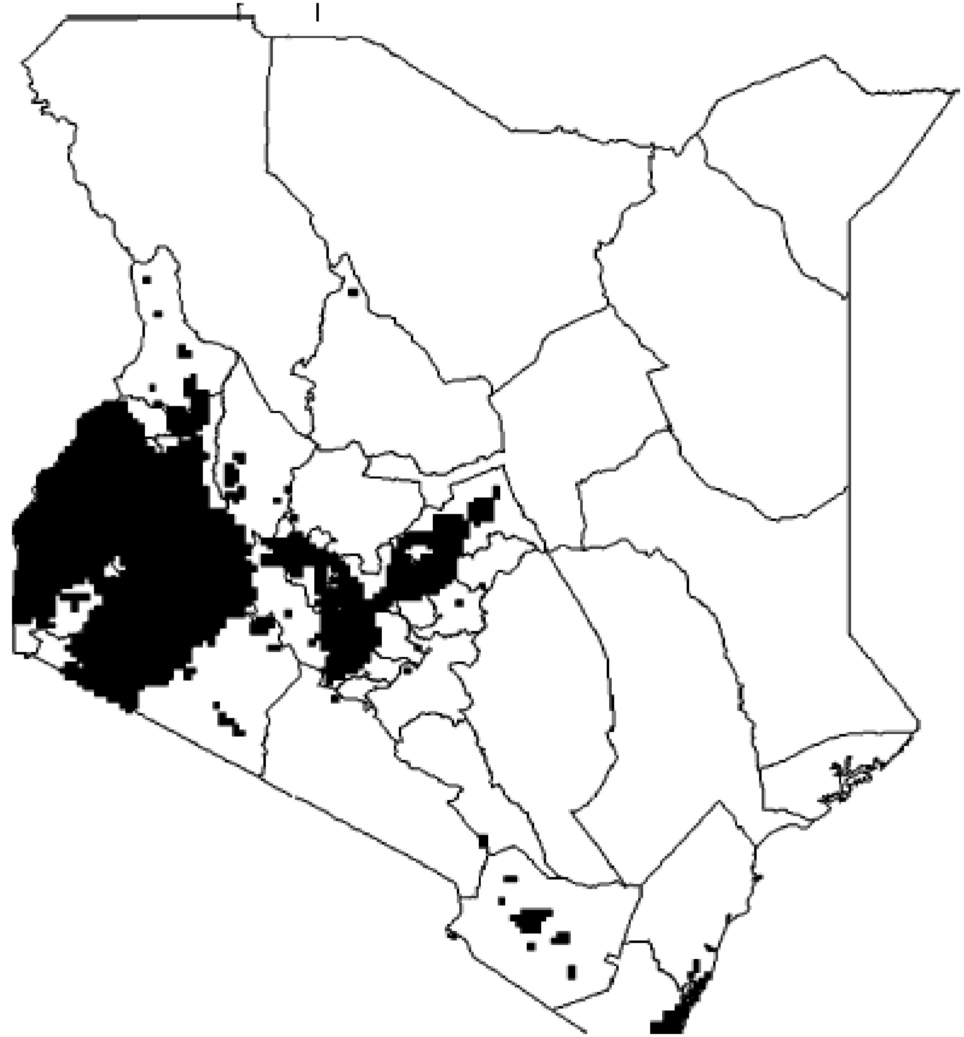

Mapping study identifies western Kenya as a potential K deficient region

(Kanyanjua et al., 2006)

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Location and selected agro-climatic characteristics of study sites

Site	District	Location*	MAI† (r/Eo)	Landform, slope	Alt‡ (m a.s.l.)	Parent rock§	Soil classification‖
SGA							
Itare	Gucha	0°49S 34°43E	.928	Upland, 12%	1617	Basalt	Typic Paleudoll
Keumbu	Kisii	0°48S 34°54E	1.312	Upland, 13%	1986	Trachyte	Typic Palehumult
Ndanai	Nyamira	0°48S 34°58E	1.293	Upland, 19%	1930	Rhyolite	Ultic Paleudoll
NGA							
Ebukanga	Vihiga	0°05N 34°36E	1.066	Upland, 16%	1440	Granite	Haplohumic Eutrorthox
Yala	Siaya	0°07N 34°31E	1.039	Upland, 4%	1439	Rhyolite	Typic Rhodudalf
Kabula	Bungoma	0°29N 34°33E	.908	Upland, 3%	1373	Granite	Plinthaquic Tropudult

- Northern geomorphic area (NGA) sites with significantly low levels of K than SGA
- 65-100% of different samples in sites within NGA showed K deficiency

(Kanyanjua et al., 2006)

Findings

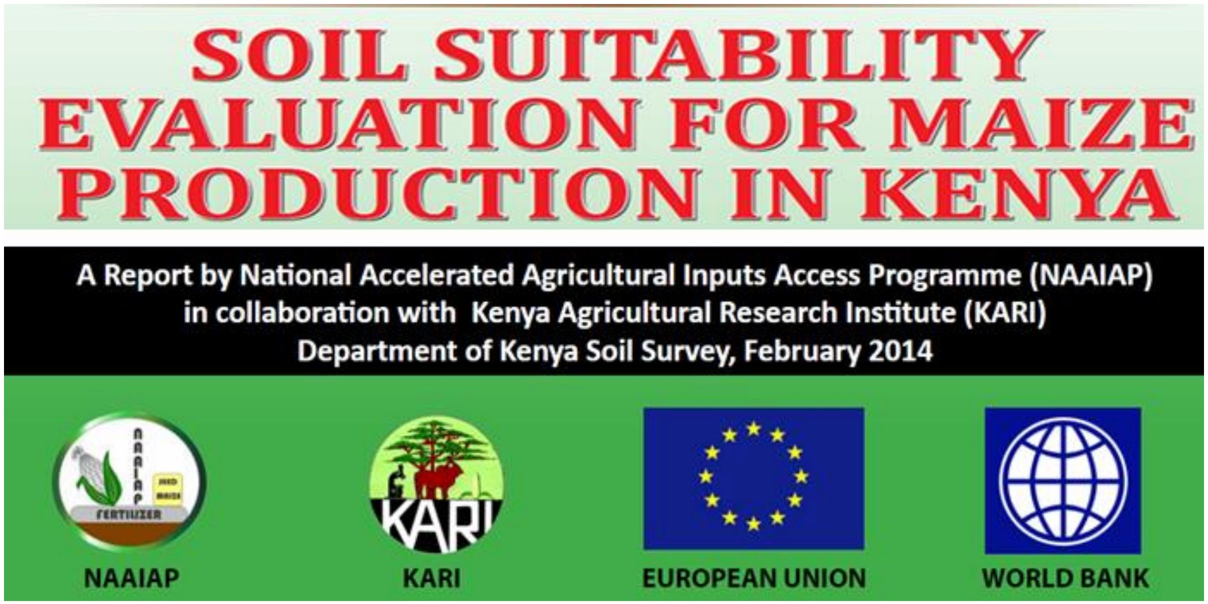
- However, NGA with low K levels showed no response to K fertilizer
- Two out of six SGA sites with adequate levels showed response despite high exchangeable K levels

(Kanyanjua et al., 2006)

- Hypothesis on low K response in the NGA sites
  - Low exchangeable Ca and medium Mg
  - Higher probability of K fixation
  - High prevalence of witch-weed
- Recommendations
  - K fertilization at a rate of 25kg/ha for the area with K deficiency
  - Highlighted the need determine appropriate soil K analysis method that better reflect the crop needs
  - Highlighted critical interacting factors that should be considered in K responses in soils of Kenya

(Kanyanjua et al., 2006)

Recent relevant output on K

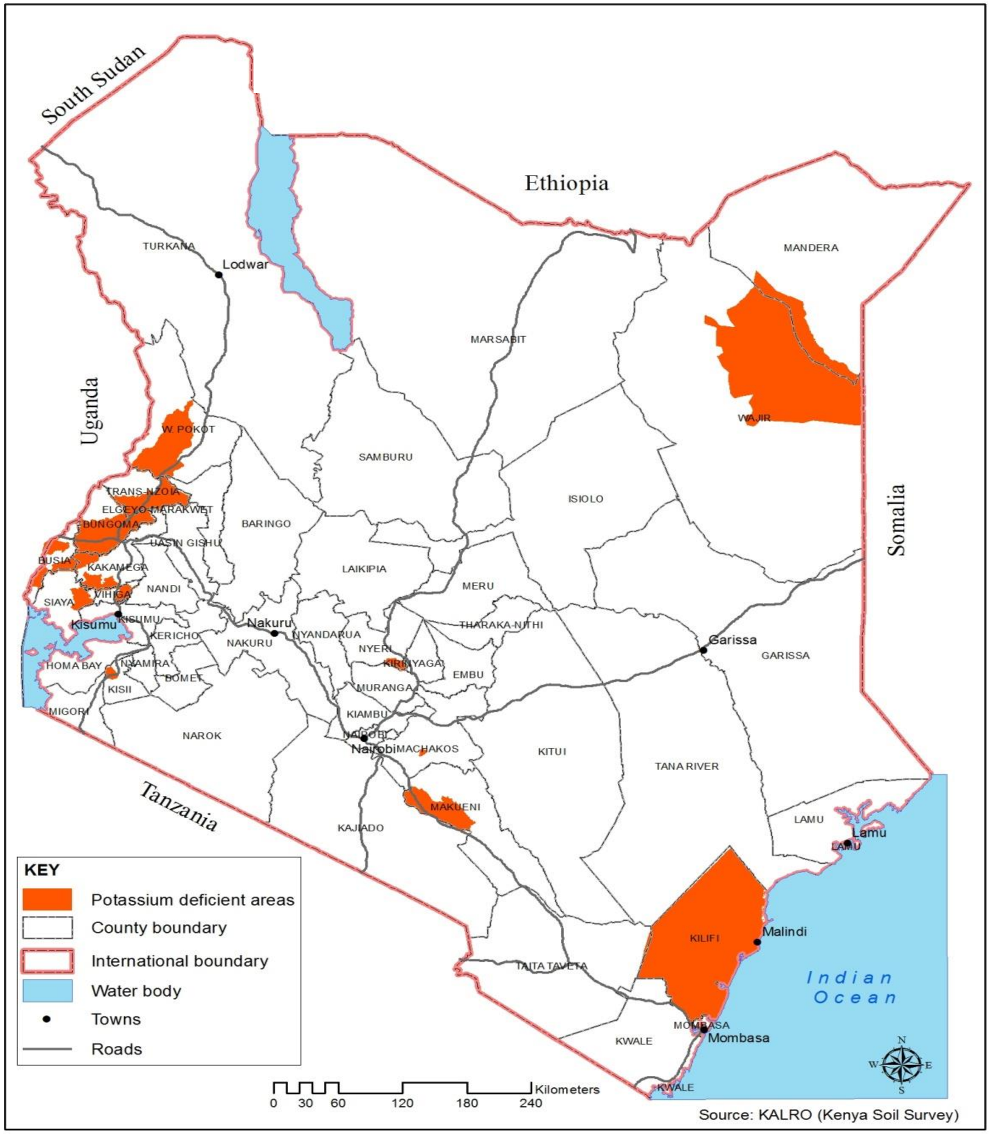

SOIL SUITABILITY EVALUATION FOR MAIZE PRODUCTION IN KENYA

A Report by National Accelerated Agricultural Inputs Access Programme (NAAIAP)
in collaboration with Kenya Agricultural Research Institute (KARI)
Department of Kenya Soil Survey, February 2014

NAAIAP
KARI
EUROPEAN UNION
WORLD BANK

- As expected that N and P were limiting factors
- **The survey revealed several regions in Kenya with K, Ca and S and some micro-nutrient deficiencies**
- **Recommended 200-300kg of NPK 17:17:17 in the regions found to be K deficient**
- The results of the report triggered the start of blending and govt. campaign including fertilizer subsidies towards ‘balanced fertilization’ to include K in basal fertilizers for maize

Potassium deficient zones for maize production



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Research gaps

- Need to understand the K dynamics in soils of Kenya i.e. interactions between different factors
- Need to carry out nutrient response studies to guide fertilizer recommendations towards balanced nutrition for different crops
- Refining the K-extraction methods to improve on recommendations
- Need to determine best sources of potassium in terms of practicalities
- Economic study on the best options of K fertilizations

Summary

- Studies show K status on the decline in many regions
- Need to rethink current fertilizer recommendations of major food crops from mainly N and P
- There is clearly a huge potential for research and development of K fertilization in Kenya

Acknowledgements

- Kenya Agricultural and Livestock Research Organization (KARLO)
- International Potash Institute (IPI)