

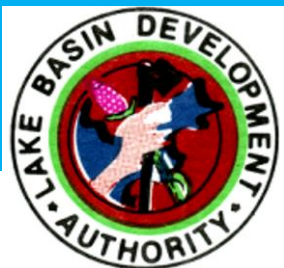
Patterns of land use and land cover change in western Kenya, 1983 - 2013

A presentation at:
CREATE Workshop Botanical Garden, Maseno
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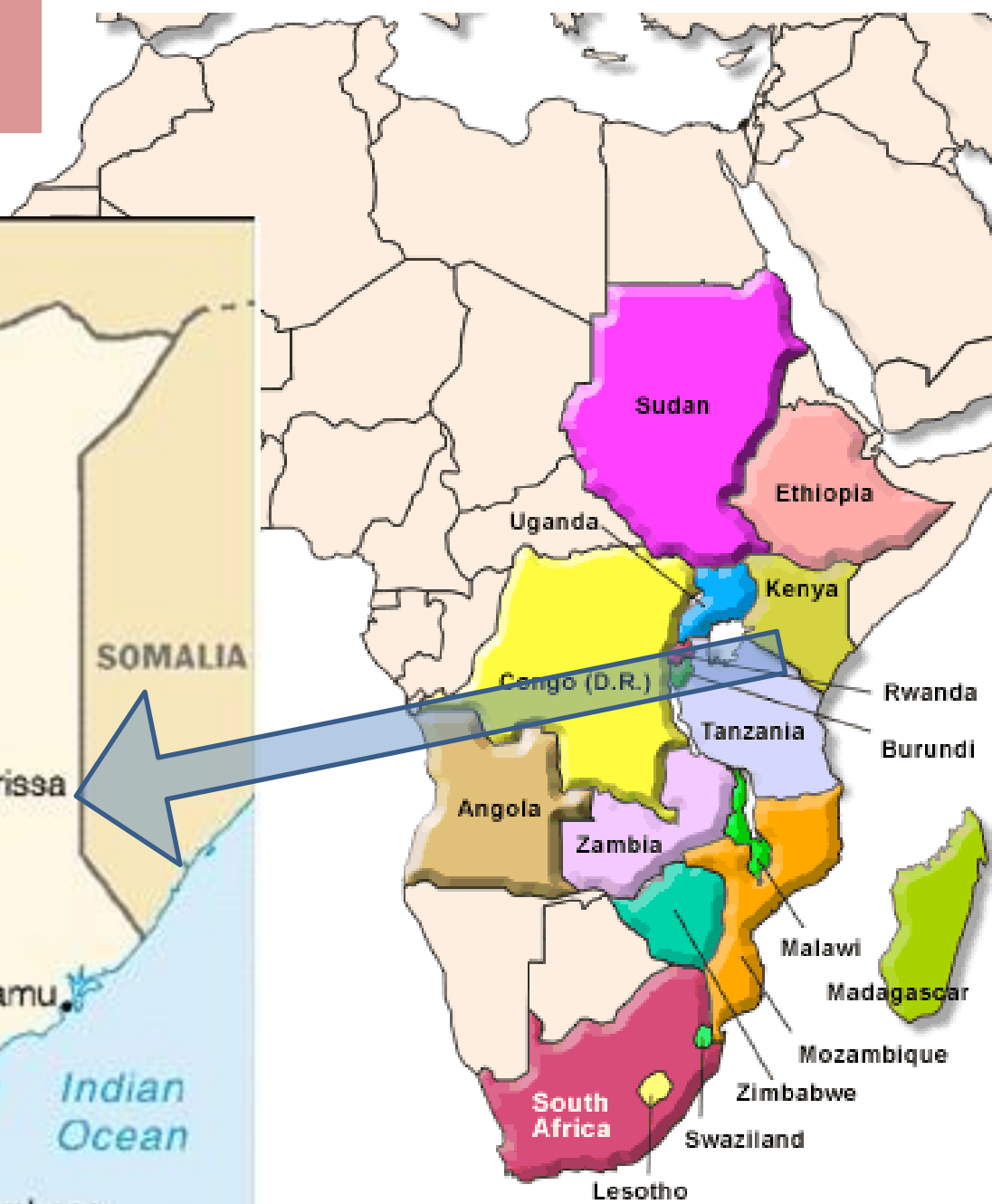


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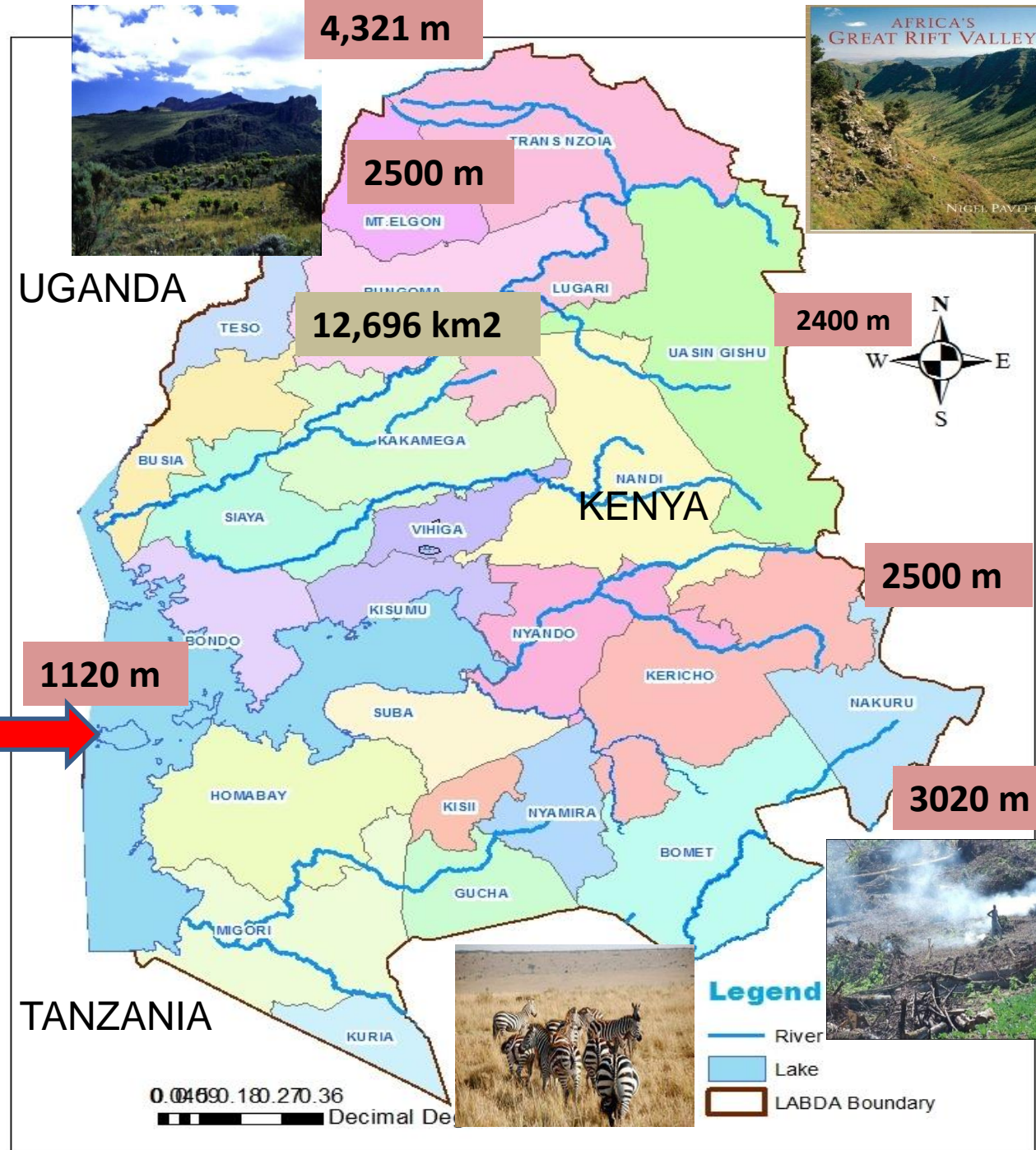
World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

Location



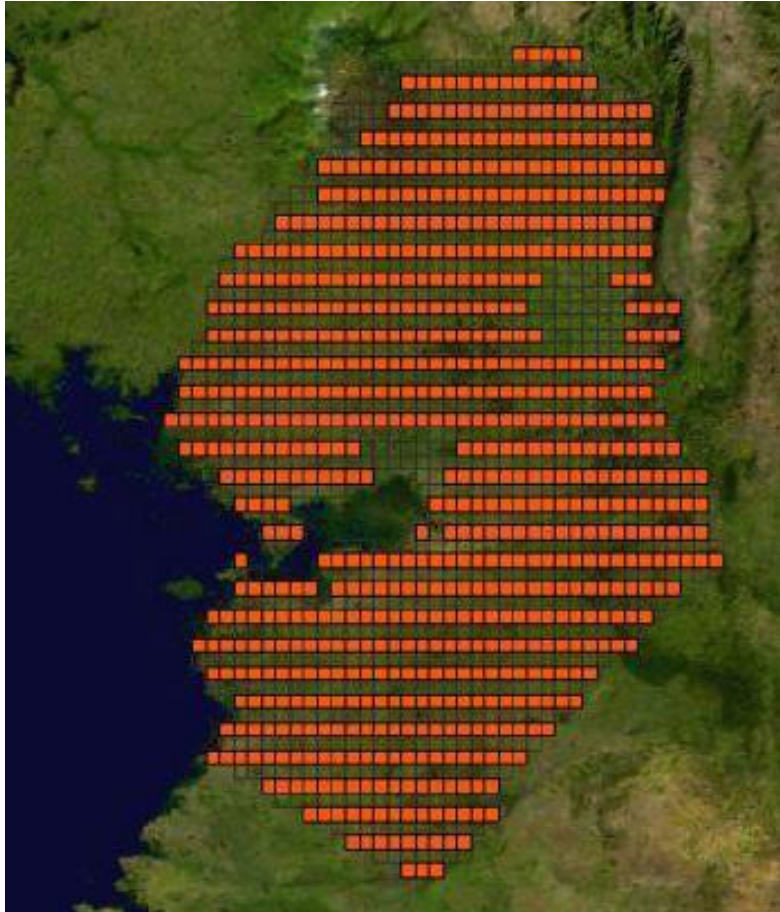
The LBDA Area in Western Kenya

- LBDA was established in 1979 under the Act of Parliament (Cap 442)
- Mandated to **Plan, Coordinate, Implement, Monitor and Evaluate** development projects and programmes (39,000 Sq Km)
- Carried out an ILUS as an Aid to Dev. Planning (Ecosystems Ltd)
- Patterned with ICRAF



Methodology

Areas Sampled with High Resolution Aerial Photography in both 1983 and 2013



1. In 1983, land use and land cover across the entire LBDA area was surveyed using high resolution (~6cm), colour sample photography as an aid to development planning.
2. In 2013 the area was resurveyed using the same methodology to quantify changes in land use and land cover over the last 30 years.
3. Each photograph is exactly geo-referenced and has a time and date stamp

Some findings 1983 – 2013

1. Population and House Density

	1983 # km⁻²	2013 # km⁻²	% Change	Number
Population	153.6	322.2	+110%	+6,447,793
Traditional Roofs	122.9	53.2	-57%	-2,663,900
Modern Roofs	28.7	171.5	+499%	+5,461,588
% Modern Roofs	19%	76%		

- There has been a > 100% increase in population density, from 154 people km⁻² to 322 people km⁻², an increase of over 6,400,000 people.
- The housing stock has also improved markedly, with 76% of all structures having modern roofs compared with only 19% 30 years ago.

Western Kenya 1983 – 2013

2. Expansion of Agriculture

	1983 Ha km ⁻²	2013 Ha km ⁻²	% Change	Hectares
Agriculture	45.9	70.2	53%	+928,485
Natural Vegetation	49.9	23.7	-53%	-1,001,877
Natural Tree Cover	12.3	7.2	-41%	-193,801
Natural Herbaceous Cover	31.0	8.8	-72%	-851,653

- Accompanying this major increase in population density has been a significant increase in the area under cultivation of over 928,000 hectares at an annual rate of 1.4 % a⁻¹.
- Agriculture has expanded at the expense of land previously classified as being under "natural vegetation" which has been converted to agricultural use.
- However, the main conversion has been from natural herbaceous cover rather than from natural tree cover

Western Kenya 1983 – 2013

3. Loss of Tree Cover

	1983 Ha km ⁻²	2013 Ha km ⁻²	% Change	Hectares
Natural Tree Cover	12.3	7.2	-41%	-193,801
Agro-forestry "managed" tree cover	7.8	11.0	+42%	+125,760
Total Tree Cover	20.1	18.2	-9.5%	-68,041

- Over the last 30 years there has been a modest loss of tree cover, from 20.1 ha km⁻² to 18.2 ha km⁻², a total loss of 68,000 ha of tree cover.
- It is clear that the natural tree cover is being largely replaced by "managed" tree cover, also known as agro-forestry.
- The cover of agro-forestry has increased by 42% over the last 30 years, from 7.8 ha km⁻² to 11.0 ha km⁻².

Western Kenya 1983 – 2013

4. Impact of Land Tenure on the changes

- Land tenure has a major influence on both the rate and the trajectory of development.
- We distinguish here between unadjudicated land, with no formal tenure, and adjudicated land with either freehold or leasehold tenure.

	Unadjudicated Land			Adjudicated Land		
	1983 Ha km ⁻²	2013 Ha km ⁻²	% Change	1983 Ha km ⁻²	2013 Ha km ⁻²	% Change
Agriculture	22.8	46.2	+103%	55.2	77.5	+41%
Total Tree Cover	16.0	8.1	-50%	16.0	16.4	+2%
Natural Tree Cover	14.0	3.6	-75%	6.4	2.2	-66%
Agro-forestry "managed" tree cover	2.0	4.5	+121%	9.6	14.2	+48%

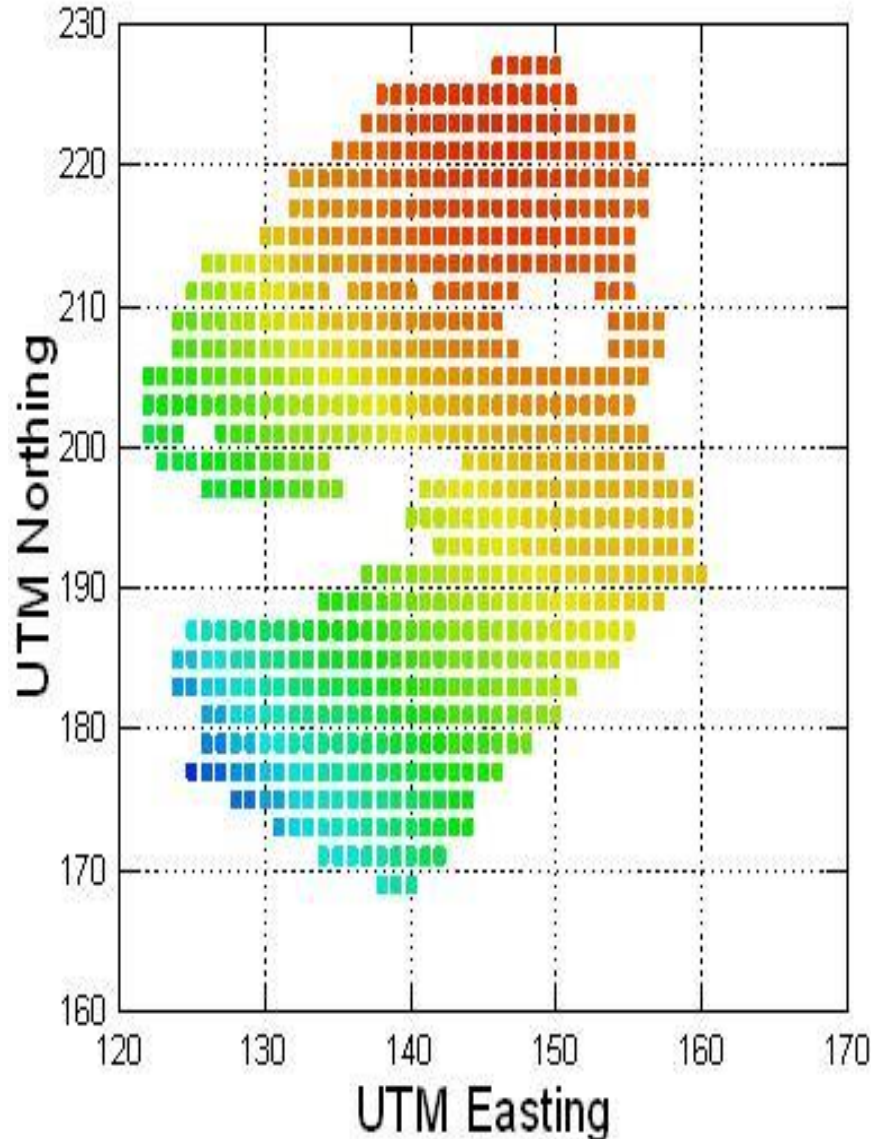
- In terms of agricultural development, while the rate of increase is greater on the unadjudicated land (103%) compared with adjudicated land (41%), the actual cover density of agriculture in 2013 of 46.2 ha km⁻² is still less than the 56.2 ha km⁻² on adjudicated land 30 years ago.
- This means that lack of adjudication seems to be holding back development by some 30 years.

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- The loss of tree cover is also closely related to land tenure.
- 30 years ago the total tree cover on adjudicated as compared with unadjudicated land was about the same (16.0 ha km⁻²).
- 30 years on, the unadjudicated land has lost 50% of its tree cover while tree cover on the adjudicated land has slightly increased.
- The difference is due to the uptake of agro-forestry which, on adjudicated land, has more than made up for the loss of natural tree cover.

Western Kenya 1983 – 2013

5. Decadal Change in Temperature (°C)



Decadal Temperature Change (°C)

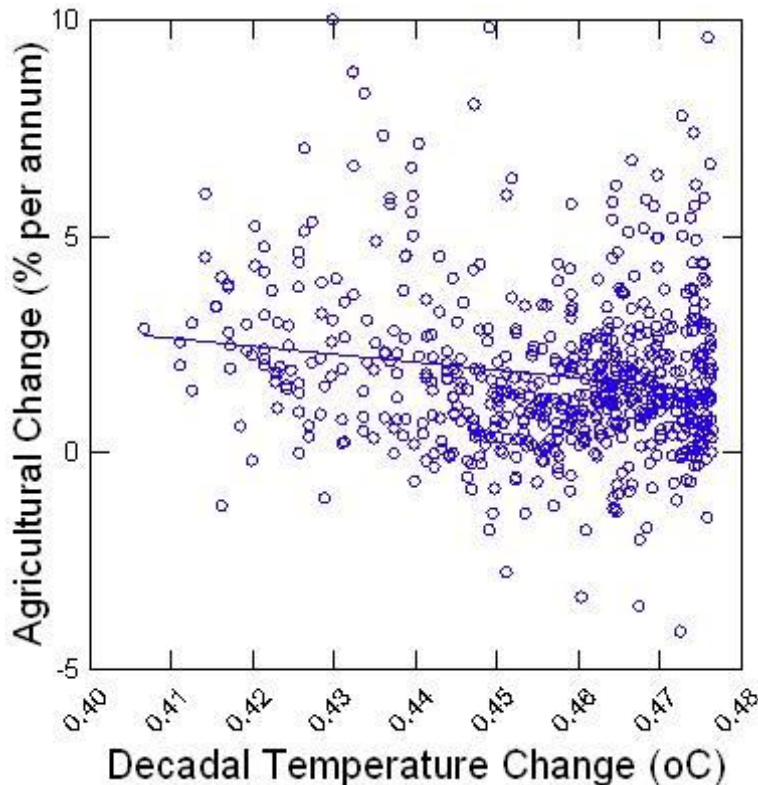


- Data from FEWS (Famine Early Warning System) demonstrate strong climate trends across western Kenya.
- The mean decadal change in temperature between 1983 and 2013 shows a strong gradient of increasing temperature from the south-west to the north-east.

Western Kenya 1983 – 2013

6. Decadal change in temperature and rate of change in agriculture

- OLS regression: $y = 30.9 - 66.8 * x$ ($t = -2.4$ $p = 0.02$)



- A regression analysis of the rate of change in agricultural expansion ($\% a^{-1}$) against the decadal change in temperature shows a slight negative relationship, with the rate of agricultural expansion being lower in areas of higher decadal trend.

Conclusion

- We can Conclude that;
- Expansion of Agriculture is at the expense of natural vegetation being turned into natural herbaceous cover rather than tree cover and this has implications on elements of climate
- As the population increases, Land tenure and decadal temperature changes negatively influences flexibility of agricultural change and this has implications on food security in the basin

Thank you