



University of Dar es Salaam



Land systems science and history

Presentation at the 3rd LaSys Workshop,
Tune Kursuscenter, 2007-10-25
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Disciplinary background

Human Geography, Historical Geography,
Landscape history

PhD on agricultural intensification in northern
Tanzania, 19th and 20th century

Current research project:

Northeast Tanzania 1850 – 2000: The political
ecology of trade networks, food production and
land cover change

Funded by the Swedish Research Council
& SIDA/Sarec

PLATINA:

People, Land and Time in Africa

- Interdisciplinary research group at
Stockholm University
- Department of Physical Geography and
Quaternary Geology
- Department of Human Geography
- Supported by SIDA/Sarec 2001-2006

www.humangeo.su.se/platina

Land use/cover change research

- three general concerns
- history central to all

1. **Mapping change:** documentation and
quantification of past land-use cover at different
temporal and spatial scales
2. **Explaining/understanding processes** of change
(at different temporal and spatial scales)
3. **Modelling** (testing, evaluating...)

Some critical challenges

Remote sensing (RS) data: covers last half century of
rapid changes (population growth, urbanisation...) –
"rapid change bias", i.e. need to link RS data to
other historical data sources.

Rindfuss et al (2004) points at:

Aggregation of data: need to match levels of
aggregation in measurement with those used in
theory. (i.e. mind the scale!)

Spatial–Temporal Mismatch of various data sources
(e.g. satellite images + historical sources (oral
history, archive data, historical maps...))

Validation of **historical data:** "a set of best practices is
needed" (i.e. mind the origin/context, biases,
comparability...)

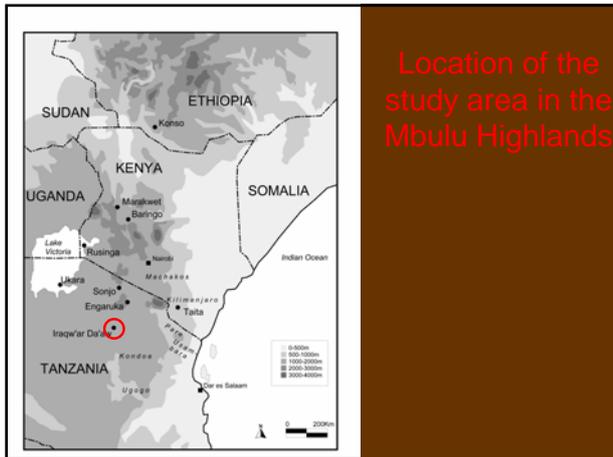
Historical data for African landscapes

- **Lack of data is a problem** – uneven global distribution
of historical data for land change studies => **biases in
global data sets on historical land use/cover.**
- Also a **methodological challenge** as regions with
sparse data and regions with rich data can not simply
use the same methods (**best practices?**)
- In Africa: historical **data is patchy** – local case
studies, oral history, documentary sources... (**last
100+ years**)
- Need for **regional data sets** – as well as long-term
historical data (**palaeoenvironmental data**)
- **Historical maps an underutilised data source:** data on
a regional scale. Can be compared with recent
regional data sets (**cf. Petit and Lambin 2002**)

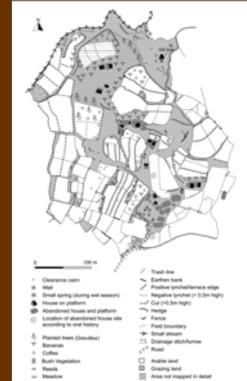
Four empirical examples: different scales – different methods/data

1. Local landscape dynamics.
2. Matching hard science data and historical geographical theory
3. Extracting vegetation and land-use data from an early 20th century colonial map to produce a regional data set.
- (4. Visual interpretation of Landsat data – mapping change at a regional scale.)

1. Agricultural intensification as “its own driving force”

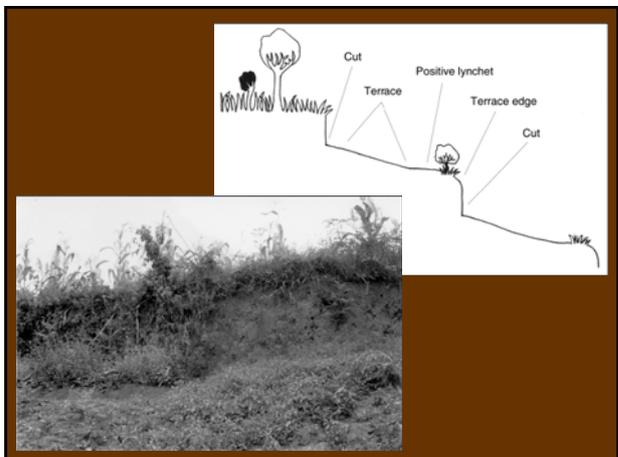


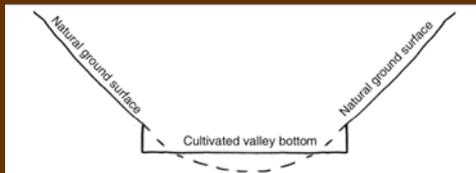
Detailed landscape study



Incremental change

- (W. E Doolittle, 1984)
- **Systematic changes** – new additions (fields, structures), made prior to cultivation
- **Incremental changes** – gradual transformations, in conjunction with cultivation => a gradual accumulation of **landesque capital** => increased productive capacity (but, marginal extra labour inputs)
- **Boserup backwards**: processes of agricultural intensification also attract people





Using theory as compensation for lack of data

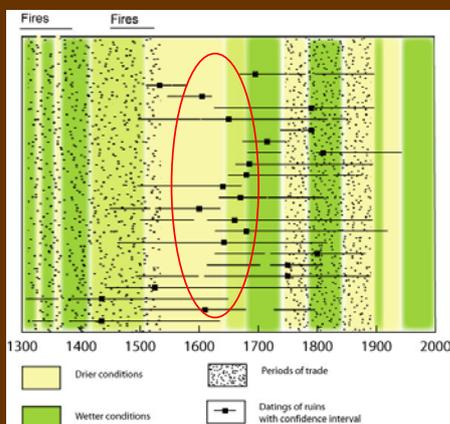
- “No” data for the 19th century – but a prominent theory
- **Previous historiography:** observed intensive farming practices explained by a “siege hypothesis” (“necessity is the mother of invention”)
- But, oral history also tell of: **large scale in-migration** and frequent **trade and exchange** – not just subsistence farming
- Historical drawings, photographs and maps – no clear evidence of a siege situation
- **Detailed historical study** => Understanding of dynamics, improved theories of land change => **new explanation of land change.**

2. The rise and fall of Engaruka, northern Tanzania



Location of Engaruka

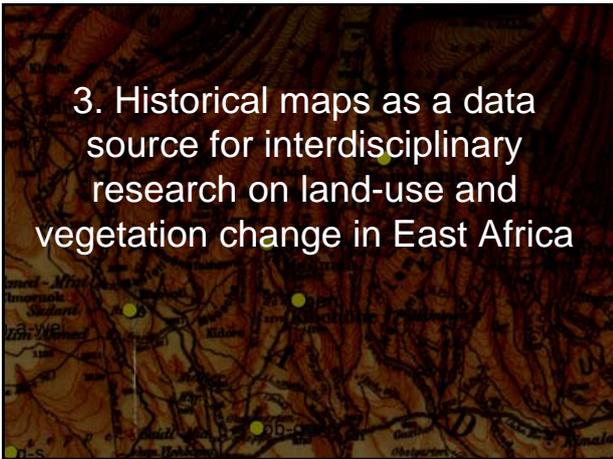
– once a large-scale irrigation system (ca 20 sq km of irrigated land and 7-12.000 people at most)



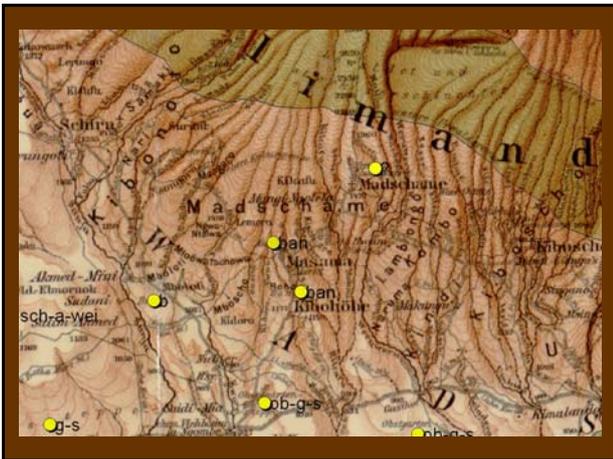
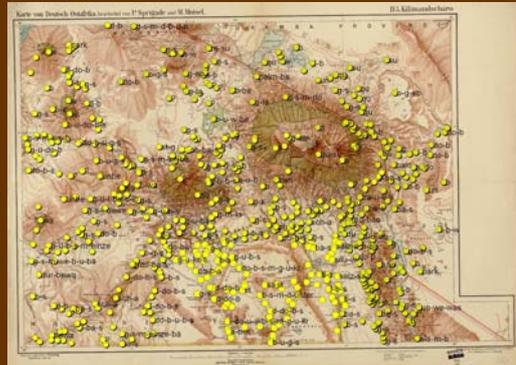
Explaining the growth of Engaruka

- **Climate** – not the only factor
- **Incremental change** (documented archaeologically, theory) – gradual build up of landesque capital (processes of soil formation, expansion of field system)
- **Regional exchange and trade** (e.g. with pastoralists and long-distance) – **geographical/regional labour division**, specialisation and economic integration... (some data, comparison with similar historical cases, theory)

3. Historical maps as a data source for interdisciplinary research on land-use and vegetation change in East Africa



Early 20th century vegetation / land use
 – extracted from a German map (publ. 1911)



What are we looking at?

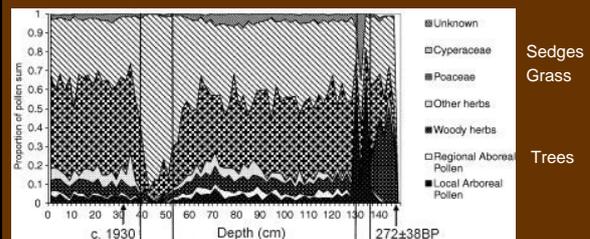
- A compilation of **different observations** over a few decades...more data in some places – less in others (**travel route bias**)
- **Late 19th century crisis** – Rinderpest killed most cattle, draughts, disease outbreaks, famines, warfare...
- ...**effects on vegetation**...
- To what extent does the maps represent an extreme situation?

Travel routes/expeditions marked and dated on the map

- c. **33 expeditions**
- **21%** from pre-crisis period
- **12%** immediately following the crisis (early 1890s)
- **24%** (late part of crisis period, late 1890s)
- **42%** (or at least **one third**) from post-crisis (recovery) period

Gillson, Lindsey: A 'large infrequent disturbance' in an East African savanna.
African Journal of Ecology 44 (4), 458-467.

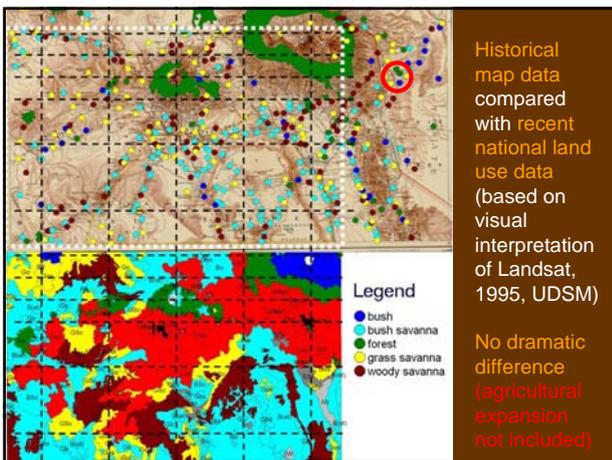
Synthesis of pollen data





Paleoecological vs. Map data

- **Paleoecological data:** drought, increased fires, sudden erosion following vegetation loss...but **rapid recovery**
- **No significant change in the grass : tree ratio** in the surrounding savanna
- **Map data matches mix of pollen** before and after the crises
- Hence, map data does not seem to reflect an extreme situation (**but only a local pollen record, thus uncertainty remains**)
- More palaeoecological studies are forthcoming...



Conclusions – how useful is the historical map data

- A number of **uncertainties remain** (effect of crisis), but more can also be done to improve the quality of the historical map data (**research on data contexts**)
- **Regional coverage**
- Relatively **easily accessible** historical data
- Can be compared with recent land-cover data (**but not without problems**)

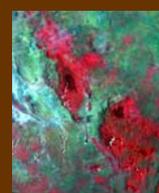
4. Tracing changes in Landsat images – a regional “fingerprint” of major land-cover changes

1. **Aim:** Identify major patterns of change (agricultural expansion)
2. **Region scale** = a handful of images (c. 5)
3. **Methodological constraint:** use a **rapid** but “good enough” method, i.e. avoid labour intensive procedures (e.g. fieldwork, image processing, classification). **Landsat archive...**
4. **Success criteria:** get a general picture of the spatial pattern of change in the region (**where are major land transformations taking place**)

1987-01-01



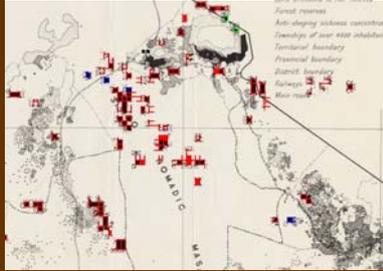
2001-03-04



- Method tested by using **open access** data of **diverse seasons**
- **Visual interpretation** in ENVI based on a 5 x 5 km grid
- Using images from the mid 1970s, 1980s and c. 2000.
- Validation?

Recent agricultural expansion compared with a population distribution map from the 1930s – Northeast Tanzania (prel. result)

- Minor changes in and around historical agricultural core areas
- Major change in former pastoral range lands
- A new regional political ecology



Land systems science and history – concluding remark

- **Data mismatch** – different methodologies needed for different purposes (aim of study)
- **Differences in scale** is perhaps more problematic than different disciplinary cultures.
- The importance of **historical thinking**, e.g. in Physical Geography (Massey 1999) and Ecology (Zimmerer 1994) – provides an important **common theoretical foundation** for interdisciplinary studies and opportunities for integrating historical analyses in Land systems science.

- Börjeson, L. 2004. *A History under Siege. Intensive Agriculture in the Mbulu Highlands, Tanzania, 19th Century to the Present*. Almqvist & Wiksell International, Stockholm.
- Börjeson, L. (2007). Boserup Backwards? Agricultural intensification as 'its own driving force' in the Mbulu Highlands, Tanzania. *Geografiska Annaler, Series B, Human Geography*.
- Westerberg, L.O., Holmgren, K., Börjeson, L., Håkansson, T., Laulumaa, V., Ryner, M., Oberg, H. (accepted after revisions) "The development of the ancient irrigation system at Engaruka, Northern Tanzania. Physical and societal factors". *Annals of the Association of American Geographers*.
- Börjeson, L. (Submitted for review) Extending the baseline – a historical map as a data source for interdisciplinary research on land-cover change in East Africa. *African Journal of Ecology*.