Predictable waves of sequential forest degradation and biodiversity loss spreading from an African city...
and how to slow them down...

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Outline

Degradation study

1. Forest degradation can be predicted - results from a forest degradation study in coastal Tanzania.

Challenges

2. Challenges.

Conclusions

3. Conclusions.

Predicting degradation important

➔ Net land-use change in the tropics (incl. degradation and deforestation) cause ~**10%** of global anthopogenic **carbon emissions** (~1 Gt C yr^{-1})[1].

➔ >150 models of **deforestation**[2] significant advances in remote sensing of deforestation[3].

➔ Spatial and temporal patterns in forest **degradation** and its impact on carbon and biodiversity much less understood.

➔ Post-Kyoto **REDD+** (Reducing emissions from deforestation and forest degradation) focus on deforestation.

➔ ~1/3 of tropical forest degraded[4]. Ability to predict degradation key to biodiversity/climate change management.

1 Van der Werf et al. 2009. *Nature Geoscience* 2: 737.
2 Kaimowitz & Angelsen 1998. *Economic models of tropical deforestation: a review*. CIFOR
3 Hansen 2008. PNAS 105: 9439; Hansen 2010. *PNAS* 107: 8650.
4 Putz et al. (2000). *Plos Biology* 6: 1368.

Economic theory

Von Thűnen model: Land allocated to activity that provides maximum rent (gain-cost).[5]

Hypotheses:
1. **People target resources in sequence** from high to low value.
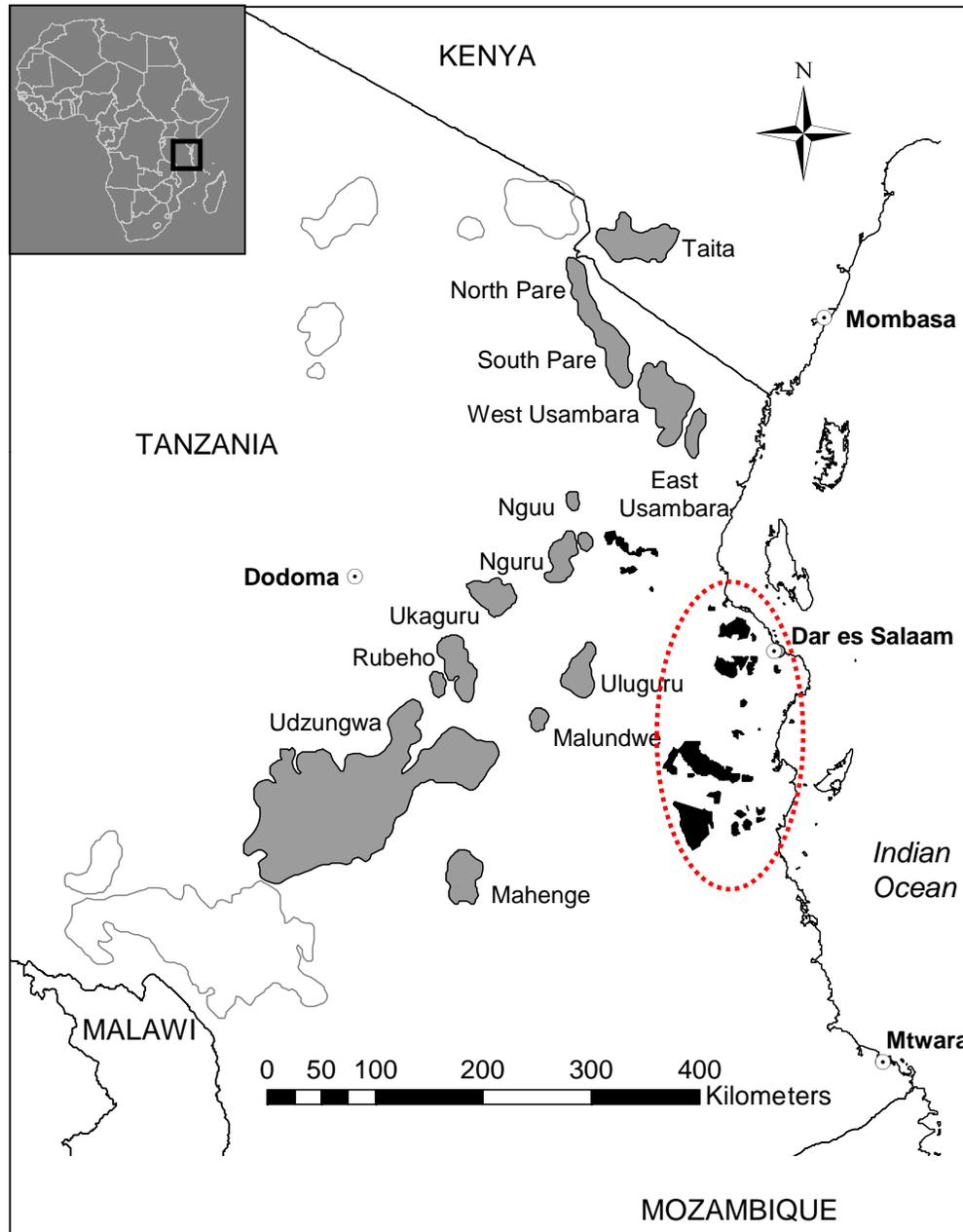2. **People choose locations to extract closer to markets first** to maximise rent

Therefore, hypotheses **waves** of forest degradation should emanate from major centres of demand **targeting resources in a strict value sequence** .

Shown for fisheries ("*fishing down the food web*")[6] but not for tropical forests.

5 Von Thűnen. (1966). *Von Thűnen's Isolated State*. Pergamon Press. Oxford.
6 Pauly et al. (1998). *Science* 279: 860.

Study area

KENYA

Taita

North Pare

South Pare

West Usambara

TANZANIA

East Usambara

Nguu

Nguru

Dodoma ⊙

Ukaguru

Rubeho

Uluguru

Udzungwa

Malundwe

Mombasa

Dar es Salaam

Indian Ocean

Mahenge

MALAWI

Mtwara

MOZAMBIQUE

0 50 100   200   300   400
Kilometers

N

Dar es Salaam, Tanzania, rapidly expanding urban centre (3-4 million).

Forest product demand rising sharply (export China, local consumption for building and fuel).

Weak resource management.

Typical of sub-Saharan Africa (urban growth 7%; Africa 33% of global fuel wood extraction).[9,10]

9 UNEP (2005). *Global Environment Outlook*. Nairobi.
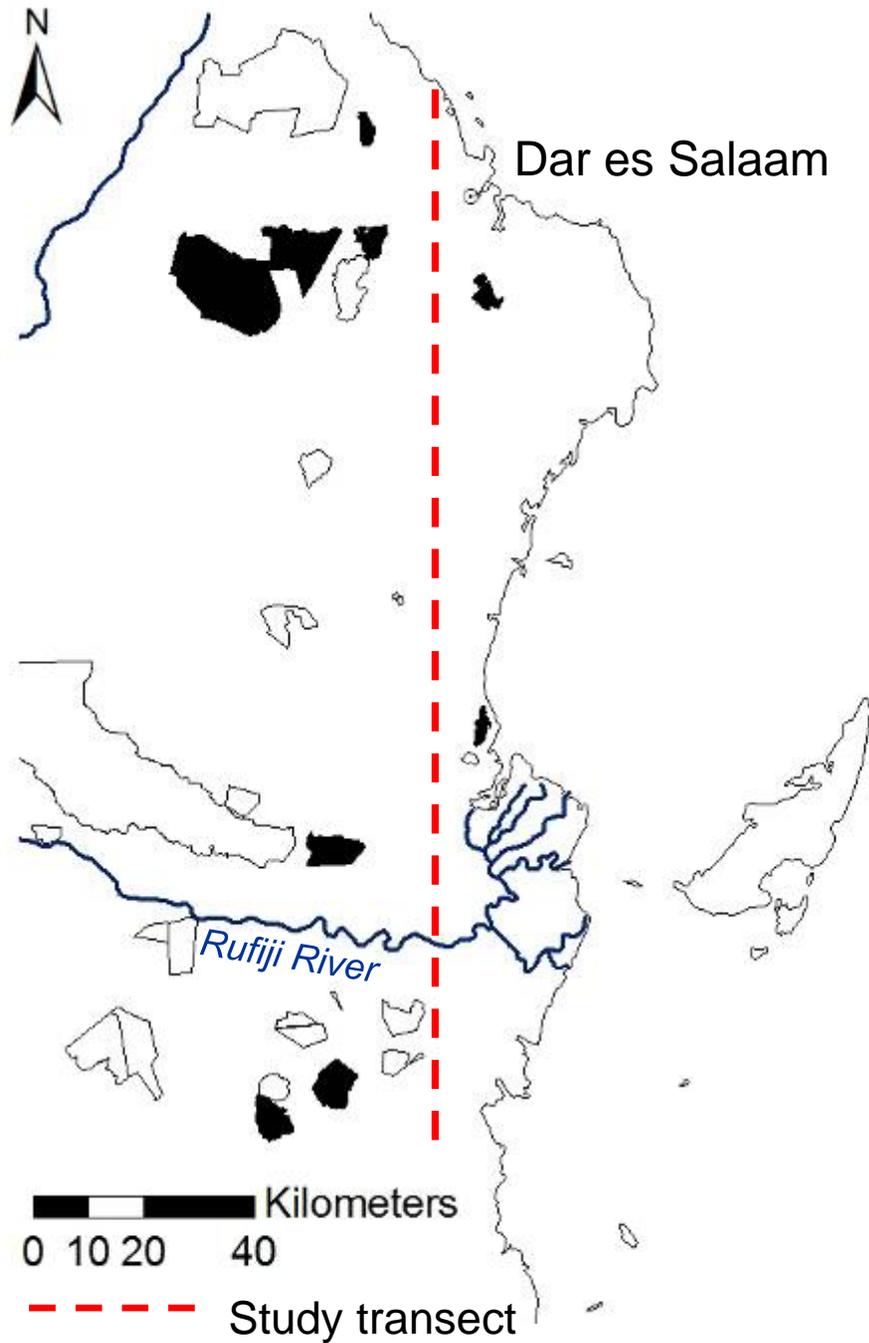10 FAO (2011). State of the World's forests 2011. Rome.

Field assessment in 1991
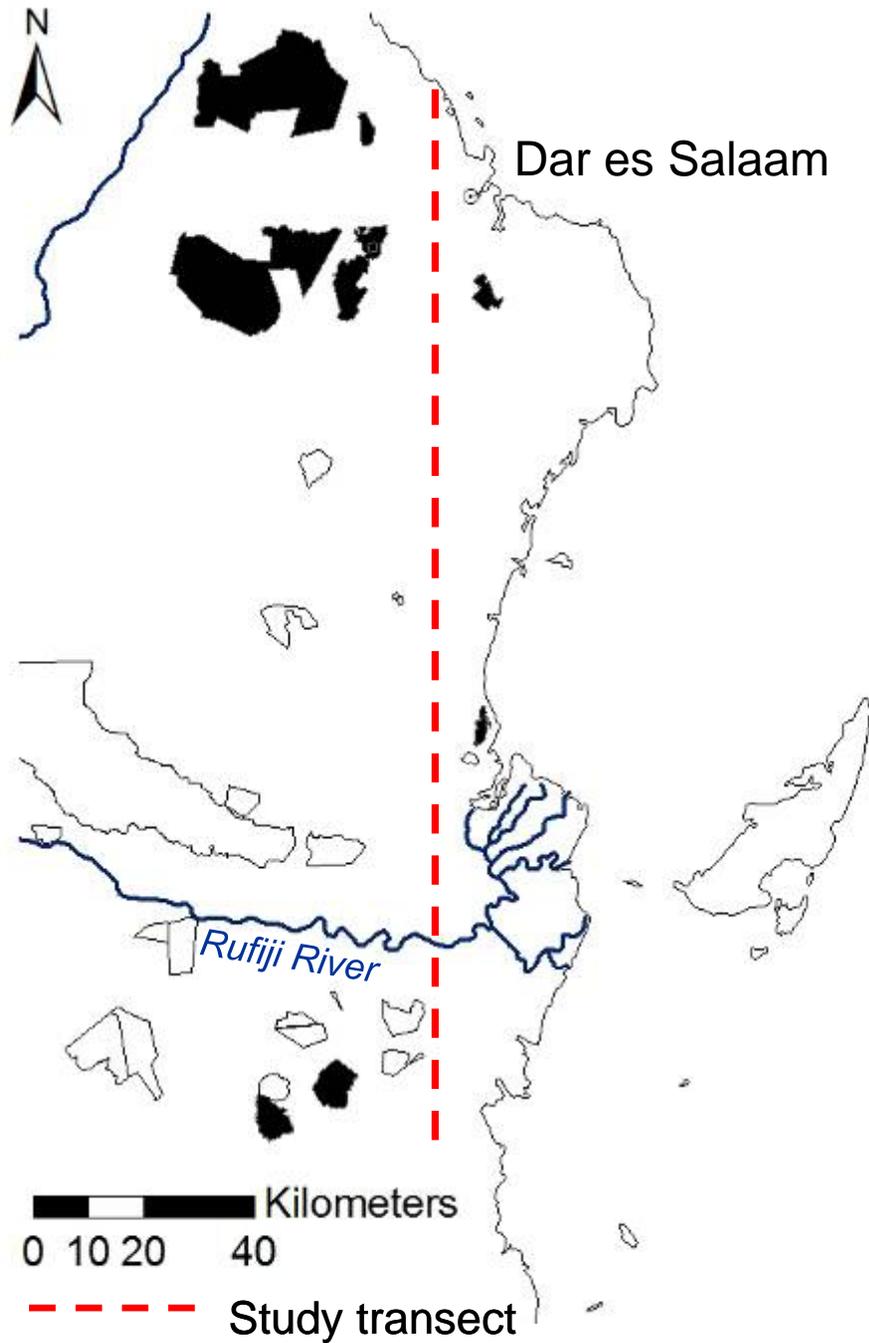
- 9 forests
- 16 vegetation plots

Recording:

- all trees ≥100 mm diameter at reference height (1.3 m; drh)
- extractive activities

Dar es Salaam

Rufiji River

Kilometers
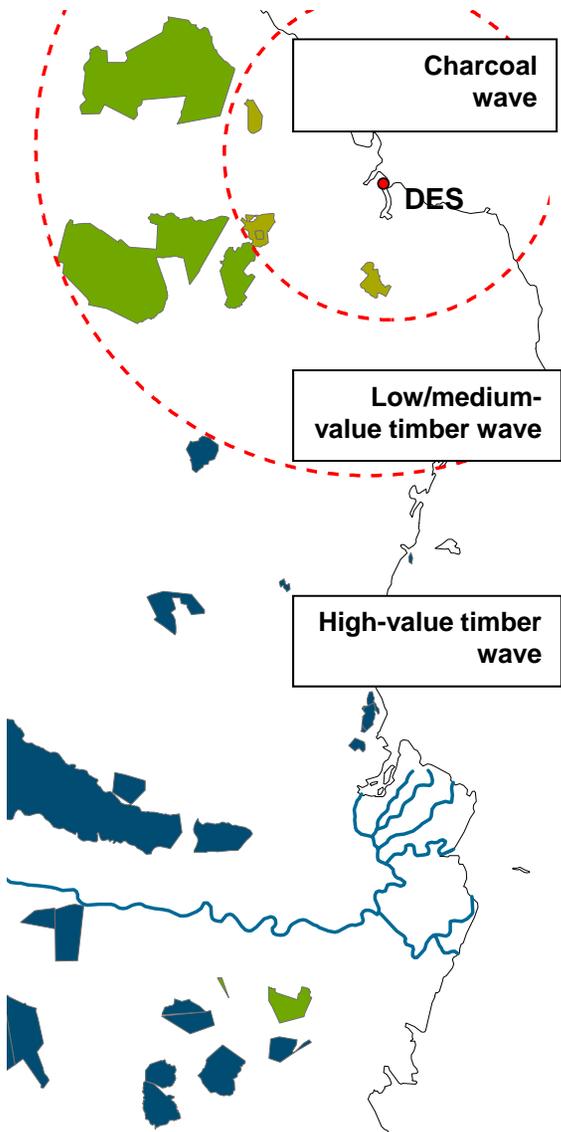0 10 20   40

Study transect

Field assessment in 2005

- resampled 8 forests
- 18 km of transects

Recording:

- all trees ≥50 mm drh
  n = 12,018
- extractive activities

Dar es Salaam

Rufiji River

Kilometers

0 10 20   40

- - - -   Study transect

1991

2005

Charcoal
wave

DES

Low/medium-
value timber
wave

High-value timber
wave

DES

Charcoal
wave

Low/medium-
value timber
wave

High-value timber
wave

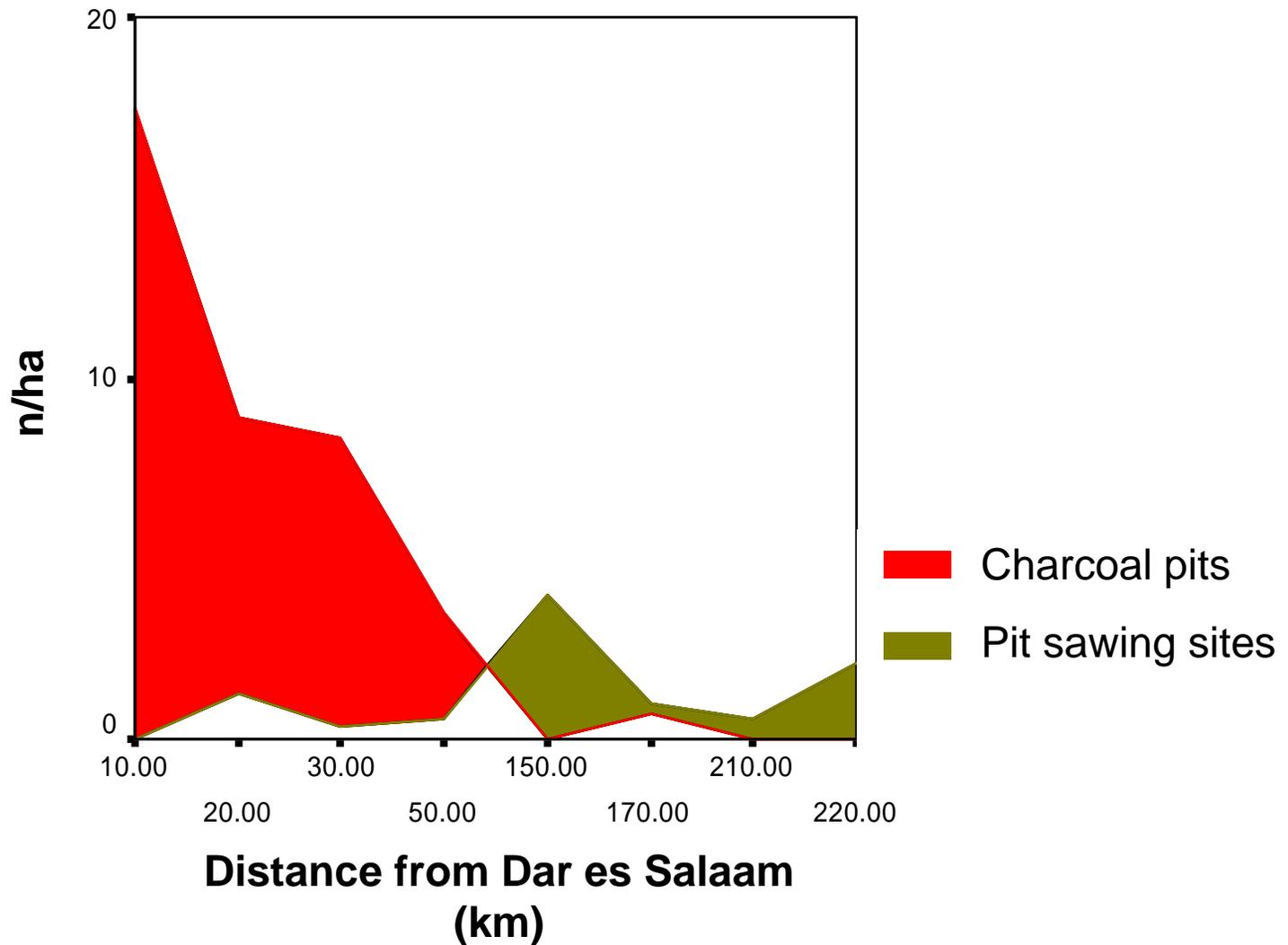0 5 10 20   30   40
Kilometer
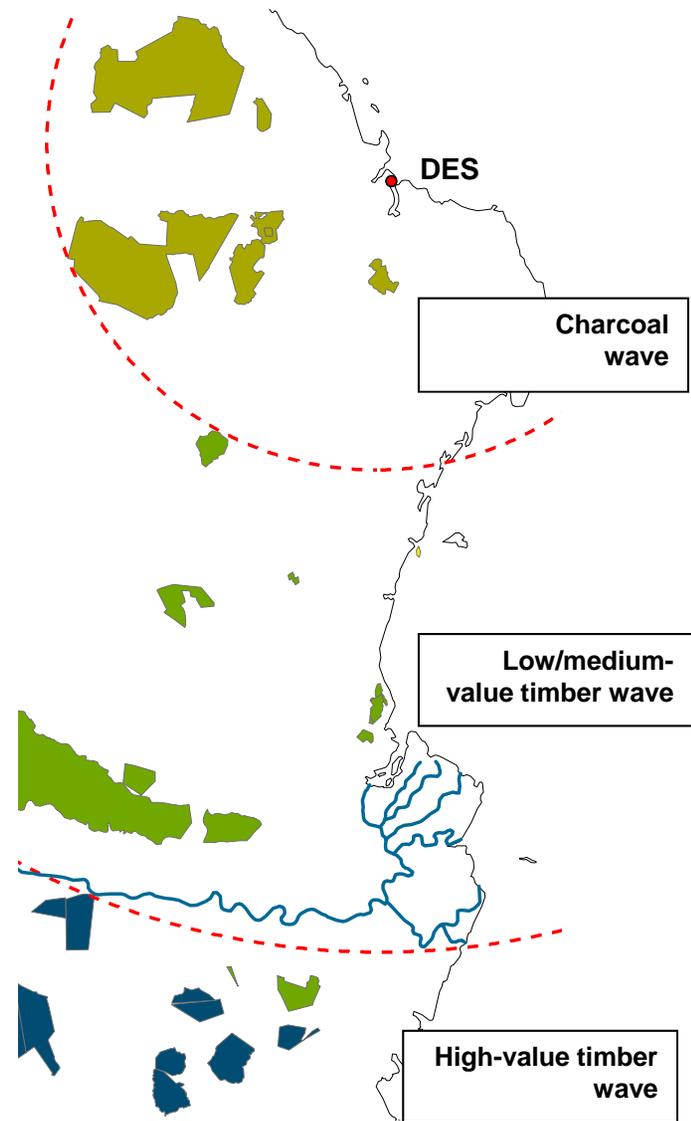
■ **Dominant forest use charcoal burning**

■ **Dominant forest use logging of low/medium-value timber**

■ **Dominant forest use logging of high-value timber**

Spatial patterns in degradation in 2005
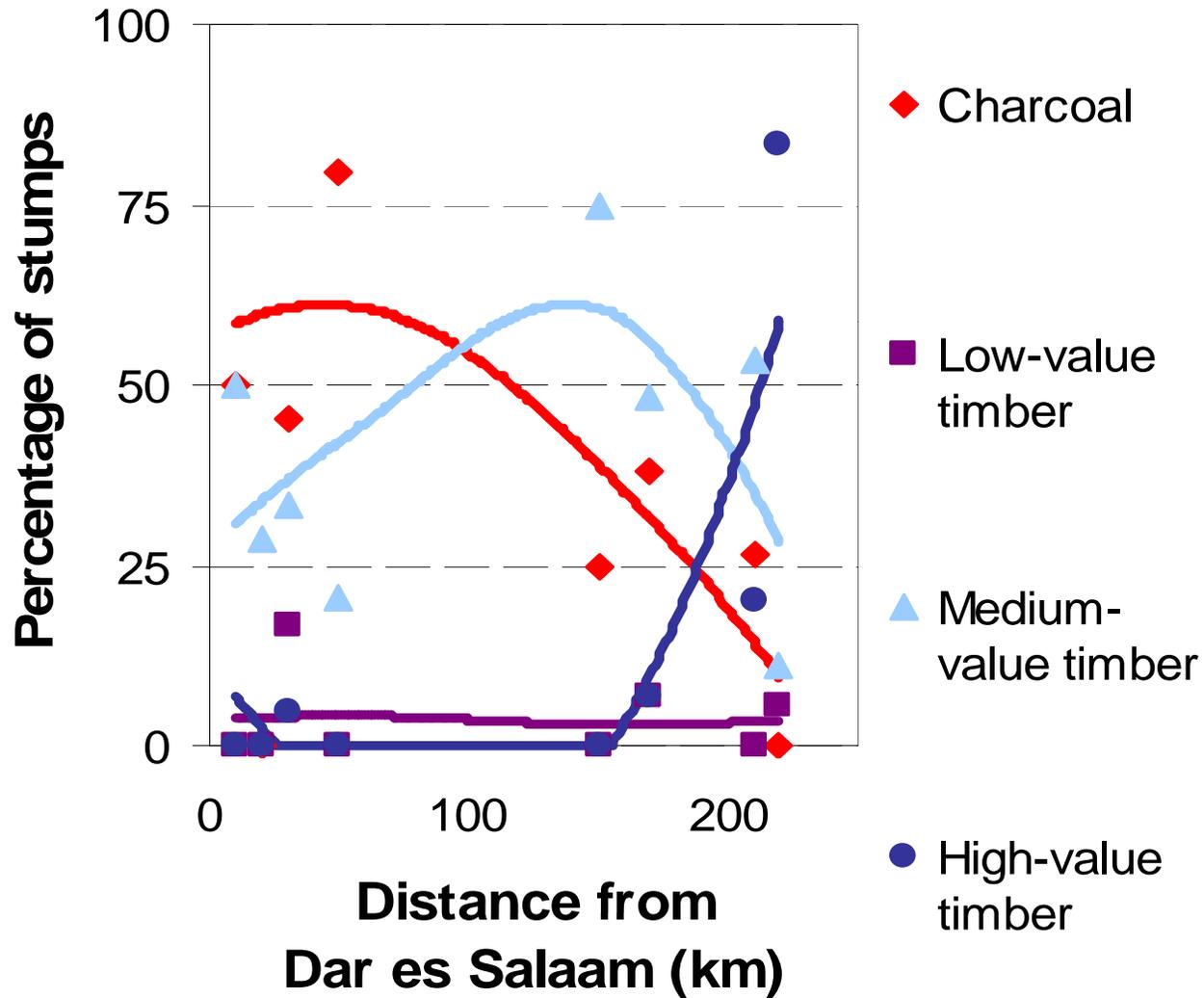
Charcoal burning versus timber logging
at increasing distance from DSM in 2005

High value timber logging moved 9 km yr^{-1}

Nambunju village

Ruvu South

Ruvu South

Nyamwagne

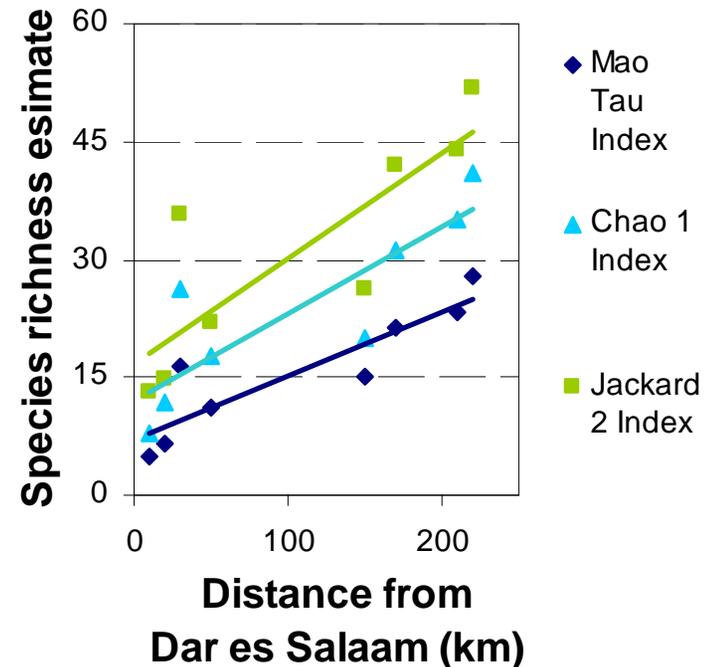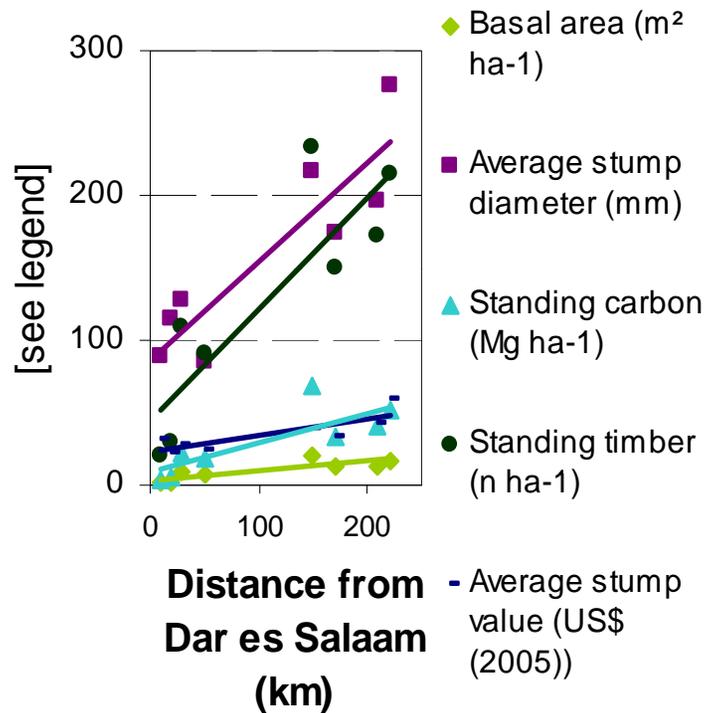# Charcoal burning moved 2 km yr^{-1}

Kisiju

Pugu

Ikiwiri

Pugu

Carbon, standing timber and biodiversity increase significantly with distance from DES

Carbon increase 0.2 Mg ha-1 with each km distance from DES.

Tree species richness 0.1 species per sample area of 0.4 ha.

Allied findings

➔ At current rates, **no high-value timber** left in coastal forests in **37 yrs**.

➔ Tanzanian government **lost 53 million US$** in 2005 (96% of harvest undeclared).

➔ **China** import 10x more timber from Tanzania than *total* declared timber exports.

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3 August 2010 Last updated at 10:17

Model shows 'waves of forest degradation'

Illegal logging: Dar now sending team to 'buyer' countries

By J.MWAMUNYANGE
Special Correspondent
The Tanzanian Revenue Authority is to send a team of experts to "beneficiary" countries China, India, Hong Kong, United Arab Emirates and Singapore to solicit their co-operation in stopping illegal logging.
A recent report by Traffic International says that Tanzania

16 Issue of the Day

Is the natural resource curse encroaching Tanzania?

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WISS...

TANZANIA

Politics o

The government has
at the Bank of Tanz

The 'government i
fighting against
and make sure p
deliver to the exp
the *wananchi* [citizen
government'. While Pres

THURSDAY Timber trade 2008 17

Scientists show waves of deforestatio

Published on 11/08/2010

A new study documents waves of forest degradation adva
East Africa in just 14 years.

Scientists from 12 organisations in Europe, Africa and th

Shocking details on timber trade

2007-06-25 08:56:31
By Abu Muse, Nairobi

The government is losing billions of shillings worth of timber revenue due to poor governance and rampant corruption in the forestry sector, according to a report issued by International TRAFFIC.

Nobel Laureate, Professor Wangari Maathai is presented with TRAFFIC's Tanzanian logging report at the launch of the anti-corruption Mama Misitu campaign. (Left)

Challenges

Challenges

Identification of major drivers of deforestation and degradation, and tackle them.

Fisher, Lewis et al. Implementation and opportunity costs of reducing deforestation and degradation in Tanzania. *Nature Climate Change*, June 2011.

Opportunity cost estimates usually ignore charcoal extraction

Opportunity cost estimates do no deal with the drivers of deforestation and degradation, and therefore promote D & D displacement not reduction , ie leakage

Need to deal with drivers of deforestation and unmet demand to avoid leakeage
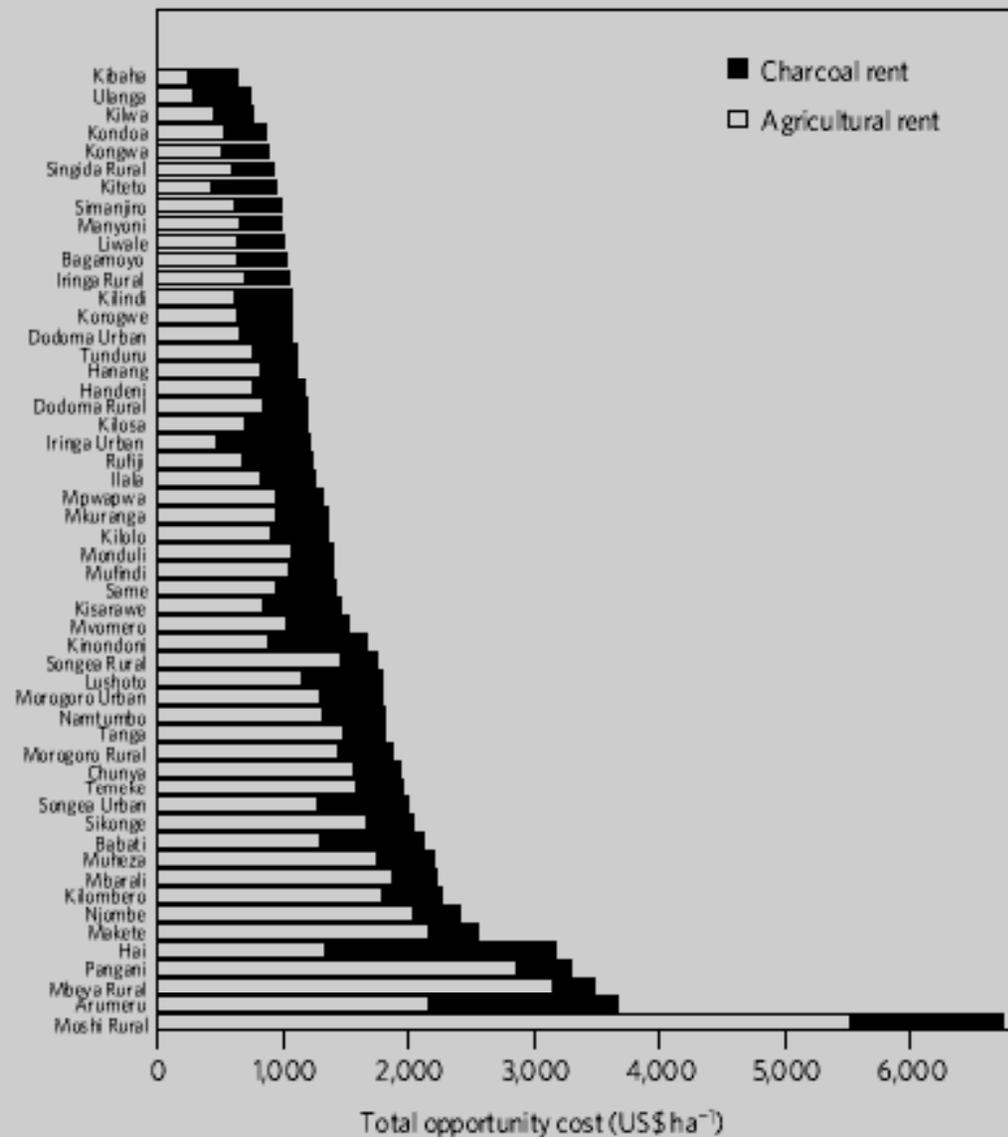
Figure 2 | Opportunity cost of forest conservation. Opportunity costs (US\$ ha^{-1}) for each of the 53 eastern Tanzanian districts as the sum of net agricultural rent (white) and charcoal rent (black). Agricultural rents are a net present value. Districts are ranked in order of increasing total opportunity cost.
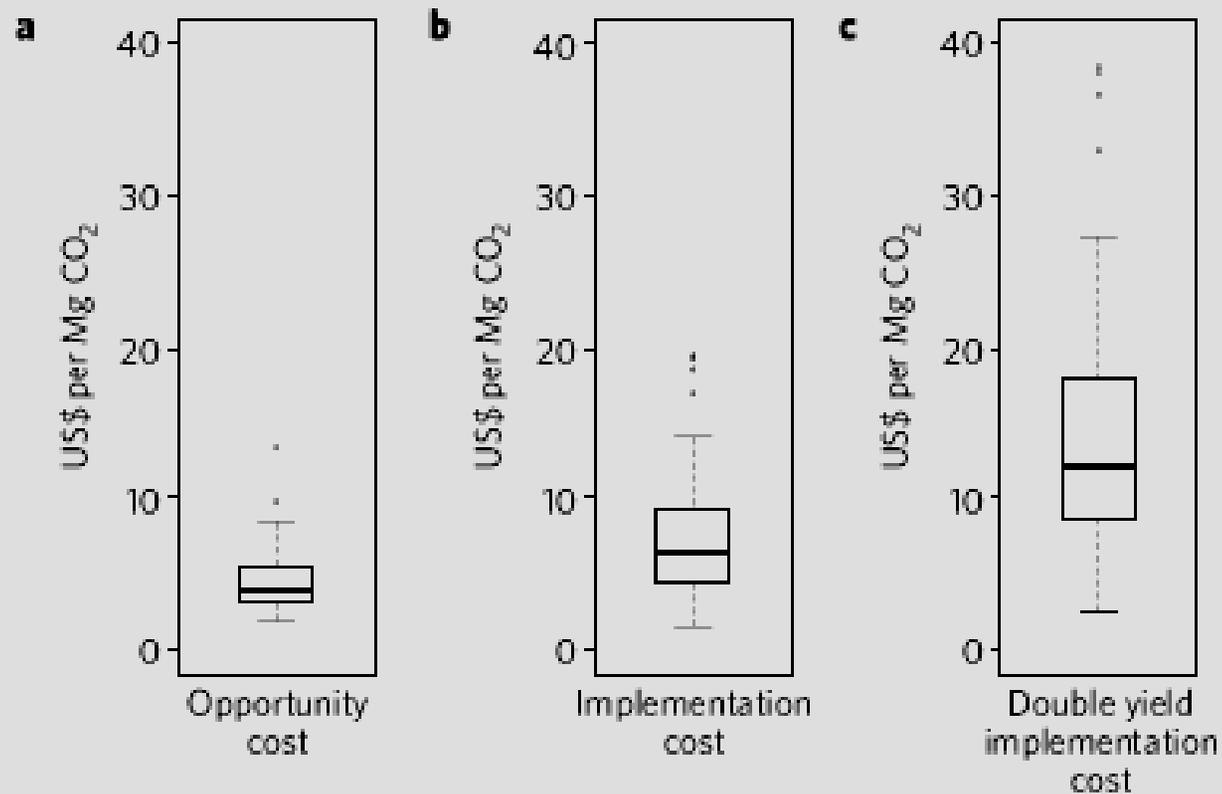
Figure 3 | Opportunity and implementation cost estimates for REDD+. District-level results for when carbon payments (US$ per Mg CO_2) offset **a**, the opportunity cost of conservation; **b**, the implementation cost of alleviating demand for the next hectare converted through gains in agricultural yield and stove efficiency (including monitoring costs); and **c**, the implementation cost of doubling agricultural yield, replacing demand for charcoal from the next hectare of forest converted, and associated monitoring. Dark bars represent median values, boxes represent interquartile ranges, whiskers equal 1.5 times the interquartile range.

Conclusions and key policy implications

1. **Degradation** and some of its attendant losses on public goods **can be modelled and predicted**.

2. **Carbon fluxes from degradation are significant.** They should be included into ecosystem service payment schemes such as REDD.

3. Opportunity cost models usually ignore the profits made made from degradation.

4. Models of degradation dynamics can **help** to tailor and **focus conservation activities** and REDD.

5. Implementation of schemes to deal with the demand for commodities , via Smart-REDD interventions, can assist in tackling the drivers of deforestation and degradation, including charcoal production and use.

Acknowledgements