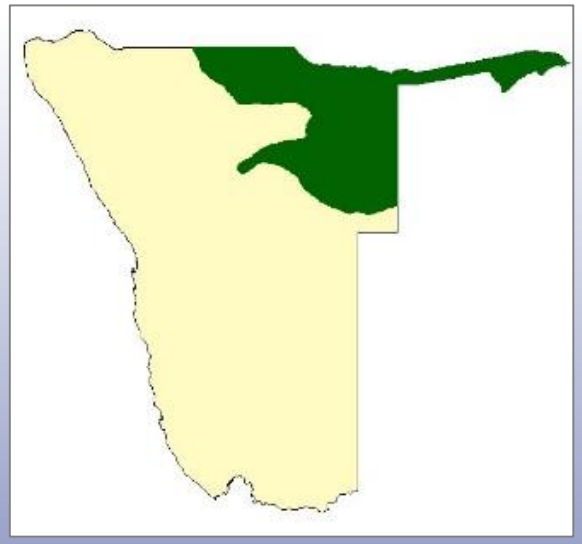
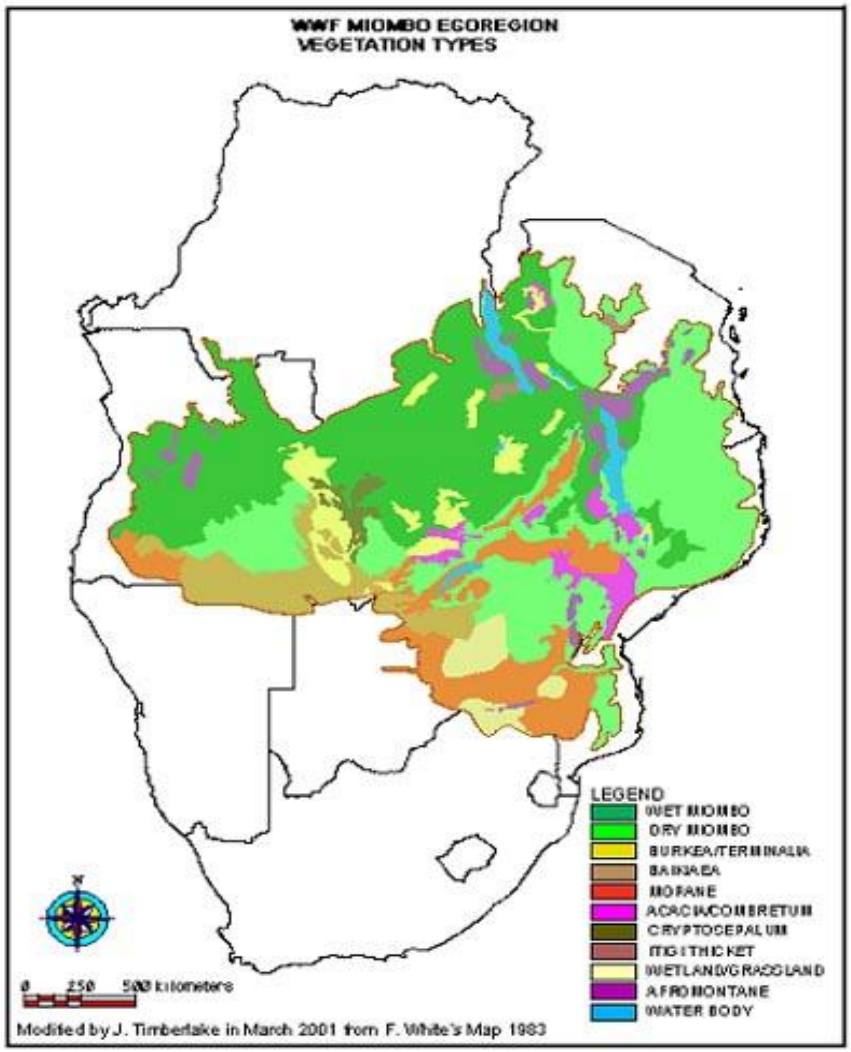
Towards estimation of growing stock for the timber tree *Pterocarpus angolensis* in Namibia

Vera De Cauwer
Department of Geospatial Sciences and Technology
School of Natural Resources and Spatial Sciences
Polytechnic of Namibia

Forests in Namibia



Kalahari dry forests & woodlands
Burkea woodlands
Zambesian *Baikiaea* woodlands



Forests in Namibia

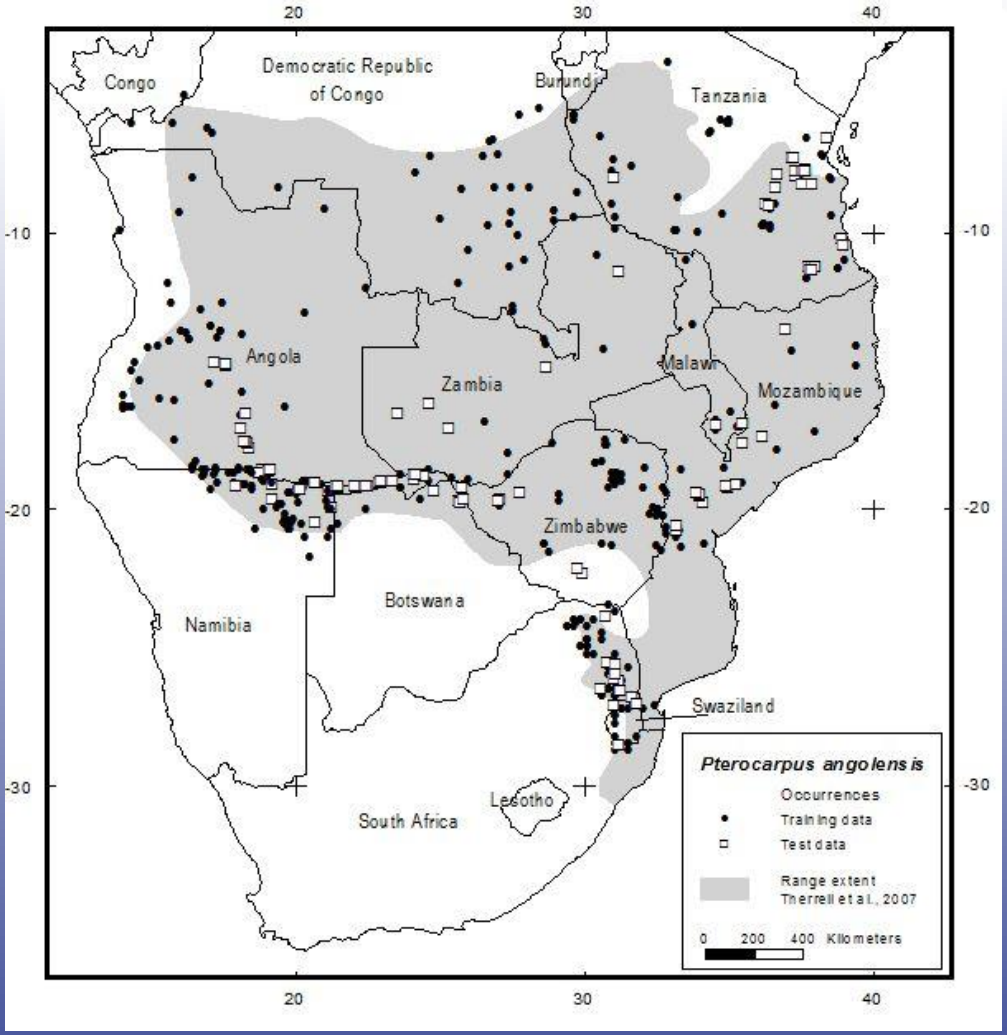
- Open forest characterised by few canopy species:

  Burkea africana, Pterocarpus angolensis, Baikiaea plurijuga, Schinziophyton rautanenii, Guibourtia coleosperma
- Characterised by disturbances
- Limited data available

Pterocarpus angolensis

Kiaat, Blood wood, Mukwa

- *Fabaceaea*
- mixed stands
- deciduous



Pterocarpus angolensis

Kiaat, Blood wood, Mukwa

- most valuable timber species in Namibia
- furniture and decking
- density : 440 - 680 kg/m^3 (air dry)
- **No estimation of growing stock in FRA reports**

Objectives

- Overview of existing data to determine total growing stock
- Compare wood volume equations available for *P. angolensis*
- Estimate total growing stock and growing stock *P. angolensis* for 2000 in Namibia by using all data available
- Discuss needs for future forest assessments

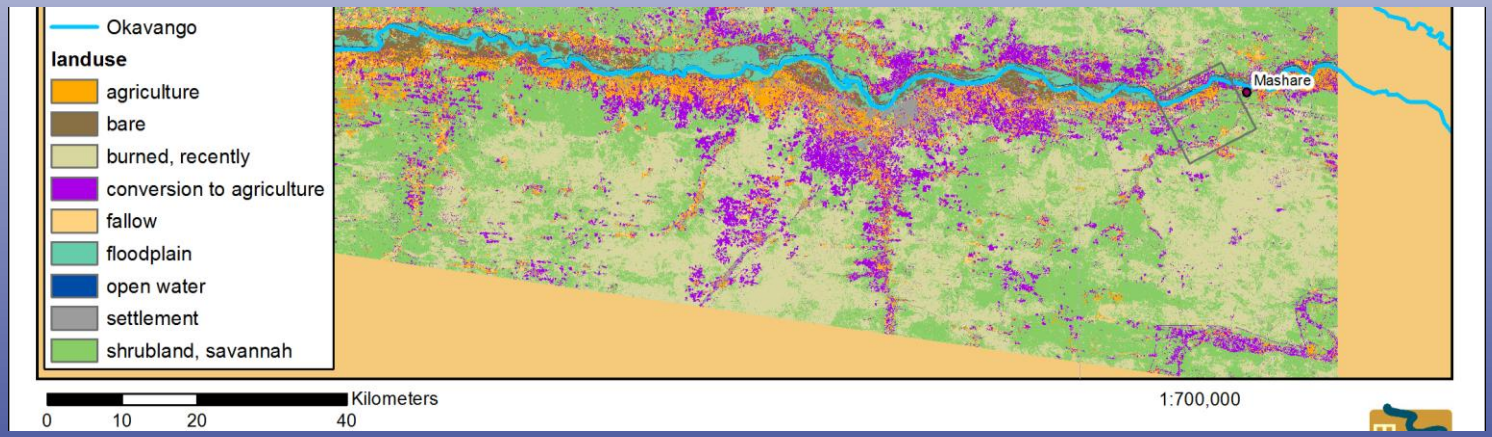
Forested area in Namibia

Growing stock = **forested area** x mean wood volume

- FRA 2015: **8.4 %**
- FRA 2010 : 8.8 % - FRA 2000: 9.7 %

No accurate assessment

- Linear extrapolation of old data
- Data not well documented
- Deforestation trend



Forested area in Namibia

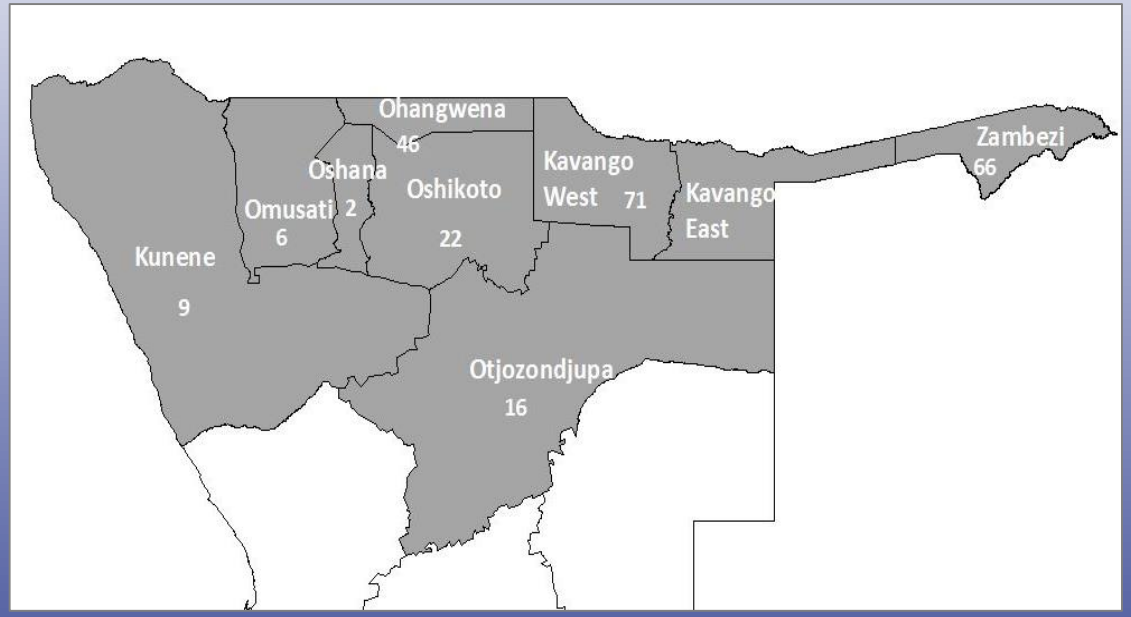
Vegetation map based on SPOT 1993

- forest and savanna classes
- 35% of savanna classes converted to forest in FRA

… with trees higher than 5 m and canopy cover > 10 %, or ***trees able to reach these thresholds in situ***

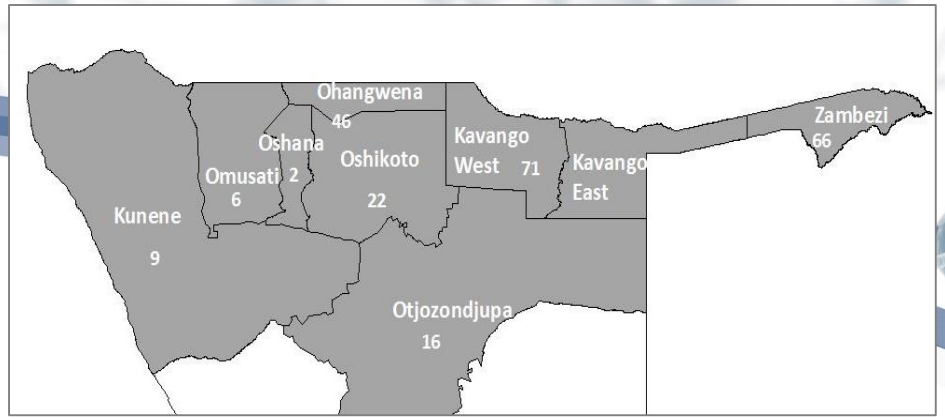
Mean wood volume Namibia

- Growing stock = forested area x **mean wood volume**
- FRA data of 3 regional inventories : Omusati, Oshana, Oshikoto
- mean wood volume : 24 m^3/ha



Based on data FRA2000, 2010 for 1992

Mean total wood volume 2000



1997 and 1998 inventories: volume for total inventory area
Kavango and Ohangwena: no regional inventory

Regions	Date	Area (ha)			% forest	Wood volume all species		Wood volume Pterocarpus angolensis	
(*)		Region	Inventory	Forested (**)		Total (m3)	Mean (m3/ha)	Total (m3)	Mean (m3/ha)
Omusati	2000	2655800	1383924	152394	11,0	1079400	7,1	0	0
Oshana	2000	868200	514163	7683	1,5	21000	2,7	0	0
Oshikoto	2002	3866900	1646401	588478	35,7	16690700	28,4	896500	1,5
Otjozondjupa west	1997	10533400	607949	341212	56,1	10756240	31,5	968200	2,8
Otjozondjupa east	1997		8212447	1757037	21,4	17449990	9,9	14880	0,0
Caprivi	1998	1446700	2007764	891671	44,4	31029700	34,8	968200	1,1
Kavango	2003	4848300	43299	38369	88,6	1578082	41,1	236138	6,2
Ohangwena	2000	1069400	55918	44509	79,6	2338800	52,5	457400	10,3
TOTAL		25288700	14471865	3821353	26,4	80943912	21,2	3541318	0,9

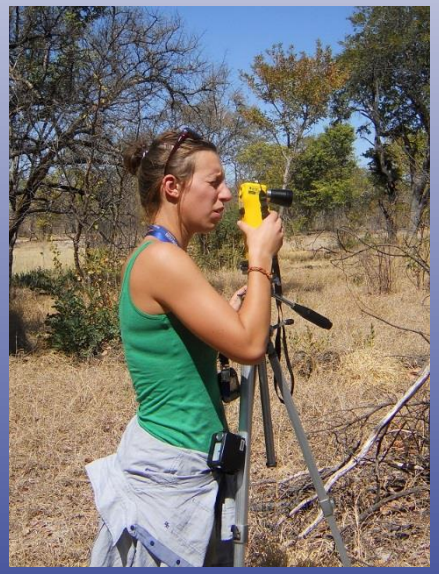
Mean wood volume: equations

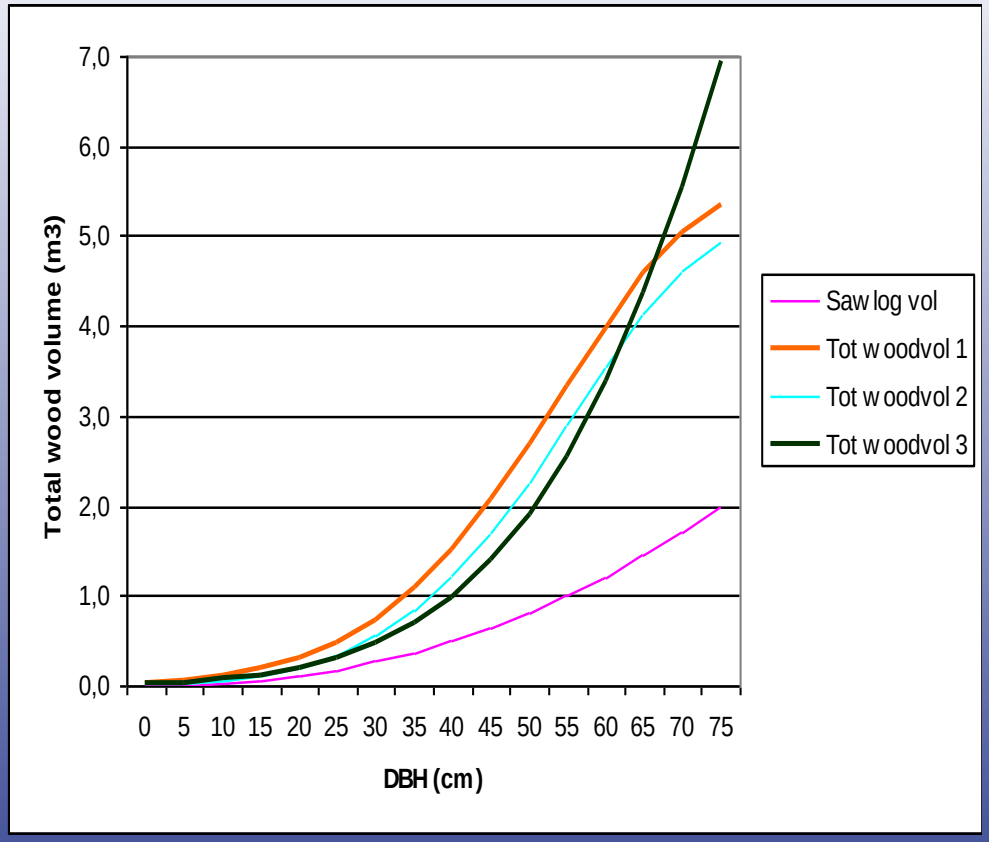
Equations for total wood volume including branches

- data : Namibia – Finland programme (n=40)
- Tot wood vol 1: equation Kavango (Kanime & Laamanen, 2002)
- Tot wood vol 2: Angombe (2004)
- Tot wood vol 3: West Tsumkwe, Julin (2002)

Equation for volume saw timber :

De Ruytter (2015)





Wood volume equations

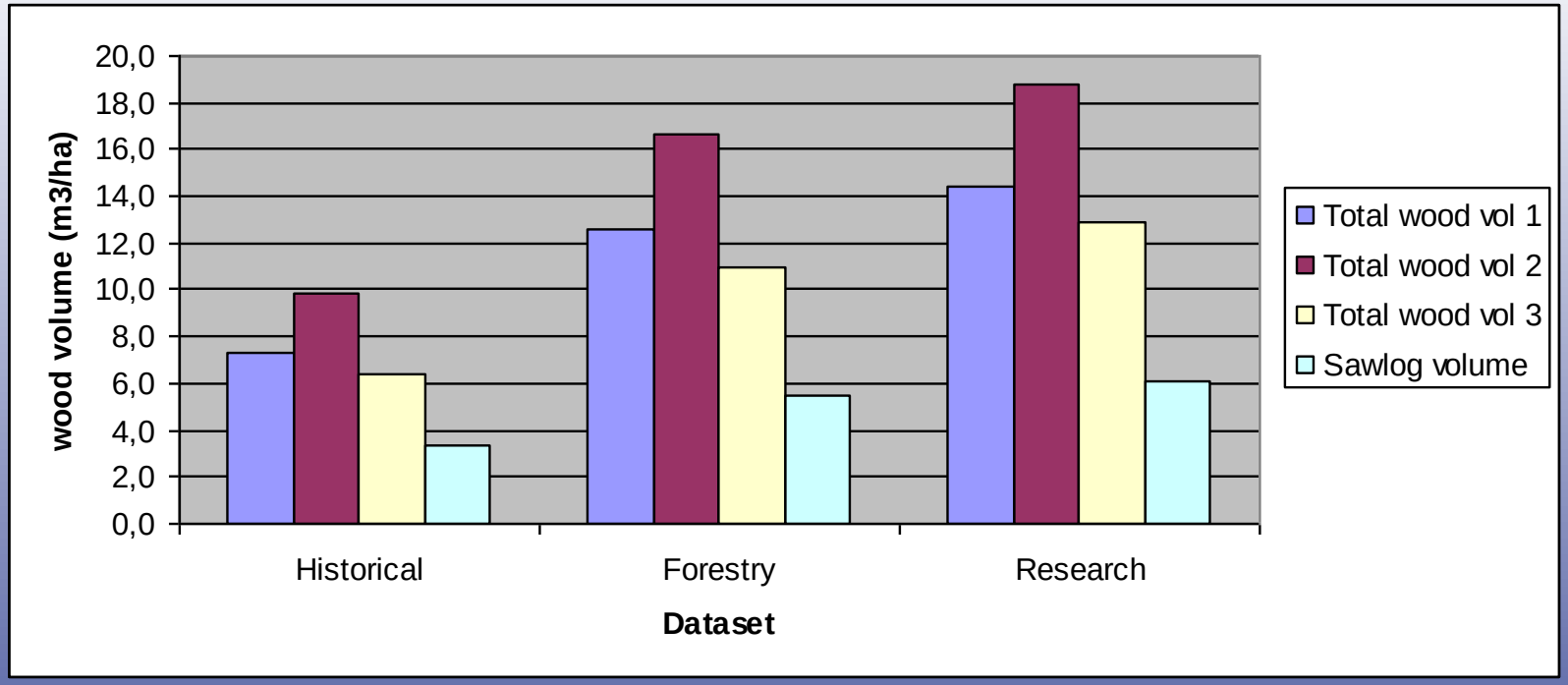
Wood volume equations compared for *P. angolensis* (Kiaat) in Kavango regions

Dataset	Historical	Forestry	Research	Grand Total
Total number of plots	492	462	185	**1139**
Number of plots with Kiaat	407	276	105	**788**
Period	1972 - 1974	1998 - 2014	2011 - 2014	**1972 - 2014**
Stems/ha	19 (16)	35 (42)	39 (35)	
Mean DBH (cm)	23,3 (8,5)	27,2 (11,3)	24,6 (12,1)	**24,8 (10,2)**
Basal area (m^2/ha)	0,9 (0,8)	1,5 (1,2)	1,6 (1,5)	**1,2 (1,1)**

Trees: woody species with DBH >= 5 cm
Historical dataset: DBH >= 10cm
Circular plots with maximum radius 30m

Comparison wood volume equations

SD 100%

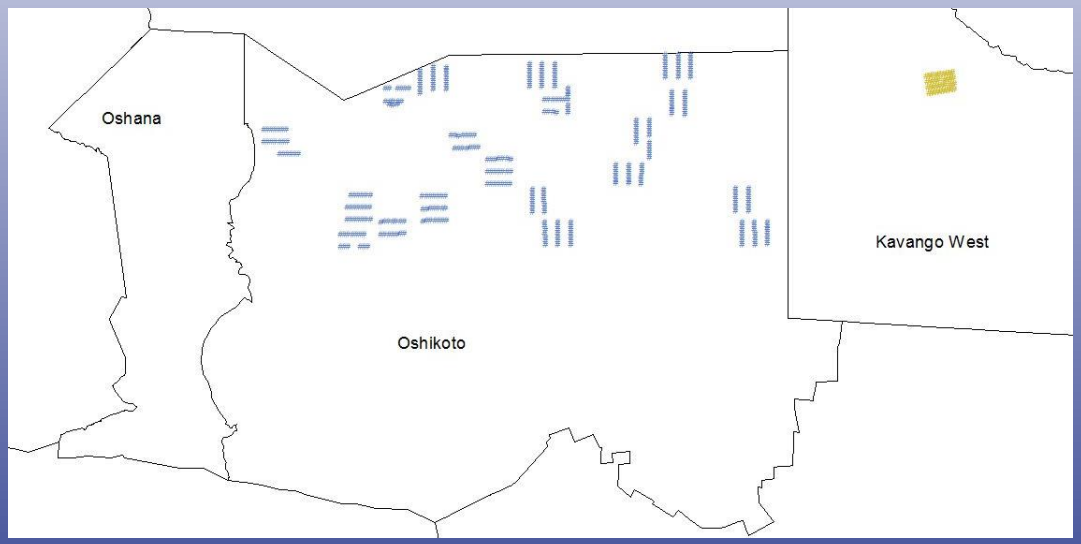


Future assessments

Concept for forest monitoring on a national basis needed

Forest inventories: appropriate sample design

- National Forest Monitoring and Assessment (NFMA) method of FAO for tropical countries ?
- Previous sample designs on regional level: stratified and systematic, often with use of clusters > can be adapted to forest cover and density
- Permanent plots



Concept for forest monitoring on a national basis needed

FRA based on field measurements only not feasible

Use of other data:

- Forested area: remote sensing

  Complicated by :

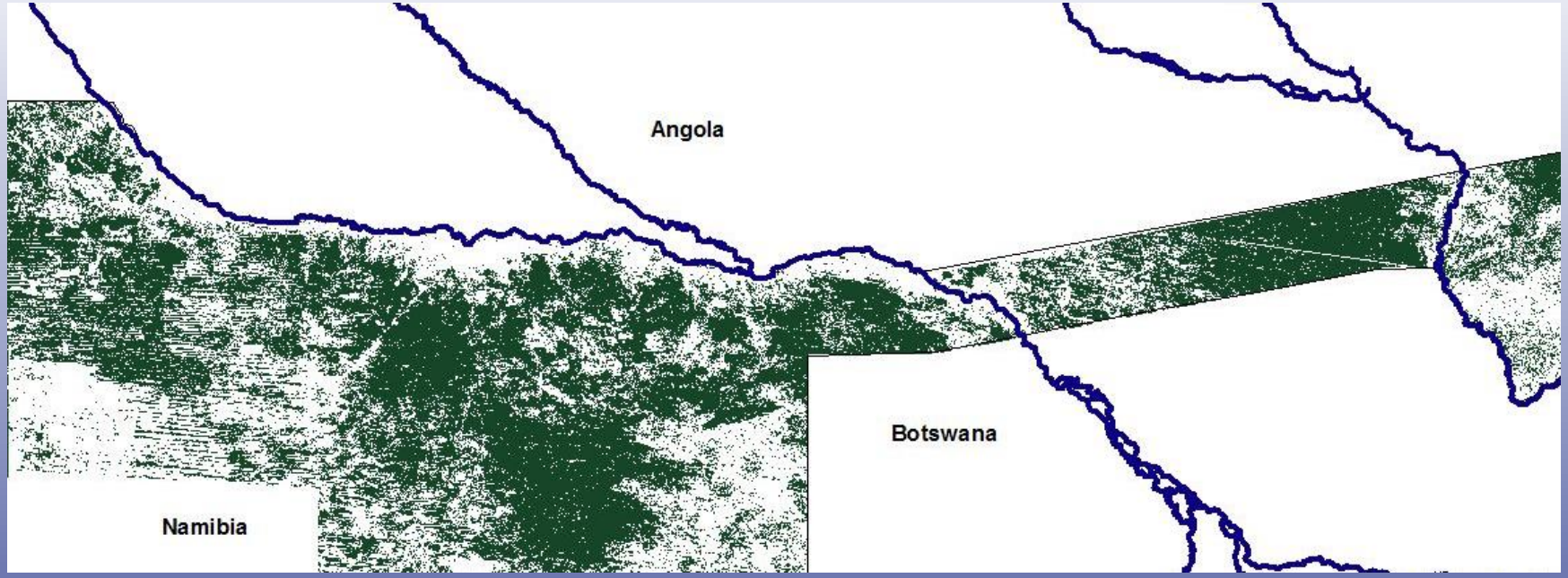
  - Open canopy
  - Variability of rainfall
  - Fire scars

Verlinden & Laamanen, 2006

Kamwi & Kätsch, 2009 : with Quickbird

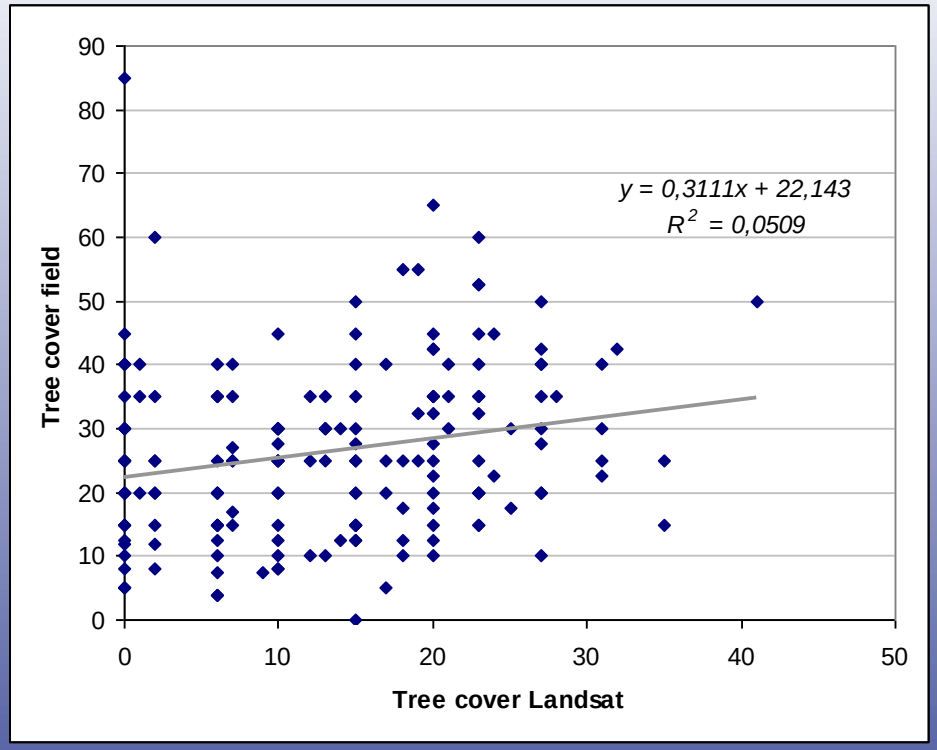
Forested area according to Verlinden & Laamanen, 2006

Based on Landsat TM band 4 : 2000



Comparison of tree cover map 2000 with field data 2011 - 2014

rho 0.25



Concept for forest monitoring on a national basis needed

Use of remote sensing for forest cover and biomass:

- Time series with wet/dry period data
  - Enhanced vegetation index (EVI) from MODIS 2000 – 2006: 0.43
  - mean EVI for 2007-2013: 0.33
  - total integral 2000 – 2013: 0.48

    phenology descriptor that represents total biomass (Mader, 2012)
- Open Foris – Earth Collect: visual interpretation

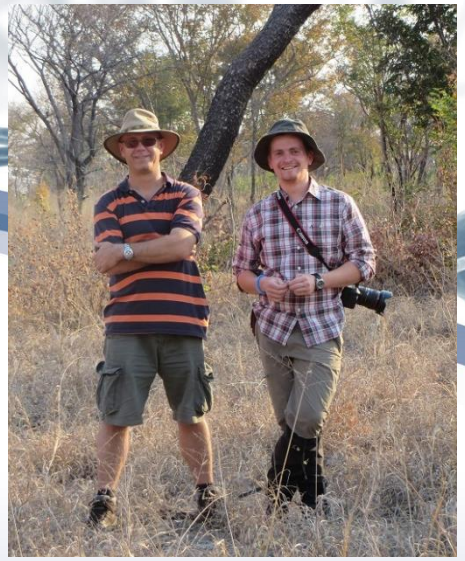
  Global Drylands Assessment: 20,000 plots in southern Africa
- Radar and lidar
- Modelling with input of RS and environmental data

Woody cover or forest cover map?

Conclusions

To assess total growing stock Namibia over last decades:

1. Data on forest cover needed
   - for 2000, 2010 and 2015 with use of FAO definitions
   - No data since 1993
2. Mean wood volume: evaluation of all forestry inventory data to establish varability
3. Establish total wood volume equation *P. angolensis*
4. National forest inventory concept: integration of different sources and adapted to local resources
   - Permanent plots
   - Earth Collect



Acknowledgements

- Future Okavango (TFO) and SASSCAL Task038 projects – funded by the German Federal Ministry of Education and Research
- Namibian Directorate of Forestry
- Colleagues and students contributing to the fieldwork of 2011 – 2014 / Hans Merensky Foundation
- Data: Dr Coert Geldenhuys, Jonathan Kamwi, Dr Alex Verlinden, Dr Marion Stellmes, Dr Simon Angombe