IX National Symposium on Cerrado
II International Symposium on Tropical Savannah

Resource use activities, management and conservation of natural resources of

African Savannas

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Outline of presentation on African Savannas

• Background
• Vegetation formations
• Resource use activities
  • Direct & Indirect socio-economic benefits
  • Consumptive & Non-consumptive use (including conservation)
  • Subsistence & Commercial
  • Timber vs non-timber
• Management for Integrated, Sustainable, Multiple-use
Background

African Savannas

• *Occupy ±40% of African land surface*
  - extensive areas between tropical moist forests & mid-latitude deserts

• **Home to**
  - Most of Human population
  - Most rapid growth in Human population
Background

• Savanna or savannah
  • no general consensus on precise definition

• Central concept:
  tropical mixed tree-grass community
  • grassland ecosystem with widely scattered trees or shrubs
  • relatively open canopy to allow sufficient light to reach ground to support
    • unbroken herbaceous layer consisting primarily of $C_4$ grasses
  • characterised by seasonal water availability
  • majority of rainfall confined to one season of year
Clarifications: Concept of African savannas
(Scholes & Walker 1993)

- Savannas existed in Africa for >30 million years
  - Since start of hot climates with markedly seasonal rainfall

↔ Fire

- Ecology of savannas: not forest or grassland
  - Own character from strong & complex interactions between woody & herbaceous plants
  - Ecological processes (primary production, hydrology & nutrient cycling) strongly influenced by both woody plants & grasses
Clarifications: Concept of African savannas
(Scholes & Walker 1993)

- Structure & Function determinants:
  - Water & nutrient supply
    - Primary determinants (of potential)
    - Define & constrain potential impacts of TWO other factors:
  - Fire & herbivory (disturbance processes)

- Savannas not ‘arrested forests’ or ‘fire sub-climax’
  - Fire = regular feature of environment (= dry season)
    - Not a natural catastrophe
  - Fire frequency varies with variation in biomass (fuel load)
    - Annual in wet savannas
    - Once every 10 or more years at dry extreme
  - Woody plant density & biomass increase with fire exclusion
Clarifications: Concept of African savannas (Scholes & Walker 1993)

- Savannas not transitional or ecologically intermediate between grasslands & forests
  - Zone in sequence along main increasing aridity gradient
  - Forest ↔ woodland ↔ savanna ↔ desert shrubland (not grassland)
  - Lack tendency towards organic matter accumulation
  - Lack microclimatic amelioration typical of forests

- BUT – I have examples of wooded grassland developing through woodland into regrowth forest with exclusion of fire!
Clarifications: Concept of African savannas (Scholes & Walker 1993)

- **Two broad classes of African savanna**
  - **Broad-leafed savannas** in nutrient-poor high-rainfall areas
    - Most of the areas
  - **Fine-leafed savannas** in nutrient-rich low-rainfall areas
    - Dominated by *Acacia* spp, often along water coarses

- **Treeless tropical grasslands**
  - Relatively small extent
  - Associated with characteristic substrate conditions
    - Water-logged sites
  - Ecologically different from tropical savannas - boundaries not always clear
Structural-Physiognomics of African savannas

• African vegetation in many different forms:
  • From: Tall, closed, multi-layered tropical moist forest
  • To: Open desert vegetation

• African 'savanna' also in many different forms:
  • Closed woodland (forest) ↔ open woodland ↔ wooded grassland ↔ bushland & thicket
## Main physiognomic vegetation units of Africa
(from White 1983)

<table>
<thead>
<tr>
<th>Vegetation Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Forest</strong></td>
<td>Continuous stand of trees ≥10 m tall, with crowns interlocking</td>
</tr>
<tr>
<td><strong>Thicket</strong></td>
<td>Closed stand of bushes and climbers, densely interlocked to form impenetrable community, 3 - 7 m tall</td>
</tr>
<tr>
<td><strong>Transition woodland</strong></td>
<td>Intermediate between forest and woodland</td>
</tr>
<tr>
<td><strong>Woodland</strong></td>
<td>Open to closed stand of trees ≥8 m tall, canopy cover ≥40%. Field layer usually dominated by grasses (shrubs in closer stands)</td>
</tr>
<tr>
<td><strong>Wooded grassland</strong></td>
<td>Grasses and other herbs cover ground, with woody plants covering between 10 and 40% of the ground</td>
</tr>
<tr>
<td><strong>Grassland</strong></td>
<td>Grasses and other herbs cover ground, either without woody plants or woody cover &lt;10% of the ground</td>
</tr>
<tr>
<td><strong>Bushland</strong></td>
<td>An open stand of bushes 3 - 7 m tall with a canopy of ≥40%. Bush = woody plant, multi-stemmed, habit between shrub and tree</td>
</tr>
<tr>
<td><strong>Scrub woodland</strong></td>
<td>Stunted woodland &lt;8 m tall, or vegetation intermediate between woodland and bushland</td>
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</tbody>
</table>
Vegetation formations in African Savannas

- 'Savanna' vegetation dynamics, both naturally & through human impact
  - Create dynamic relationship of vegetation structure within each mapped vegetation unit
- 'Savanna' vegetation unit is >80% savanna
- Transition zones: Savanna - Forest; Savanna - Arid shrubland
  - Contain 20 - 80% savanna by area
- Vegetation units a basis to discuss
  - Use & conservation
  - General natural disturbance & recovery processes
  - Management for sustainable resource use
Regional Transition Zones
XVI Sudania/Sahel
XI Guineo-Congolia/Sudania
Regional Centres of Endemism
IV Somalia-Masai
III Sudanian
I Guineo-Congolian (RF)
II Zambezian
Regional Transition Zones
X Guineo-Congolian/Zambezia
XIV Kalahari-Highveld
Regional Mosaics
XII Lake Victoria
XIII Zanzibar-Inhambane
SUDANIAN Woodlands & Savannas

Guinea Bissau

Guineo-Congolian – Sudanian transition, CAR

Bamboo stands

Broad-leafed Savanna
SOMALIA-MASAI Woodlands & Savannas

Fine-leafed Savanna
Southern TRANSITION ZONES & MOSAICS

Woodlands & Savannas

Guineo-Congolian – Zambezian transition, DRC

Kalahari-Highveld, South Africa

Fine-leafed Savanna

Zanzibar-Inhambane, Mozambique

Broad-leafed Savanna
Miombo

ZAMBEZIAN Woodlands & Savannas

Broad-leafed Savanna

Mopane

Mopane woodland, Namibia

Ovambo, Namibia

Liwonde, Malawi

Sofala, Mozambique

Copperbelt, Zambia

Mopane woodland, Namibia

Wolkberg, South Africa

Shrub Mopane, Zimbabwe

Undifferentiated

Ovambo, Namibia
## Resource use activities

### Who are the users?

<table>
<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td>Millions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northern Africa</td>
<td>111.6</td>
<td>143.9</td>
<td>175.6</td>
<td>208.8</td>
<td>239.0</td>
<td>2.86</td>
</tr>
<tr>
<td>West Africa*</td>
<td>126.9</td>
<td>169.5</td>
<td>219.0</td>
<td>277.6</td>
<td>344.0</td>
<td>4.28</td>
</tr>
<tr>
<td>East Africa*</td>
<td>103.5</td>
<td>138.0</td>
<td>180.4</td>
<td>230.0</td>
<td>289.0</td>
<td>4.48</td>
</tr>
<tr>
<td>Central Africa</td>
<td>54.4</td>
<td>73.6</td>
<td>97.2</td>
<td>127.0</td>
<td>163.8</td>
<td>5.03</td>
</tr>
<tr>
<td>Southern Africa*</td>
<td>69.6</td>
<td>89.0</td>
<td>111.2</td>
<td>128.7</td>
<td>150.2</td>
<td>2.90</td>
</tr>
<tr>
<td>AFRICA</td>
<td>466.0</td>
<td>614.0</td>
<td>783.4</td>
<td>972.1</td>
<td>1,186.0</td>
<td>3.86</td>
</tr>
</tbody>
</table>

- Population growth critical factor altering resource use patterns
  - Resource use conflicts
- High population growth in densely populated areas
  - <5 people/km² in desert areas: North & Southern Africa
  - <10 people/km² in tropical rainforest belt - Central Africa
  - >50 people/km² in West Africa
- Large inter-country variation
  - Nigeria (>110 m people), Ethiopia, DR Congo & South Africa (all >40 m people)
  - Most populous African countries have large areas of savanna
Use of African Savanna Biological Resources

- Direct & Indirect socio-economic benefits
- Consumptive & Non-consumptive use
- Subsistence & Commercial use

- **Daily domestic consumptive use**
  - most rural, poor people
- **Small, micro & medium enterprises (SMME’s)**
  - Fewer individuals, families & some communities with entrepreneurial skills
- **Industries, mainly export markets (using natural areas)**
  - Use specialized skills, technology & investment
  - Timber industries (for construction, furniture and plywood)
- **Conversion of woodland/savanna**
  - Other products/purposes: livestock, crops, infrastructure
- **Conservation & Nature-based tourism**
Conservation of African Savannas

- Quantitative review of species, ecosystems & protected areas for African Savannas problematic
  - savanna vegetation types diverse & over many countries
  - information only at country level for sites hosted by WCMC & IUCN
  - many inaccuracies in data - scarcity of reliable & complete field-based data
  - peoples’ livelihoods sustained by widespread use of indigenous knowledge of plant (fuelwood, poles & timber) & animal (wildlife & livestock) resources

- Diverse threats in African savannas
  - Direct human impacts generally localised
  - Secondary effects more serious
    - eg erosion, siltation & floods
  - Political destabilisation & war increase long-term negative effects
  - LACK OF POLITICAL WILL
Conservation approaches

- African Savannas globally known for
  - large mammals eg herbivores (elephant, buffalo, giraffe, hippopotamus, zebra & antelope) & predators (lion, cheetah & leopard)
  - Low human population low density across vast areas & concentration of people in small towns & villages

- The outcome is twofold:
  - Parks (protected areas) primarily designed to accommodate movement of wildlife, not plant species, with ecotourism
  - Reserves additionally incorporate people’s needs & socio-economic factors as prominent considerations in meeting conservation objectives through sustainable use approaches & conservation ideals
Conservation issues

- Parks legally gazetted protected areas in national legislation
  - But have unfortunate reputation of 'Parks on paper'
    - inadequately managed with biodiversity loss (perception?)
  - Requirements for adequate management:
    - Mobilisation of political will for
    - Adequate human, financial & infrastructural resources
    - Include people living in/around protected areas in decisions

- Sustainable conservation in African savannas
  - Requires 'real world' sustainable use solutions
Conservation & Nature-based Tourism

• Nature-based tourism
• Mainly non-consumptive use of biological resources
  • Fast-developing industry in savanna areas
  • Mainly in Southern & East African countries
  • Lodges, game viewing, safaris, big trees
Converting woodland/savanna for Other Uses

- Settlement & infrastructure;
- Livestock & crops (+ irrigation) – subsistence to commercial;
- Mining;
- Where is main loss of biodiversity?
Converting savannas for Other Uses

• Some examples of production systems with conversion

- Tropical fruit orchards: avocado, litchi, mango, nuts, etc
- Oil palm plantations
- Irrigation systems with vegetables & livestock
- Commercial timber plantations with pines, eucalypts, etc.
Timber industries at different scales

- Industries, mainly Timber for export & local use
  - Use specialized skills, technology & investment
- Several tree species selected from concessions
  - Sawn timber, joinery, veneer (plywood), parquet flooring, railway sleepers & diverse range of other products
Low level of Sustainable forest management

- Commercial timber use from woodlands not quantified
- Very little resource management
  - No silviculture for regeneration of target species
  - Much waste of useful timber
  - No control of influx of rural people for slash & burn agriculture
Subsistence & Commercial Use of Wood & NWFPs

- **Daily domestic consumptive use (subsistence)**
  - Most rural, poor people
  - From immediate vicinity of village

- **Small, micro & medium enterprises (SMME’s)**
  - Fewer individuals, families & some communities
  - Use resources & entrepreneurial skills
  - Earn income beyond daily livelihood needs (commercial)

- **Diverse products (mainly plants, also animals)**
  - Fuel wood & Charcoal
  - Poles for construction
  - Bark/roots/bulbs for Traditional medicine: practitioners & traders
  - Small furniture enterprises on streets & Woodcarving for curious & home utensils
  - Fibers for Basket & mat crafts
  - Food, fruit, juices, dyes, etc
  - Bush meat, caterpillars, etc

*Major impact on resources*
Subsistence & Commercial Use: Fuel wood & Charcoal

• Fuel wood: smaller trees & shrubs
  • burn wood in kilns on site
  • clear large tracts of tree stands
  • Big trade to cities/villages

• Charcoal: larger trees
Subsistence & Commercial Use: Poles

- Houses - medium-size; Fences - smaller & brush
  - Large volumes used
    - In Undifferentiated woodland in Owambo, Namibia
    - 45 tons in construction of typical farm
    - 0.5 tons per capita for annual maintenance
    - Annual consumption of wood in Owambo: ±600 000 tons
Subsistence & Commercial Use: Furniture & Wood carving

- Inefficient equipment
- Much waste
Subsistence & Commercial Use: Fibre crafts

- Basket & mat crafts
- Walls of homes
- Bee hives

Palm Hyphaene spp

Bamboo walls

Wine boxes

Women from a weavers group busy weaving new products

Gift boxes

Lamp shades

Testing market needs

Simple hand-made loom
Subsistence & Commercial Use: Traditional medicine

- Traditional medicine practitioners & traders
  - Bark
  - Roots & Bulbs
  - Fruit
Subsistence & Commercial Use:
Food, Fruit/Juices, Meat

- Juice from Carissa macrocarpa
- Indigenous jams for tourism market
- Sclerocarya birrea (marula) fruit nectar, jam and chutney
- Bark hive for honey
- Mopane worms
- Beans for soup
- Mushrooms

Fruit from wild to village market: CAR
Commercial SMMEs versus rural subsistence business
Management for Integrated & Sustainable, Multiple-Use from African Savannas

- Development of African savanna resources has two dimensions:
  - Integrated land use planning at a regional scale (across international boundaries within development regions)
  - Local scale (landscape level) planning & management within regions
Management for Integrated & Sustainable, Multiple-Use from African Savannas

Components of management systems:

- Policy for sustainable, integrated, multiple-resource use
  - Agriculture, forestry & nature conservation
  - Timber, NTFPs, Crops, Livestock & Eco-tourism
- Assessment of socio-economic needs (Products & services)
- Assessment of resource potential & availability
- Match use with availability - regulate harvests
  - Timber & NTFPs
- Appropriate extraction & transport systems for produce
- Strategic marketing of products (effective use of resources)
- Regeneration, rehabilitation & reforestation
- Monitoring of resource-use impacts
- Training & education of people
- Research programmes: Ecology & Socio-economics
Practice of Sustainable Forest Management requires a Legal Framework
Matching use needs with resource availability

CONCEPTUAL BASIS OF SUSTAINABLE RESOURCE MANAGEMENT

Biophysical Resources

- Diverse Plant Resources
- Resource dynamics: Disturbance & Recovery
- Physical Resources & constraints

Diverse Animal Resources

Human Resources

- Traditions & Structures: Institutional Structures
- Resource economics: Diverse use-values
- Community dynamics: Livelihoods

Resource-use practices: Land tenure

BASIS FOR Integrated, sustainable Resource Management
Generally local people alienated from conservation areas and timber concessions.
Better utilization of cut trees

Trees in Deciduous Woodland

POTENTIAL USES FROM TREE CROWNS

NON-WOOD (from live trees):
- Leaves (fodder, food & medicine)
- Flowers, fruit, seed
  (food, medicine, decoration, cultivation)

WOOD (from live and/or dead trees):
- Branches
  (Wood carving, fuelwood, charcoal, DIY packages)

POTENTIAL USES FROM MAIN STEM

NON-WOOD (from live/dead trees):
- Bark (medicine, fibre, exudates [gum, dye, rubber])

WOOD (from cut/dead trees):
- Bole
  (timber for construction, furniture, veneer, paneling, carving)
- Main Branches (50% of timber in woodland)
  (wood carving, fuelwood, charcoal, DIY packages)

Fruit vs Seed
Timber vs Carvings vs Bark

Basis for integrated resource use by different stakeholders:
Concessionaire, carpenter, wood carver, health practitioner, fiber crafter
Concessionaire vehicle to market for small entrepreneur: Agreements!
General approach for development of NTFP SMMEs

PRODUCT DEVELOPMENT PROCESS
Natural Resource : Cultivation : Harvesting : Processing : Marketing

Resources required for Success
- Plant Resources
- Technology
- Markets
- Information

Critical partnerships required for Success
- Government
- NGO's
- Private Sector
- Communities

'Strategic Products from Wild' models of success:
Different product groups : Different areas : Different parts of value chain

www.cpwild.co.za
Maintain essential Ecological Processes

- Disturbance & Recovery processes of system
  - Basis of biodiversity of system
  - Determine adaptations of biota
  - Necessary to maintain system in healthy state
- Other processes part of Disturbance/Recovery
  - Reproductive processes (flowering, fruiting, dispersal, germination & establishment)
  - Nutrient cycling processes
- Disturbance/Recovery processes & Rates of change
  - Basis of silviculture & management practices
  - Recognize scales of disturbance at different levels
    - Non-event, Incorporated or Disaster
    - At level of Individual, Population, Community or Ecosystem
- Management actions must relate to or simulate natural disturbance processes & regimes
FIRE: main factor in African Savannas

- Seasonal event
- Non-selective
- More intense with grass layer
FIRE: main factor in African Savannas

• Survival strategies (or lack of)
• Natural & integral part of vegetation dynamics
• Useful tool in woodland management
  • reduce & manipulate woody vegetation
  • favour regeneration & growth of selected species

Annual burning dry season

Pterocarpus angolensis regeneration stages

Fire role: species dominance change
How do we assess disturbance-recovery requirements for target species inside the forest?

From Forest inventory develop

GENERALISED MODEL OF STEM DIAMETER DISTRIBUTIONS

Stems/ha

Regular fire disturbance eg *Pterocarpus angolensis*

<table>
<thead>
<tr>
<th>Species 1</th>
<th>Inverse J-shaped</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species 2</td>
<td>Bell-shaped</td>
</tr>
<tr>
<td>Species 3</td>
<td>Static</td>
</tr>
</tbody>
</table>

Fire control for fire-sensitive species eg *Baikiaea plurijuga*

a. Different species in same stand

Size
## Fire management approach: Namibia

### Management class zones: Ecological requirements of target/dominant species

### Fire-control priorities: Inventory information (regeneration status) & fire-tolerance characteristics of dominant species

<table>
<thead>
<tr>
<th>Management group/class</th>
<th>Fire management</th>
<th>Fire control priority</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baikiaea improvement</strong>&lt;br&gt;Regeneration in shrub form</td>
<td>Total protection&lt;br&gt;Burn every 5 years in early dry season</td>
<td>Extinguish fire as soon as possible</td>
</tr>
<tr>
<td><strong>Baikiaea improvement</strong>&lt;br&gt;Regeneration mainly small trees</td>
<td>Burn every 3 years in early dry season</td>
<td>Limit burning area; allow fire to burn out</td>
</tr>
<tr>
<td><strong>Pterocarpus-Baikiaea-Guibourtia improvement</strong></td>
<td>Burn every 3 years in early dry season</td>
<td>Try to contain fire. Limit burning area; allow fire to burn out</td>
</tr>
<tr>
<td><strong>Pterocarpus improvement</strong></td>
<td>Burn every 2 years in early dry season</td>
<td>Limit burning area; allow fire to burn out</td>
</tr>
<tr>
<td><strong>Open woodland &amp; Grassland</strong></td>
<td>Burn annually in early dry season</td>
<td>Limit burning area; allow fire to burn out</td>
</tr>
</tbody>
</table>
Grazing/browsing important factor in Savannas

- Selective nature of grazers/browsers
  - Specific effects in specific layers of vegetation
  - Elephants damage bark & roots, e.g., *Pterocarpus angolensis* & *Acacia nigrescens* - increase susceptibility to fire damage
  - Insects cause severe cyclic defoliation of specific host species
Grazing/browsing important factor in Savannas

• Impacts of grazing/browsing >severe during droughts
• Intensive grazing could substitute controlled burning
  • Impacts vary, eg regeneration of target tree species
• Large mammal herds (elephant, buffalo, antelopes)
  • Natural grazers/browsers but replaced by livestock
  • How would increased wildlife and/or livestock impact on regeneration of forest species through grazing/browsing & burning for grazing & hunting?

Lack of fire & selective grazing by cattle cause:
  bush encroachment & loss of production
How do we manage for regeneration of harvested species in Timber concessions?

Is there adequate regeneration? What is regeneration?

Understorey conditions in Miombo woodland stands
Seedling banks of target species

• Many seedlings of main canopy species in understorey
  • Dense shrubby to dense grass understorey
  • = Seedling banks of Brachystegia species
• BUT very few to no saplings & poles!

• Few seedlings of rare Afzelia quanzensis near scattered big trees
• Some areas with concentrations of Pterocarpus angolensis with plants in all stages

• When do Seedling Bank plants grow into trees?
Rootstocks of seedling bank plants of target species:
Why do seedlings not grow into poles?

Brachystegia spp

Millettia stuhlmannii

Afzelia quanzensis
Silvicultural management of regeneration: Spot fire management
Silvicultural management of regeneration in concessions: Selective coppice management
Silvicultural management of regeneration in concessions:
Selective pruning
Silvicultural management of regeneration: Selective thinning
Development of alternative timber crops via Slash & Burn sites

- Miombo regrowth in abandoned Slash & Burn sites
- Selective thinning & pruning
- Ownership of silviculturally managed regrowth
- Can we combine Timber harvesting with controlled Slash & Burn
Miombo regrowth in abandoned Slash & burn sites

= S&B site abandoned 7 yrs ago

Interior of stand advanced

S&B site abandoned 10 yrs ago
Can we combine Timber harvesting with controlled Slash & Burn?

- Extensive potential areas of secondary forest
- Productive Miombo regrowth of several target timber species in abandoned Slash & burn sites
  - Many of species with stunted/arrested seedling banks under woodland canopy
- Selective thinning & pruning to improve tree form
- Financial benefit to farmer if sold to concessionaire
- but the problem is
- Ownership of silviculturally managed regrowth in abandoned slash & burn sites?
Concluding remarks

- African woodlands/savannas include floristic & structural diversity
- Savannas basis of livelihood & business of majority of African people: rural & urban
- Formal conservation status is insecure because of uncontrolled resource use and fires
- Many misconceptions of savanna ecology & dynamics
  - For example: Fire; Slash & burn agriculture
- Sustainable, participatory, integrated & multiple resource use management can provide
  - Diverse use needs of diverse resource users
  - Infrastructure, agriculture, forestry & nature conservation
  - Resource use in BALANCE with conservation ideals
Mosaic of different types of undifferentiated woodland, Namibia

Thanks for your Interest

Muito Obrigado