Financing improved forest management by carbon valuation, a bioeconomic modelling approach applied to Central African concessions

Florian CLAEYS

Forests and Livelihoods : Assessment, Research and Engagement (FLARE)
Musée de l’Homme, Paris
November 28th, 2015
Summary

Context

Central Africa, a climate change hotspot
Forestry and adaptation in Central Africa

Methodology

Forest inventory and climate time series
Forest dynamics model
Feasibility study of IFM projects

Results

Forest dynamics and climate change
Carbon stock change
Harvest profiles
Carbon BEP

Conclusion
Central Africa, a climate change hotspot

- Extreme seasonal temperature and precipitation (Diffenbaugh and Giorgi 2012)

The occurrence of the 1986-2005 maximum JJA seasonal temperature in the 2016-2035, 2046-2065 and 2080-2099 periods of RCP 4.5 (left) and RCP 8.5 (right). The panels show the absolute occurrences as the percent of years in each 20-year period. The frequency of occurrence of the 1986-2005 maximum JJA seasonal temperature value is, by definition, 5% at each grid point during the 20-year 1986-2005 period.
Forestry and adaptation in Central Africa

▶ Great emphasis on mitigation, with REDD+ (Bele et al. 2011, Somorin et al. 2012)

▶ Climate change adaptation
  ▶ Hydrology and energy: wetter wet seasons, drier dry seasons (Beyene et al. 2014, Faramarzi et al. 2013)
  ▶ Agriculture: reduction of yields and productivities (Dinar et al. 2012, Knox et al. 2012)

▶ Rise of forest adaptation issues
  ▶ Research projects by GIZ, CIFOR and CIRAD (Sonwa et al. 2014)
  ▶ Integration of adaptation in REDD+ (Elias et al. 2014)

▶ Which prospects for Improved forest management (IFM)?
  ▶ Voluntary change of logging practices (Griscom and Cortez 2013)
  ▶ Carbon credits valued through voluntary markets (Goldstein et al. 2014)
  ▶ Carbon-based compensatory approach (Karsenty et al. 2012)
  ▶ Case of Central African forest concessionaire (Bayol et al. 2012; 2014)
Improved forest management in Central African concessions

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Références

M’Baïki dataset

Central African Republic (CAR)
- 6 x 4 ha : Boukoko
- 4 x 4 ha : La Lolé

30 yrs long monitoring 1982-2012
- 239 species
- 37 539 trees
- 639 815 measures

3 treatments
- Control
- Logging
- Logging and thinning

M’Baïki dataset (Bedel et al. 1998)
Climate dataset

- Simulation data
  - Atmospheric model CMIP5-CNRM (Voldoire et al. 2013)
  - 2 RCP (Representative Concentration Pathways)
    - RCP 4.5 and RCP 8.5
Forest dynamics model

Mixture of inhomogeneous matrix models for species-rich ecosystems

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- **Usher matrix model** (Usher 1966; 1969)
  - Issue of sample size (Picard et al. 2008)
- **Species clustering into groups** (Gourlet-Fleury et al. 2005)
  - 3 processes
    - Growth
    - Death
    - Recruitment
  - Variables selection for each group (Monni and Tadesse 2009)
    - 9 variables
      - 2 diameter variables
      - 2 competition indices
      - 5 climate variables
Logging company model

UML simplified representation

**Forest resources**
- Species
- Diameters
- Quality
- Carbon

**Standing timber**
- Surface
  - 100,000 ha

**Cutting**
- Capacity Yield
  - 8,000 tr.yr⁻¹; 100 %

**Logging choices**
- Commercial species
  - FCD
  - MCD
- 22; 25 yrs; 80 cm

**Sawmill**
- Capacity Yield
  - $7 \times 10^3$ m³.yr⁻¹; 30 %

**Logs yard**

**Kilns**
- Capacity Yield
  - $6 \times 10^3$ m³.yr⁻¹; 90 %

**Outputs yard**

**Export yard**
- Timber revenue
Feasibility study of IFM projects

- Simulation over 2012-2100
  - M’Baïki 2012 control average stand
  - Modelled steady state
  - Current climate, RCP 4.5, RCP 8.5

- "Extension of rotation age" (ERA) projects (Vcs 2013)
  - Alternative logging scenario
    - Felling cycle duration (FCD) : [25 ; 50] yrs
    - Minimum cutting diameter (MCD) : [80 ; 120] cm
  - Baseline : {25 yrs; 80 cm} ; 2 trees.ha$^{-1}$.yr$^{-1}$

- Break-even analysis
  - Net present value (NPV)
    - Shortfalls from reduced timber logging
    - Revenu from carbon credit sales
  - Calculations assumptions
    - Net margin : 10 %
    - Buffer rate : 20 %
    - Discount rate : sensitivity analysis

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Forest dynamics and climate change

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High dependence between forest dynamics and climate
  • Temperature more influential than rainfalls

High impact of climate change: severe thinning

Acceleration of transformation from 2030
Carbon projections to 2100

Time variation of carbon gain for several alternative scenarios to the baseline logging scenario (in tCO₂·ha⁻¹), under several RCP.

- Increased carbon stocks with climate change:
  - CO₂ fertilization (Lewis et al. 2009)
- Opposite effects between logging and climate change
- Different temporalities in FCD and MCD effects
Harvest projections to 2100

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- **Step-like reduction of timber income**
  - **Primary forest premium** (Putz et al. 2012)
  - **No logging scenario is exception to this**
    - **Unsustainability** of management plans (Zimmerman and Kormos 2012)

- **No economic effect of climate change**
  - **Discrepancy** between impacts on forest stands and logger’s perception
  - **Urgent need for adapted incentives or rules**
Carbon break-even price

**Feasibility of ERA projects**
- Forest carbon as a cheap mitigation option (Grieg Gran 2006; 2008)
- True for primary forests (non-restrictive management rules)

**Major issues of acceptability and perenniality**
- Mismatch between public and private interests
- Increased expensiveness for further logged forests

Discount rate sensitivity.
Conclusion

▶ Key messages

▶ Two major challenges for Central African production forests
  ▶ Climate change: adaptation and mitigation
  ▶ Timber production in the long run

▶ Weaknesses of current logging practices
  ▶ Unsustainability of a mining-like harvesting
  ▶ Insensitivity to climate change impacts on forest stands

▶ Potential of a carbon-based compensatory approach
  ▶ Short-term: feasible in some limited cases
  ▶ Long-term: not a solution

▶ Prospects

▶ Improve the realism of model
  ▶ Dynamic model of logger’s choices

▶ Broaden the scope of study
  ▶ Other climate models
  ▶ Company heterogeneity
  ▶ Other IFM projects: post-logging silviculture
References


References II


References III


### Acronyms I

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tbody>
<tr>
<td>BEP</td>
<td>break-even price</td>
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<tr>
<td>CAR</td>
<td>Central African Republic</td>
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<td>CIFOR</td>
<td>Centre for International Forestry Research</td>
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<td>CMIP5</td>
<td>Coupled Model Intercomparison Project Phase 5</td>
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<tr>
<td>CIRAD</td>
<td>Centre for International Cooperation in Agricultural Research for Development (Centre de coopération internationale en recherche agronomique pour le développement, Montpellier, France)</td>
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<tr>
<td>CNRM</td>
<td>French National Centre for Meteorological Research (Centre national de recherches météorologiques, Toulouse, France)</td>
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<tr>
<td>ERA</td>
<td>&quot;Extension of rotation age/cutting cycle&quot;</td>
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<tr>
<td>ERA</td>
<td>&quot;Extension of rotation age&quot;</td>
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<tr>
<td>FCD</td>
<td>felling cycle duration</td>
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<tr>
<td>FLARE</td>
<td>Forests and Livelihoods : Assessment, Research and Engagement</td>
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<tr>
<td>GIZ</td>
<td>Deutsche Gesellschaft für Internationale Zusammenarbeit Société allemande de coopération internationale</td>
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<td>IFM</td>
<td>Improved forest management</td>
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<td>JJA</td>
<td>June-July-August</td>
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<td>MCD</td>
<td>minimum cutting diameter</td>
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<td>NPV</td>
<td>net present value</td>
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<td>RCP</td>
<td>Representative Concentration Pathway</td>
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<td>REDD+</td>
<td>&quot;Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries&quot;</td>
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<tr>
<td>SBSTA</td>
<td>Subsidiary Body for Scientific and Technological Advice</td>
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<tr>
<td>UML</td>
<td>Unified Modeling Language</td>
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<tr>
<td>VCS</td>
<td>Verified Carbon Standard</td>
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