Mitigation strategy and the REDD:

Application of the GLOBIOM model to the Congo Basin region

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Mitigation strategy and the REDD: Application of the GLOBIOM model to the Congo Basin region

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INTRODUCTION




Introduction

REDD+ : Reducing Emissions from Deforestation and forest Degradation in developing countries

- Idea that reducing deforestation could be an efficient and cheap strategy to fight against climate change
- International community should transfer money to developing countries which make efforts to reduce deforestation or forest degradation

Introduction

- First talks in 2005, launched in 2008, part of the post-2012 Kyoto protocol ?

- From RED to REDD+ : avoiding deforestation + avoiding forest degradation + enhancing forest carbon sequestration

- Global REDD+ system has not been yet decided => gradually taking shape. One implementation could follow 3 phases:

  1/ REDD+ strategy definition and capacity building

  2/ implementation of policies and measures to reduce emissions

  3/ full UNFCCC compliance

Introduction

Core idea is performance-based-payments

- Main issues
  - Reference level: historical vs. prospective approach
  - Performance indicators and MRV (Monitoring, Reporting and Verification)
  - Assessment of the cost of these efforts
  - Source of the funding: carbon markets, fund-based finance, voluntary contributions
  - Payments to carbon rights holders: direct, through government, through separate REDD+ fund

Introduction

- Requirements
  - Vertical integration across different scales: global-national-local system
  - Horizontal integration across sectors: need for a broad set of policies (land tenure, institutions, forestry, agriculture, energy)

Introduction

- The role of agriculture in REDD+
  - agriculture is a driver of deforestation => $\frac{3}{4}$ of tropical deforestation is due to agriculture
  - mitigation costs depend on the profitability of agriculture
  - Status of agro forestry and plantations
  - Alternatives to subsistence agriculture => off-farm jobs opportunities
  - Role of agriculture/forests in national development strategy

INTRODUCTION

GLOBIOM




GLOBIOM

DEMAND

Exogenous drivers
Population growth, economic growth

- Wood products
- Food
- Bioenergy

28 regions

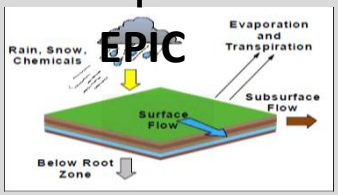
PROCESS

- Primary wood products
- Crops

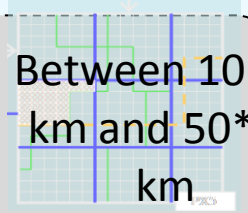
SUPPLY

Aggregation in larger units (max 200*200 km)

Biophysical models



RUMINANT



Between 10*10 km and 50*50 km

GLOBIOM

Bottom-up approach: detailed land characteristics

- Global database (Skalsky et al., 2008)
  - Sources of data: global observation data, digital maps, statistical and census data, results of complex modeling
  - Thematic datasets: land cover, soil and topography, cropland management, climate

⇒Support bio-physical models

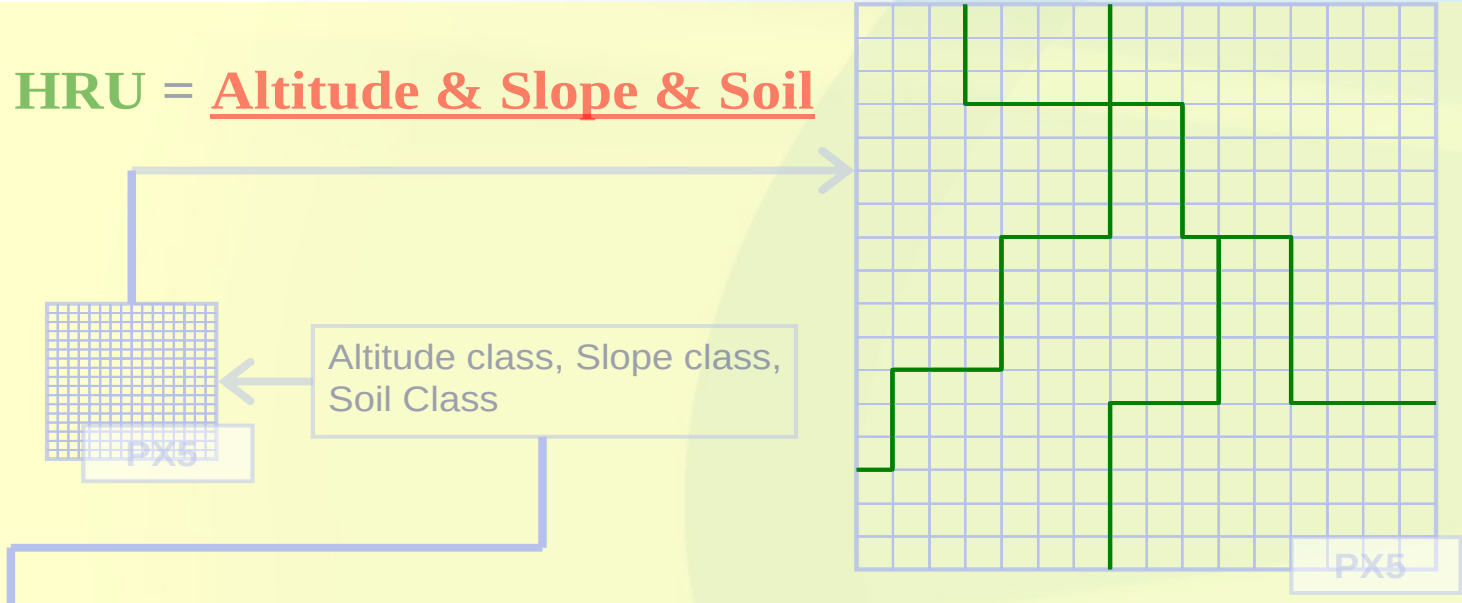
⇒Source of data on land cover for GLOBIOM

⇒Tool for identification of the gaps in availability of necessary global data

GLOBIOM

Approach for data harmonization

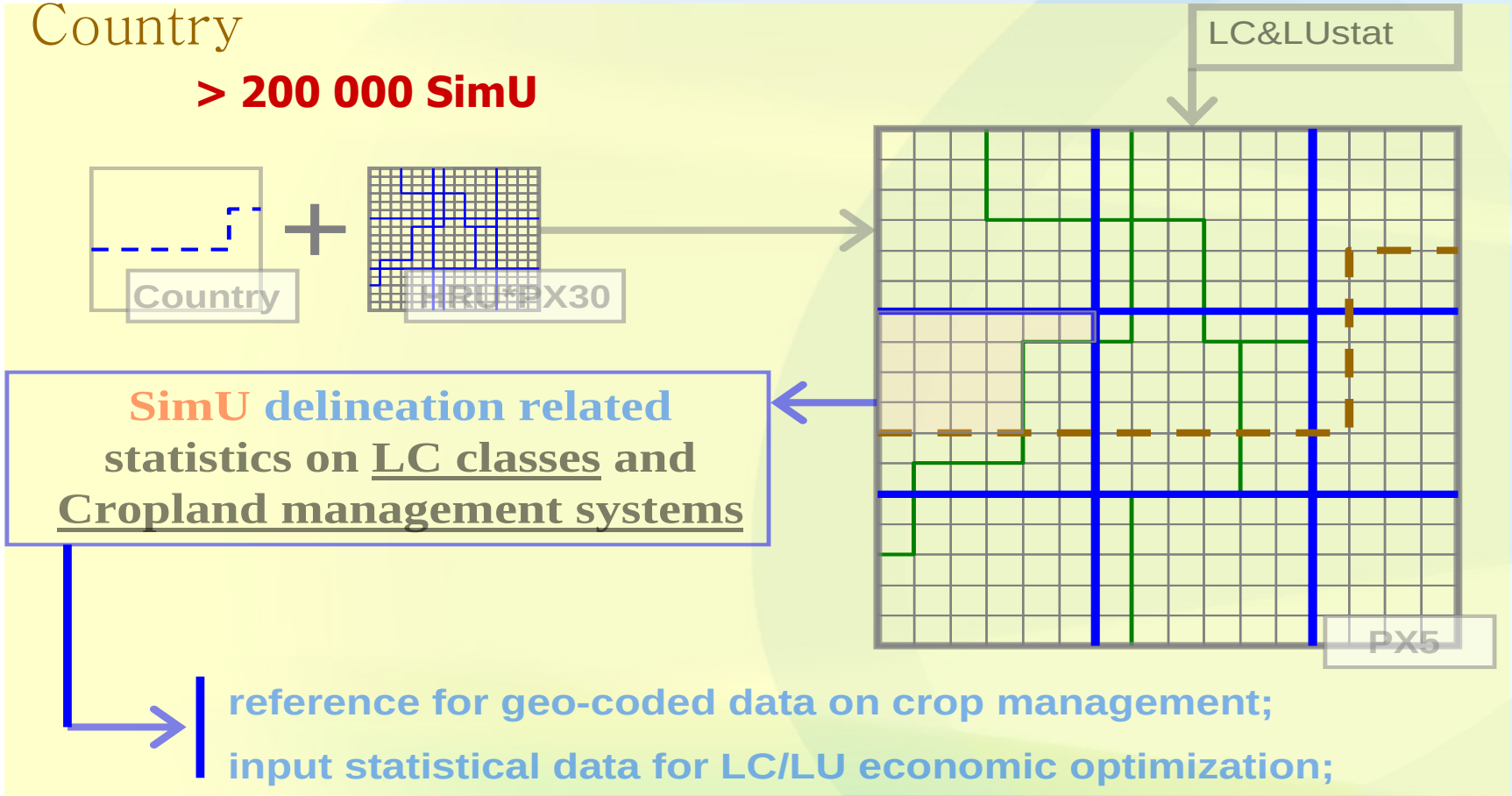
- Homogeneous response units (HRU)



Source: Skalský et al. (2008)

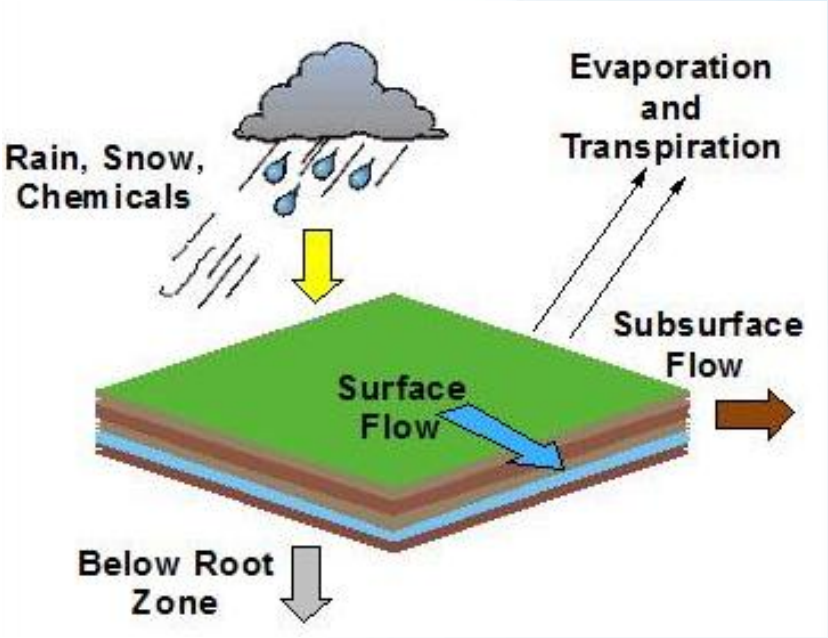
GLOBIOM

- Simulation Units (SimU) = HRU & 50x50km grid & Country



Source: Skalský et al. (2008)

GLOBIOM



Processes

Weather, Hydrology, Erosion,

Carbon sequestration, Crop growth, Crop rotations, Fertilization, Irrigation,…

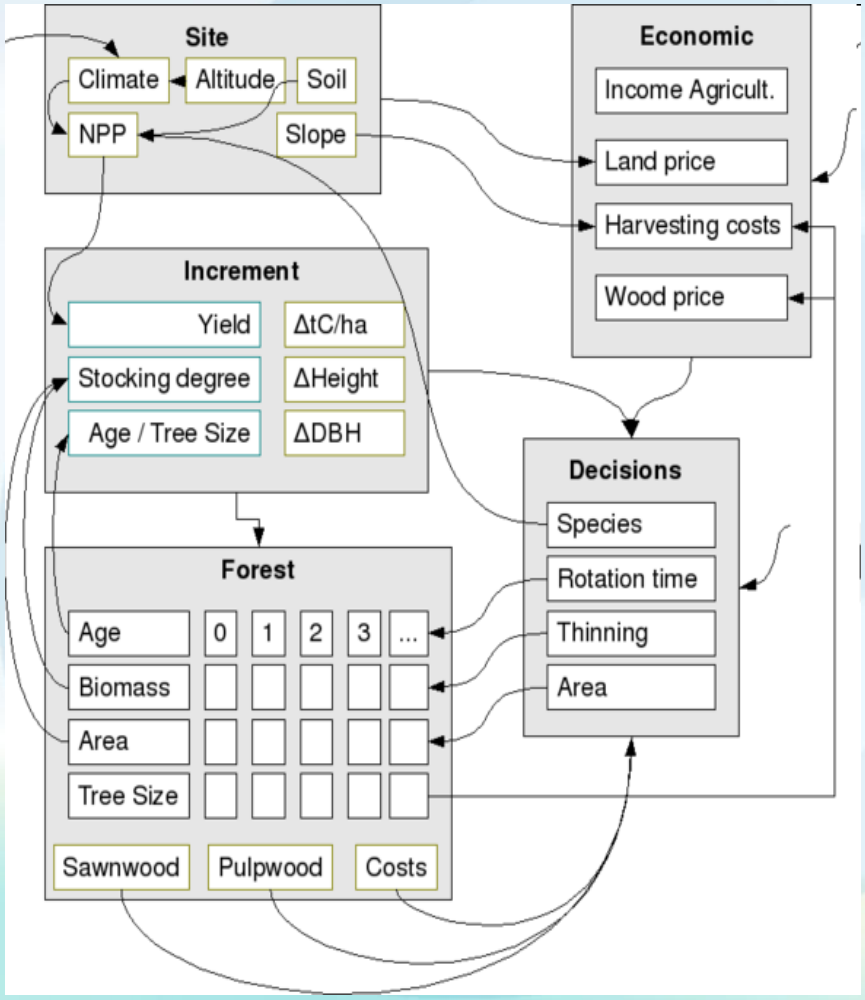
17 crops, 4 management systems (subsistence, low input, high input, high input irrigated)

=> Outputs: Crop yield, Water requirement, Fertilizers requirement, Environmental indicators

Biophysical models: G4M for Forests

- **Step 1**: Downscaling FAO country level information on above ground carbon in forests (FRA 2005) to 30 min grid (Kinderman et al., 2008)
- **Step 2**: Forest growth functions estimated from yield tables

=> Outputs: Annual harvestable wood, Harvesting costs, Carbon stock



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Supply representation

- Flexible Aggregation reflects the trade-off between computational time and land heterogeneity representation
- Implicit Leontieff supply functions

  technology 1 (rainfed) → yield 1 + constant cost 1

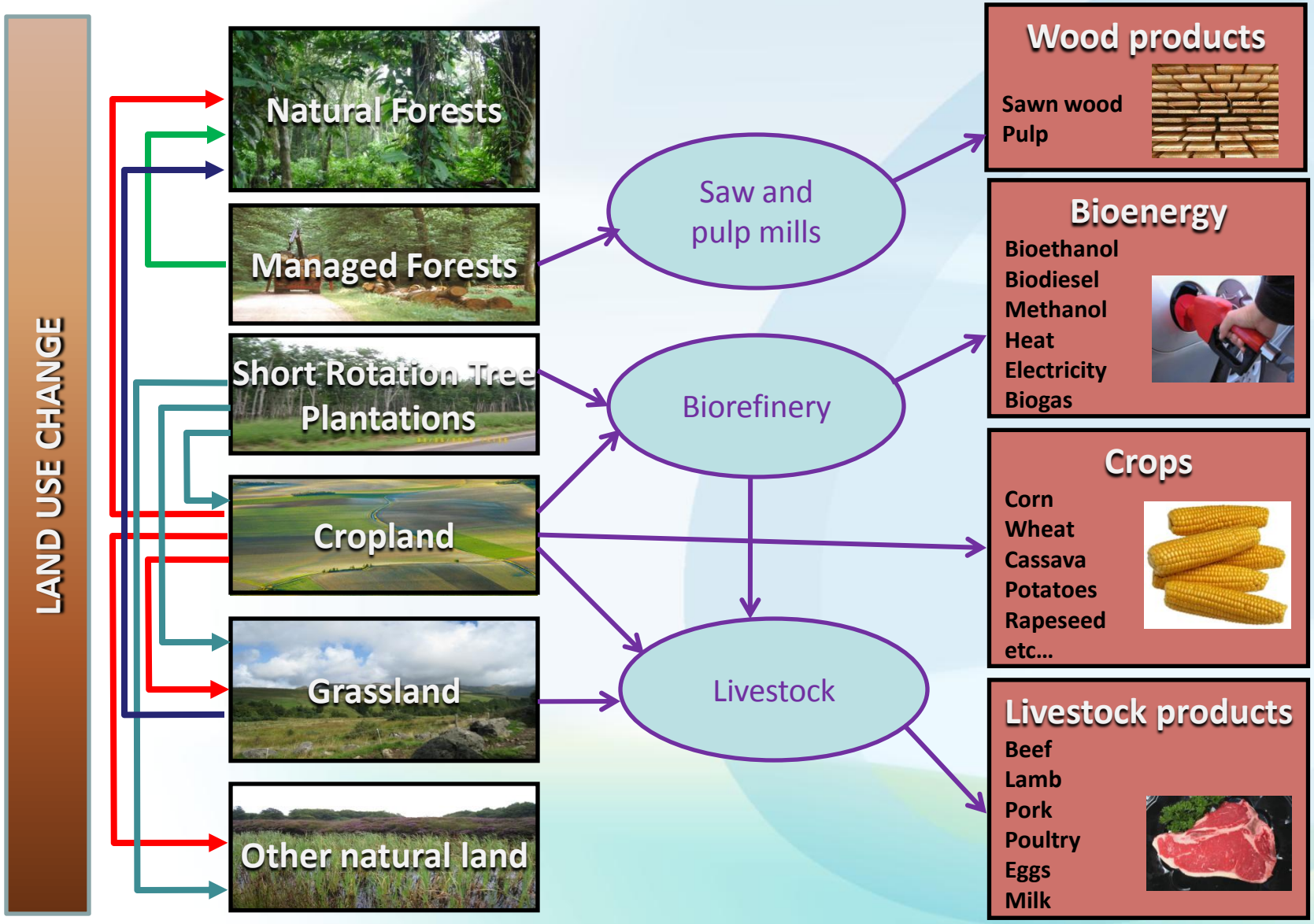
  technology 2 (irrigated) → yield 2 + constant cost 2
- Endogenous productivity change possible through:
  - Reallocation of the production to more productive units
  - Change in management systems

GLOBIOM

Demand representation

- Regional level (28 regions)
- Explicit demand functions (linearized non linear function), own-price elasticities taken from USDA
- Exogenous constraints
  - Minimum calorie intake (differentiated between vegetable and meat) based on population increase and FAO food projections (Bruinsma)
  - Minimum processed wood demand based on population and GDP p.c.
  - Minimum bioenergy demand (POLES model, WEO,…)

Supply chain



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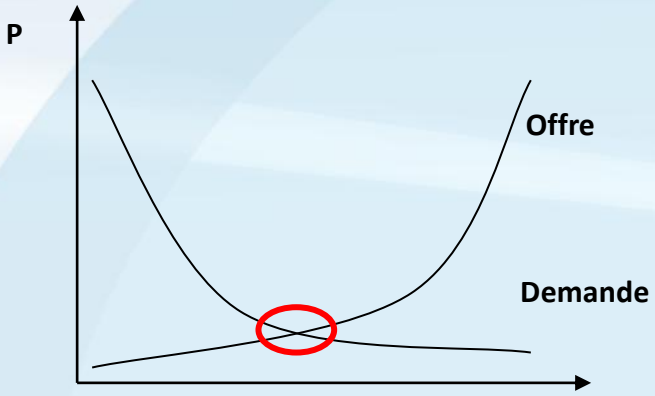
Optimization model

- Objective = Maximization

of global welfare i.e. producer and consumer surplus



Spatial equilibrium model

- Homogenous product (price differences = trade costs)
- Endogenous bilateral trade flows (minimization of trading costs)

- Recursive dynamic

GLOBIOM

- Main outputs
  - land use (cropland, natural and managed forests, short rotation tree plantations, grassland and other natural land),
  - CO2 emissions related to land use change,
  - spatially explicit agricultural production (19 crops, 6 livestock products),
  - spatially explicit forest production,
  - food consumption and food prices,
  - bilateral trade flows

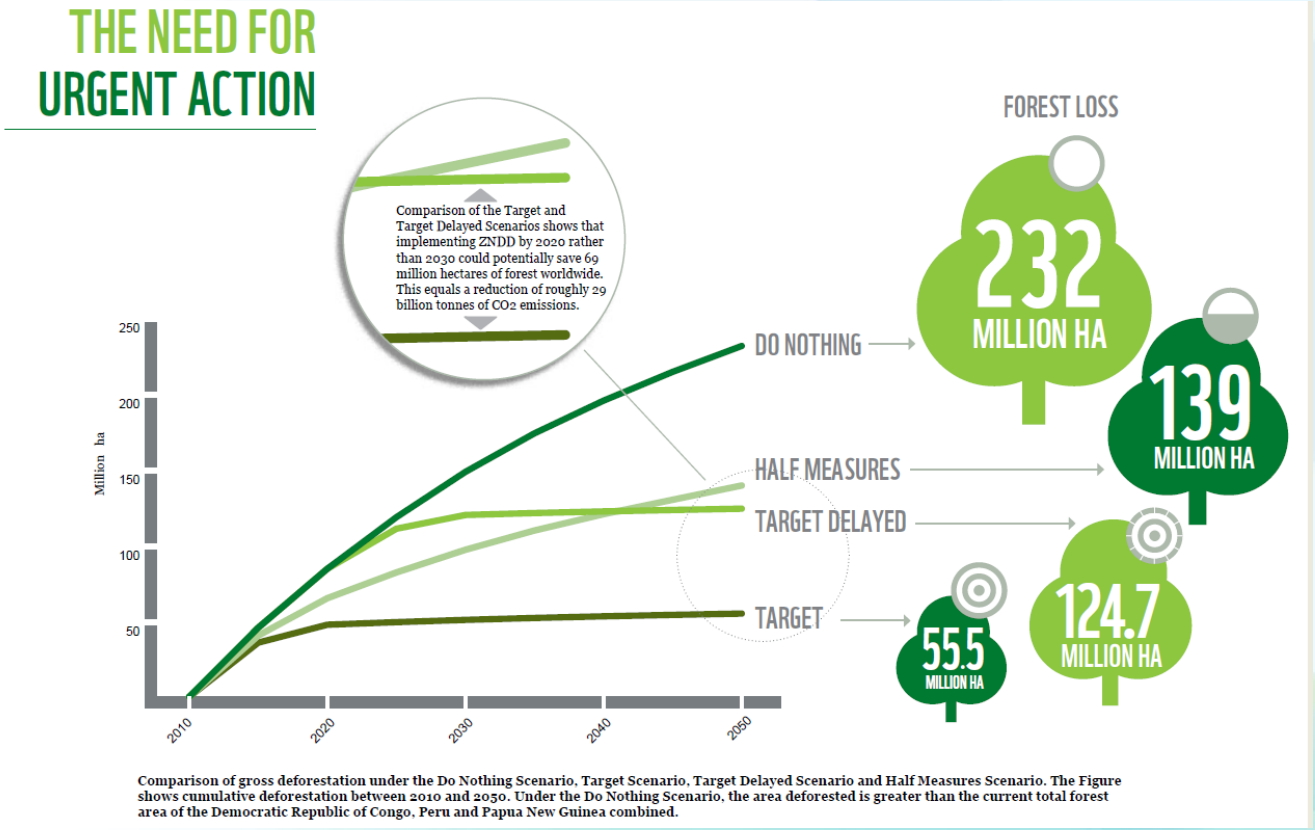
GLOBIOM

Examples of issues addressed with GLOBIOM

- Bioenergy => Havlik et al. (2010), Mosnier et al. (2010), Fuss et al. (2011)

GLOBIOM

- Deforestation: the Living Forest Report (WWF-2011)



Comparison of gross deforestation under the Do Nothing Scenario, Target Scenario, Target Delayed Scenario and Half Measures Scenario. The Figure shows cumulative deforestation between 2010 and 2050. Under the Do Nothing Scenario, the area deforested is greater than the current total forest area of the Democratic Republic of Congo, Peru and Papua New Guinea combined.

GLOBIOM

- GHG emissions
  - "Climate change mitigation and food consumption patterns" , Valin et al. (2010)
  - "Analysis of potential and costs of LULUCF use by EU member states", Bottcher et al. (2009)
  - "Production system based global livestock sector modeling: Good news for the future", Havlík et al. (2011)

INTRODUCTION
GLOBIOM

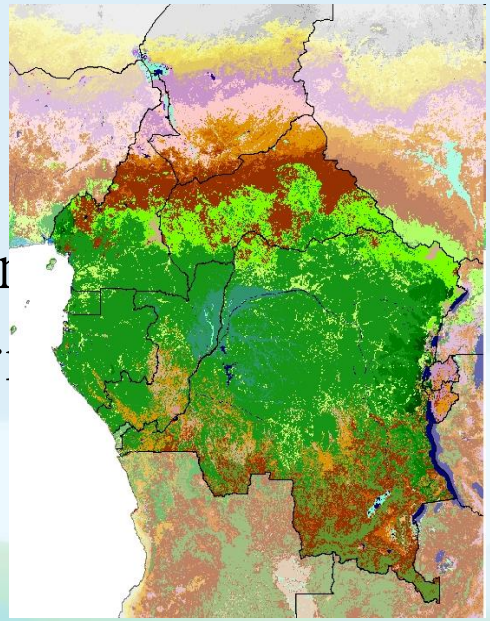
REDD IN THE CONGO BASIN




REDD in the Congo Basin

6 countries: Cameroon, Republic of Congo, Democratic Republic of Congo (DRC), Gabon, Central African Republic (CAR), Equatorial Guinea

- Total dense forest area:
  - 162 million ha
  - 2d rainforest area after Amazon
  - 80% of the Congo Basin countri territory



=> Strong interest in REDD+

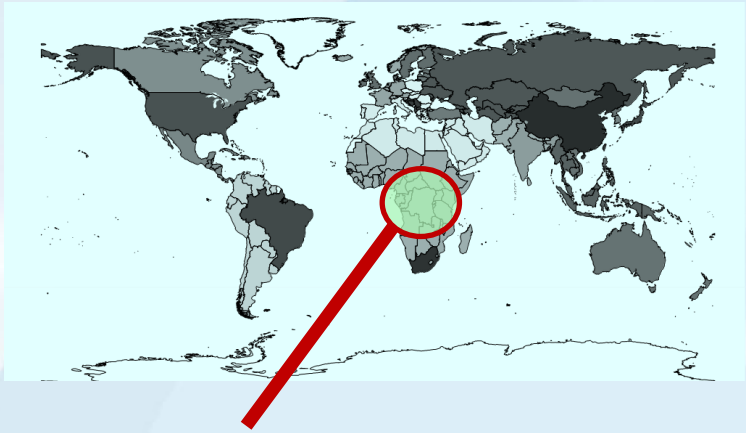
REDD in the Congo Basin

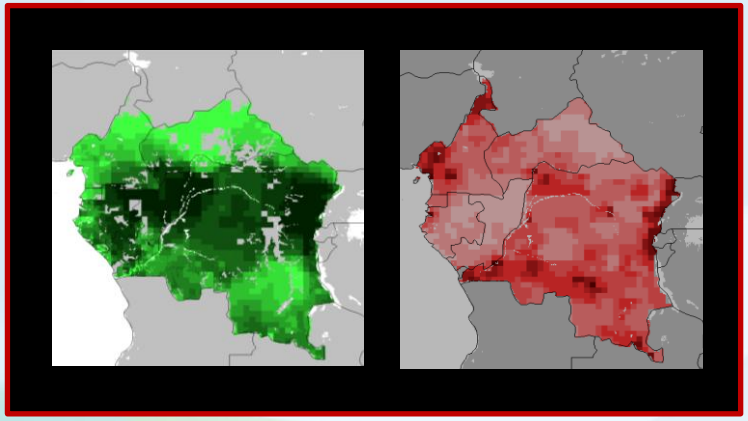
- Low historical level of deforestation in the region: 0.17% per year over 1990-2000 compared to 0.5% in Brazil
- 70% of cropland for subsistence agriculture => food production per capita has decreased over the last decade
- Main drivers of deforestation and forest degradation:
  - shifting agriculture
  - illegal logging
  - fuel wood collection
  - agricultural plantations in some part of the region

REDD in the Congo Basin

CONGOBIOM

- Detailed representation of land use activities (1550 simu between 10x10 and 50x50 km)
- Internal transportation costs
- Spatial representation of wood demand
- Cocoa and coffee added
- Delineation of forest concessions and

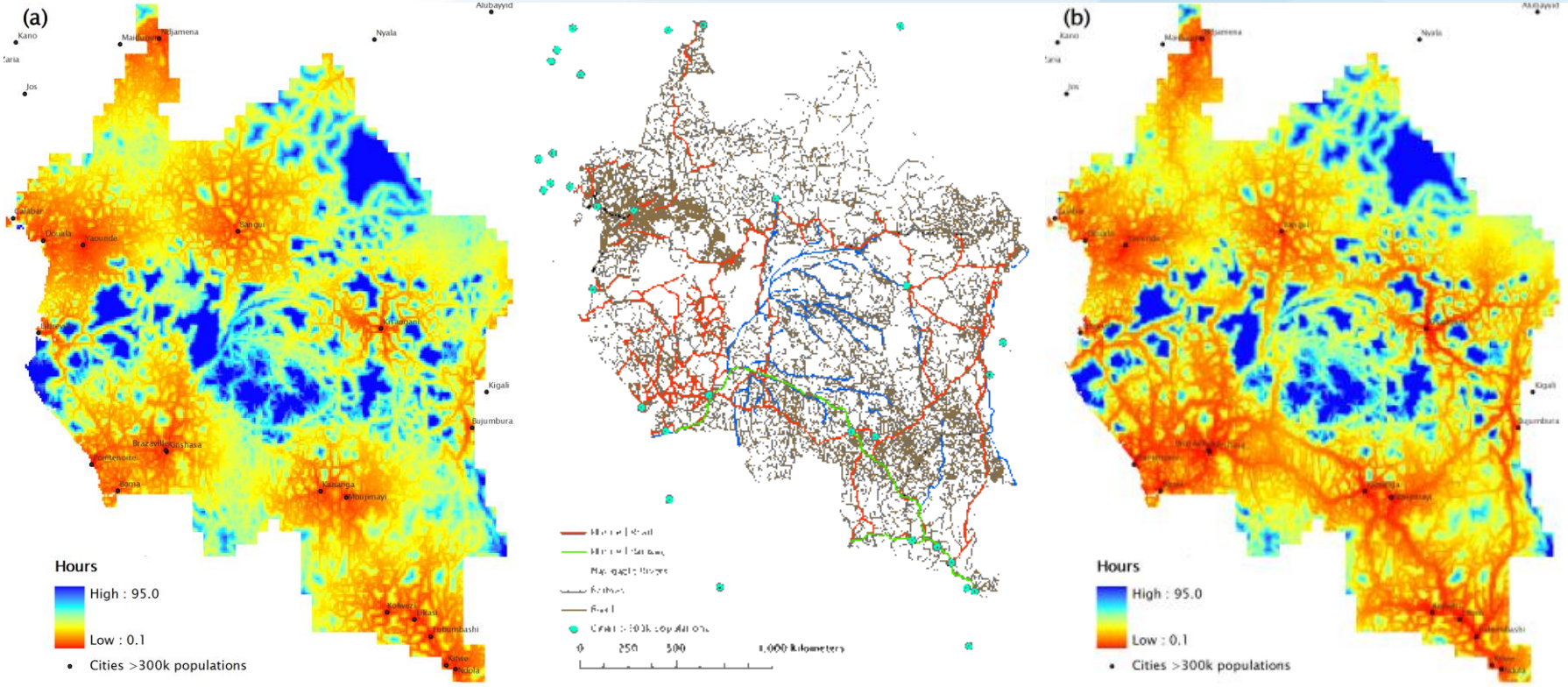




REDD in the Congo Basin

	Scenario	Description	REDD
International drivers	Meat	↑15% global demand	↓ 0%, 50%, 75%, 95%
	Biofuel	↑100% demand for 1st generation biofuels	↓ 0%, 50%, 75%, 95%
Internal drivers	Infrastructure	Planned infrastructures realized	↓ 0%, 50%, 75%, 95%
	Productivity	↑30% yields for cash crops, 100% for other crops	↓ 0%, 50%, 75%, 95%
REDD	REDD-L	No participation of Congo Basin in REDD	↓ 0%, 50%, 75%, 95% (only for ROW)

REDD in the Congo Basin



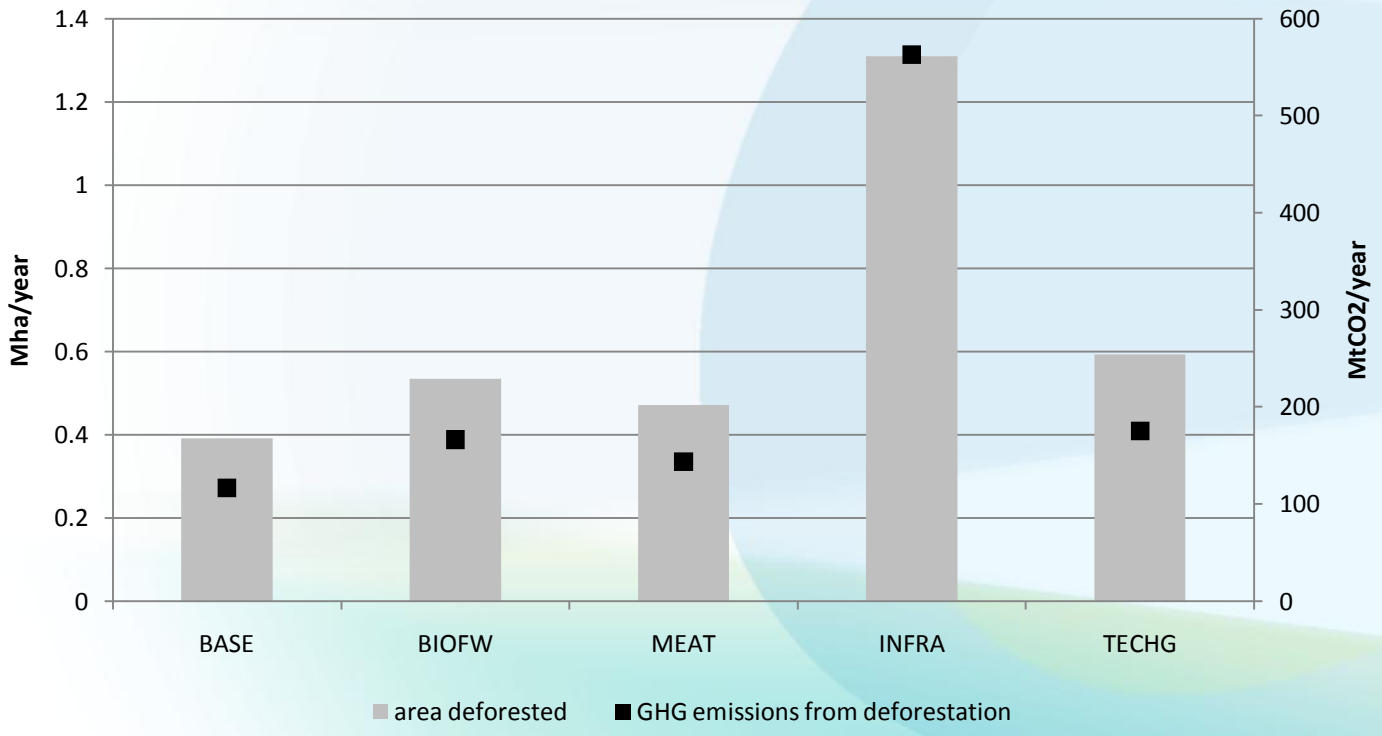
Transport time with existing infrastructures (Circa 2000)

Transport time with new infrastructures

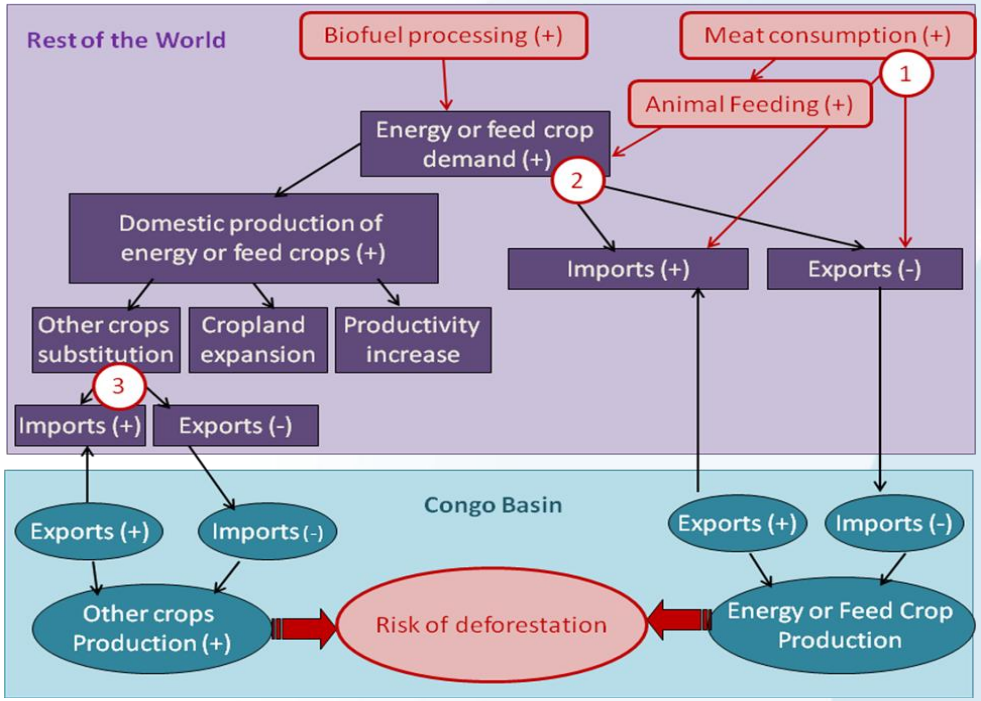
***Source*: National Ministries, World Bank**

REDD in the Congo Basin

- Average deforested area (in million hectares) and average GHG emissions (in million tons CO2) from deforestation per year over the period 2020-2030 in the Congo Basin



External drivers



Channels of transmission

1/ Through trade of the product itself

2/ Through trade of the intermediate product

3/ Through trade of other crops

Without increase in agricultural competitiveness in Congo Basin, the substitution effect dominates (3)

⇒ Biofuel scenario = +0.14 million ha deforested per year (+50%)

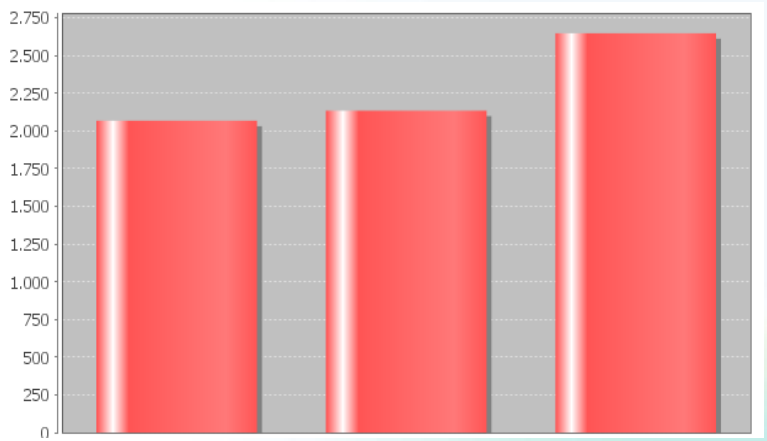
⇒ Meat scenario = +0.09 million ha deforested per year (+30%)

Internal drivers

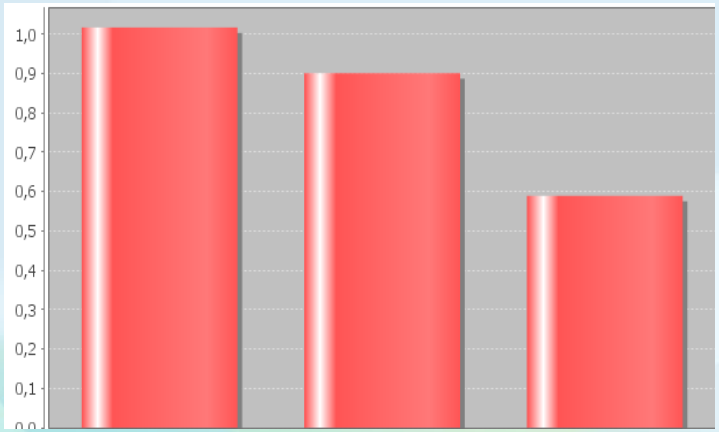
COST / TON=
(Cost of production per hectare+ other costs per hectare)/ Yield
+ Internal transportation cost

Both scenarios (productivity and infrastructures) reduce the unit cost of agricultural and forestry products => stimulate local demand

Calorie Consumption (kcal/cap/day)



Crop price index

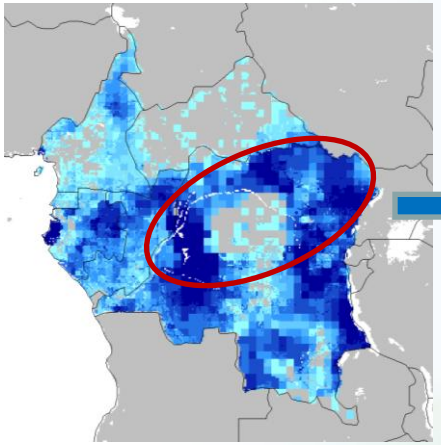


Internal drivers

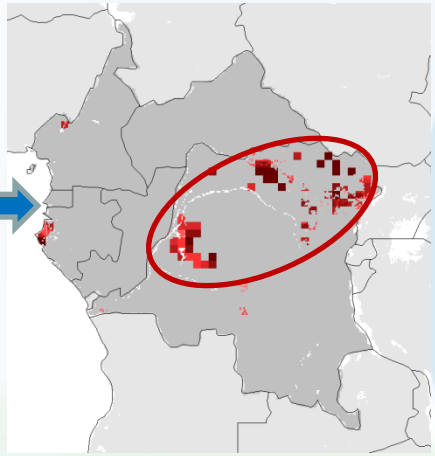
But very different effects in terms of deforestation patterns !

Infrastructure scenario : + 0.6 Mha deforested/year (x3)

Transport cost difference



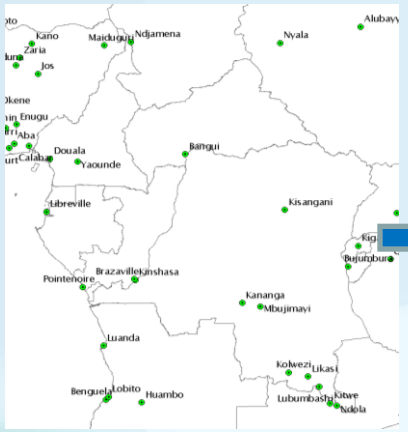
Deforestation due to cropland



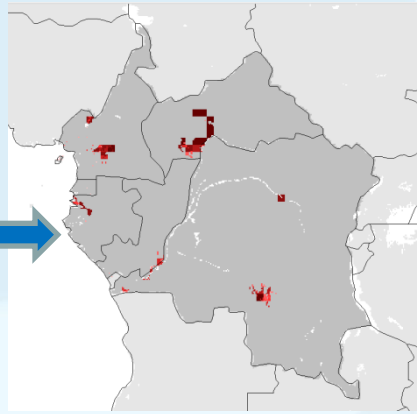
=> Deforestation in DRC dense forest

Productivity scenario : +0.2 Mha deforested/year

Main cities



Deforestation due to cropland



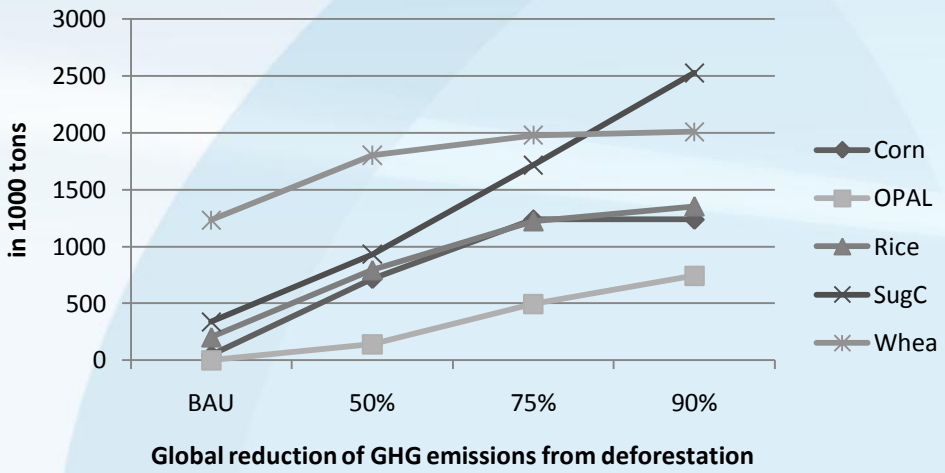
=> Deforestation close to the big cities

REDD in the Congo Basin

Food security

- Crop price index

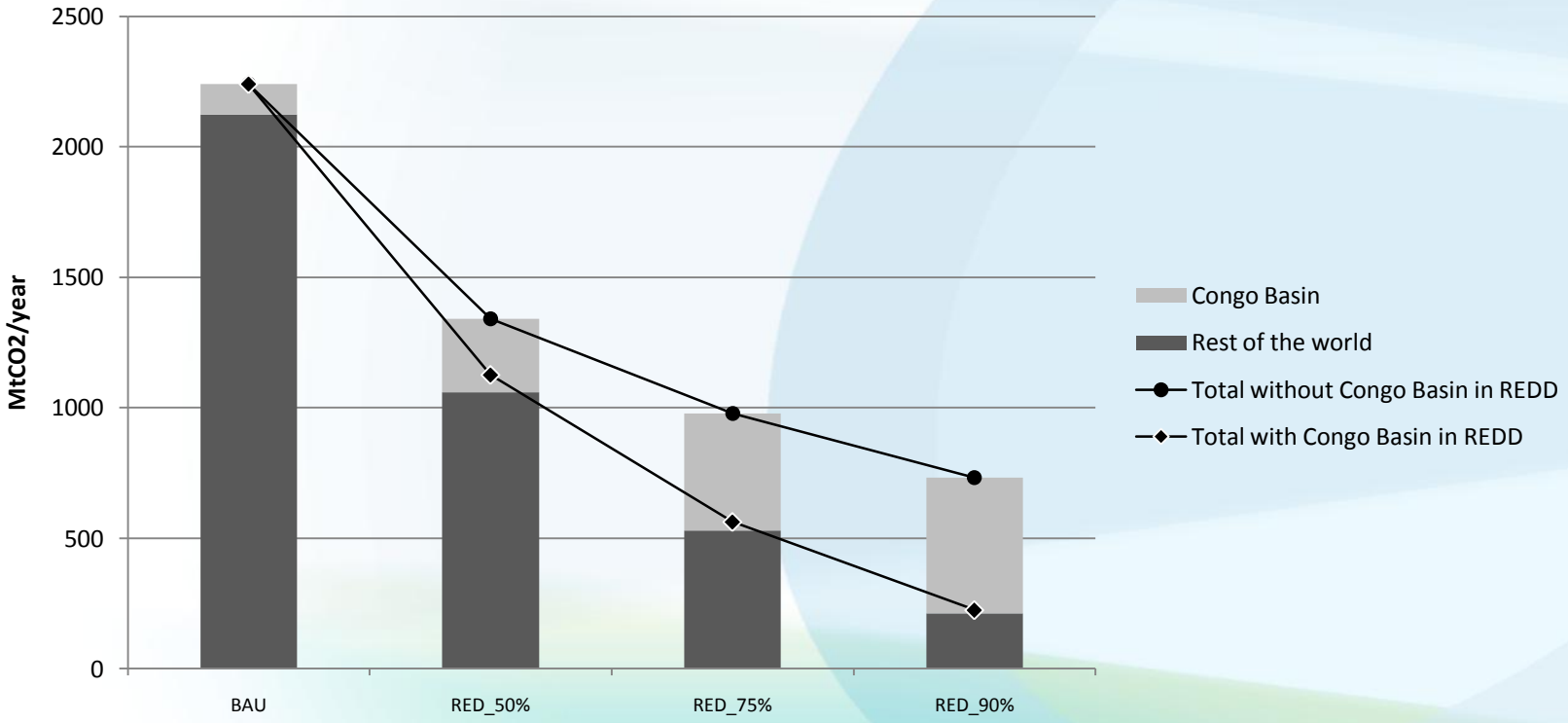
	Global reduction of GHG emissions from deforestation			
	BAU	**-50%**	**-75%**	**-90%**
Congo Basin				
BASE	1.02	1.19	1.38	1.61
BIOFW	1.02	1.42	1.85	2.52
MEAT	1.02	1.28	1.49	1.71
INFRA	0.90	1.09	1.24	1.47
TECHG	0.59	0.68	0.81	0.96
REDL	1.02	1.04	1.06	1.07



- Main imports (1000T)

REDD in the Congo Basin

Leakage effect



INTRODUCTION
GLOBIOM
REDD IN THE CONGO BASIN

CONCLUSION




Conclusion

REDD issues that can be addressed with GLOBIOM:

- what would be the deforestation levels without REDD (reference levels) ?
- impact of different deforestation and forest degradation drivers (external/internal, energy/wood/food production)
- cost and efficiency of different mechanisms to reduce deforestation and forest degradation
- impact of these mechanisms on agricultural sector and food markets

Conclusion

From the Congo Basin experience, the modeling exercise:

- gives an illustration of the value of information
- highlights the necessity of including agriculture in discussions around REDD+ and the need for horizontal cooperation
- what will the future look like ? Prospective exercise which requires long term view => what is the development strategy of the country ?
- help building an argumentation for international negotiations

Conclusion

Future challenges relevant for Africa

- Adaptation of GLOBIOM to local context is time consuming => requires human resources
- Data availability and quality
- Poverty analysis
- Governance issues

For more information :

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