ASSESSMENT AND PREDICTION OF ABOVE-GROUND BIOMASS IN SELECTIVELY LOGGED FOREST CONCESSIONS USING FIELD MEASUREMENTS AND REMOTE SENSING DATA: CASE STUDY IN SOUTH EAST CAMEROON

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Outline of the presentation

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Introduction

- The REDD+ mechanism is a global initiative for the reduction of GHG emissions resulting from deforestation and forest degradation in developing countries

- REDD+ eligible activities include:
  - Reduce the area of forest converted to other land uses (deforestation)
  - Reduce the area of forest where forest degradation is taking place
  - Maintain and increase area of production forest under sustainable management (SFM)
  - Maintain the area of intact forest (conservation)
  - Enhance carbon stocks (enrichment plantings etc..)

Introduction cont…

- The Effective implementation of the REDD+ mechanism require the establishment of national systems that ensure efficient and precise monitoring, reporting & verification (MRV) of emissions reductions from REDD+ eligible activities:

- Methodological challenges in monitoring forest degradation; especially in the African tropical rainforest environment

- Selective logging is an important economic activity in the Congo Basin, but also one of the main direct causes of forest degradation

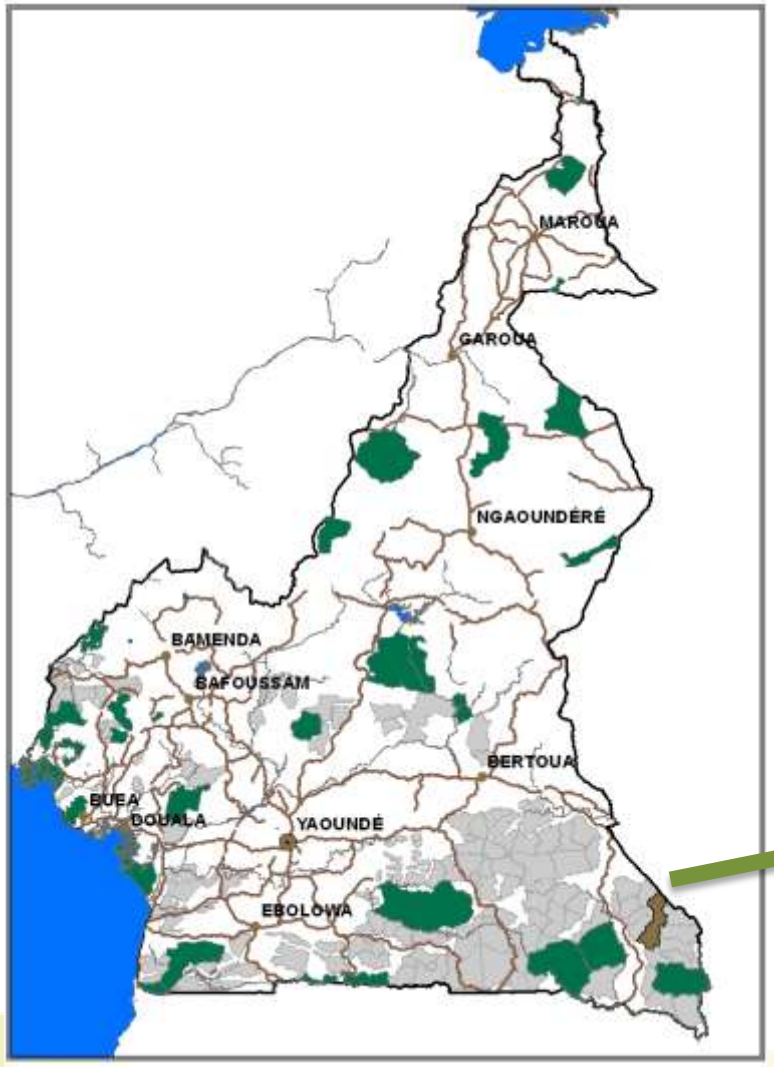
- Thus the crucial need for quantitative information on the impact of selective logging on forest biomass for the design of appropriate forest management policies that are beneficiary to the REDD+ process

Objectives of the study

To assess the impact of selective logging on above-ground biomass

- To quantify above-ground biomass affected by selective logging activities:
  - Above-ground biomass logged
  - Above-ground biomass affected by Logging roads & log yards
- To investigate whether the density of logging roads & remote sensing variables (NDVI from MODIS 250 m) are suitable proxies that can be used to indirectly determine the quantity of above-ground biomass harvested in selectively logged forest concessions

Study area



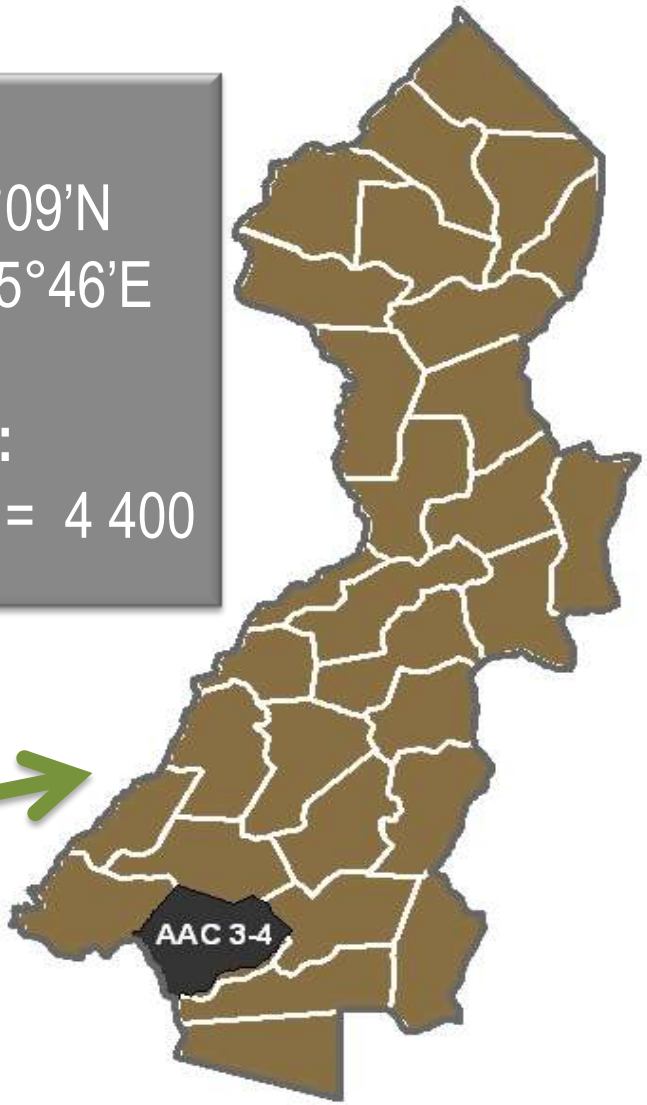
Location :

2°40’ & 3°09’N

15°20’ &15°46’E

Surface area (ha):

AAC 3-4 = 4 400



Materials & Methods

- Above-ground biomass of trees quantified using allometric equations:

AGB_{trunk} (Mg) = Wood volume (m^3) x wood density (Mg m^{-3})..... [Eq. 1]

AGB_{total} (Mg) = AGB_{trunk}) + AGB of tree portions left in the forest..... [Eq. 2]

According to Brown et al. (2005)

AGB_{total} (Mg) = ρ*exp (-1.499+2.148ln (D) +0.207(ln(D))^2-0.0281(ln(D))^3).....[Eq. 3]

Chave et al. (2005)

- Above-ground biomass affected by logging infrastructures:
  Above-ground biomass for the forest zone of Cameroon 292.7 Mg ha^{-1} (MINFOF and FAO, 2005) multiplied by surface area of logging infrastructure (calculated using GIS tools)

- Correlation & Linear regression modelling in stepwise backward mode to investigate the suitability of the density of logging roads & NDVI from MODIS 250 m as proxies for indirect determination of the quantity of above-ground biomass logged.

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Results

Table 1: The synthesis of above-ground biomass harvested by species

Tree species	DME average	Tree count	%	Count ha^{-1}	AGB ha^{-1}	% AGB ha^{-1}
E. angolense	108	9	0.26	0.002	0.153	0.3
E.candollei,	120	37	1.07	0.008	2.171	2.2
E.cylindricum	103	632	18.34	0.144	0.046	31.1
E. utile	110	14	0.41	0.003	0.023	0.7
Erythropleum ivorense	79	92	2.67	0.021	0.176	2.5
Guarea spp,	78	61	1.77	0.014	0.092	1.3
Guibourtia ehié	105	2	0.06	0.000	0.007	0.1
Khaya sp	86	26	0.75	0.006	0.043	0.6
Mansonia altissima	43	3	0.09	0.001	0.002	0.0
Milicia excels	115	6	0.17	0.001	0.023	0.3
Pericopsis elata	80	109	3.16	0.025	0.059	0.8
Pterocarpus soyauxii	58	106	3.08	0.024	0.101	1.4
Swartzia fistuloides,	63	3	0.09	0.001	0.005	0.1
T. scleroxylon	104	2346	68.08	0.533	4.074	58.4
Total	-	3446	100	0.783	6.975	100

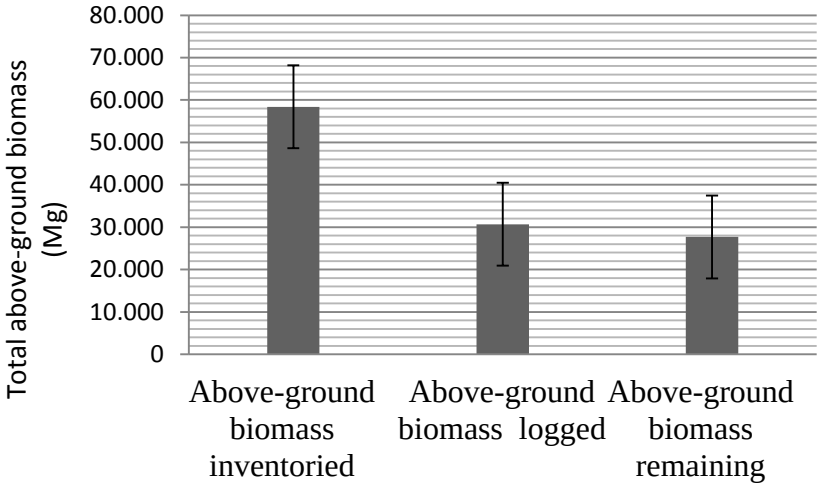
Results cont….

Table 2: The synthesis of the area covered by logging infrastructures

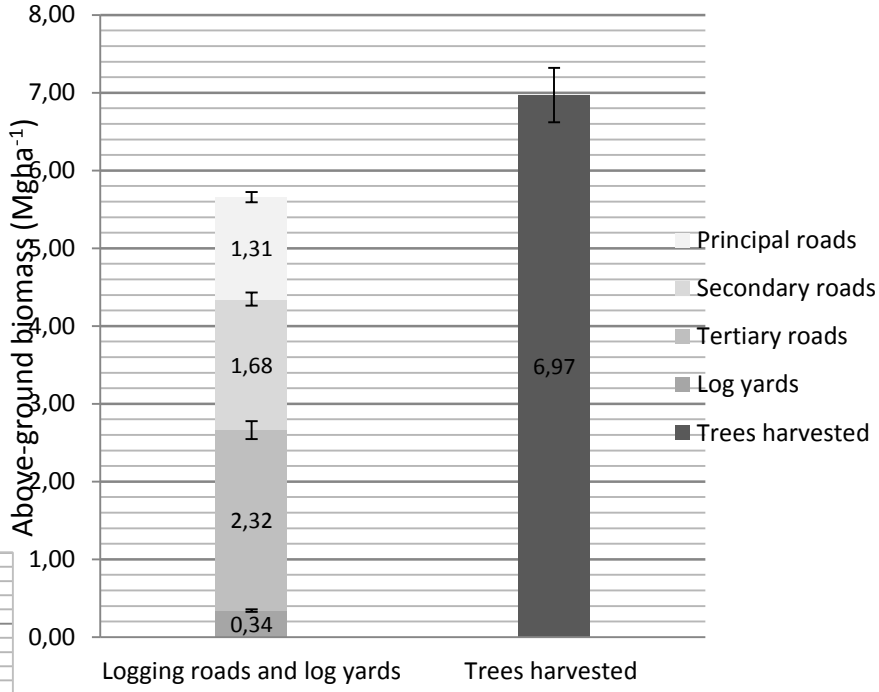
Logging infrastructure	Length (m)	Width (m)	Total area damaged (ha)	%tage of the AAC area damaged	%tage of total damage
Tertiary logging road	23246.15	15	34.87	0.79	41.0
Secondary logging road	12661.49	20	25.32	0.58	29.8
Principal logging road	7892.78	25	19.73	0.45	23.2
Log yards	-	-	05.12	0.12	06.0
Total	-	-	85.04	1.93	100

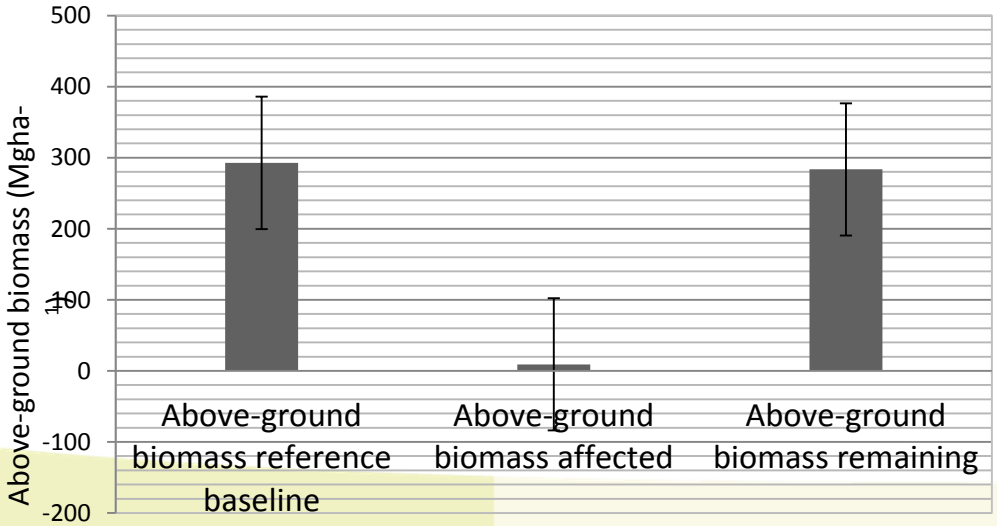
Results cont…

Harvested trees compared with initial commercial trees potential



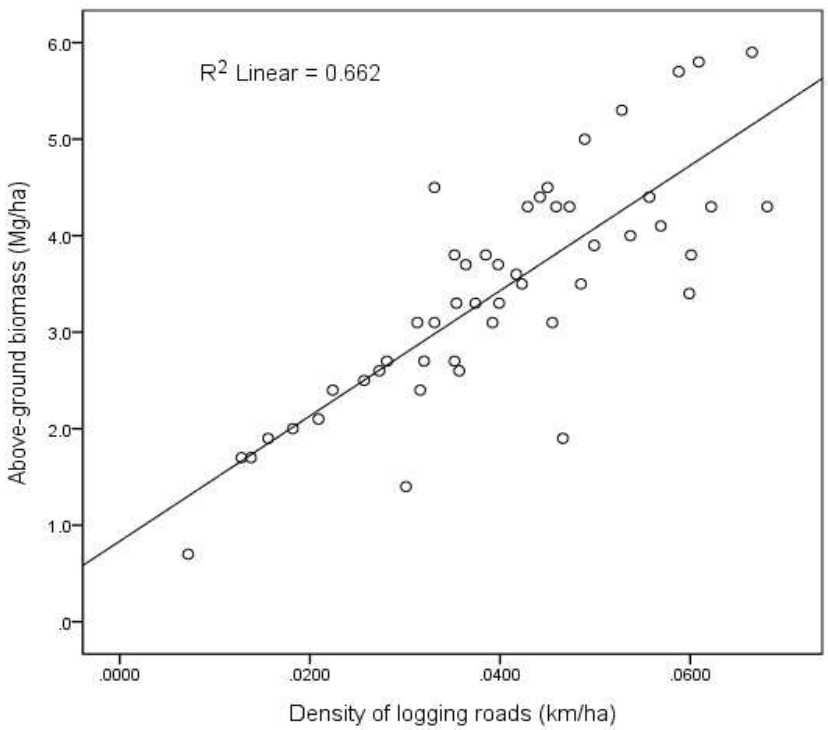
Above-ground biomass affected by selective logging

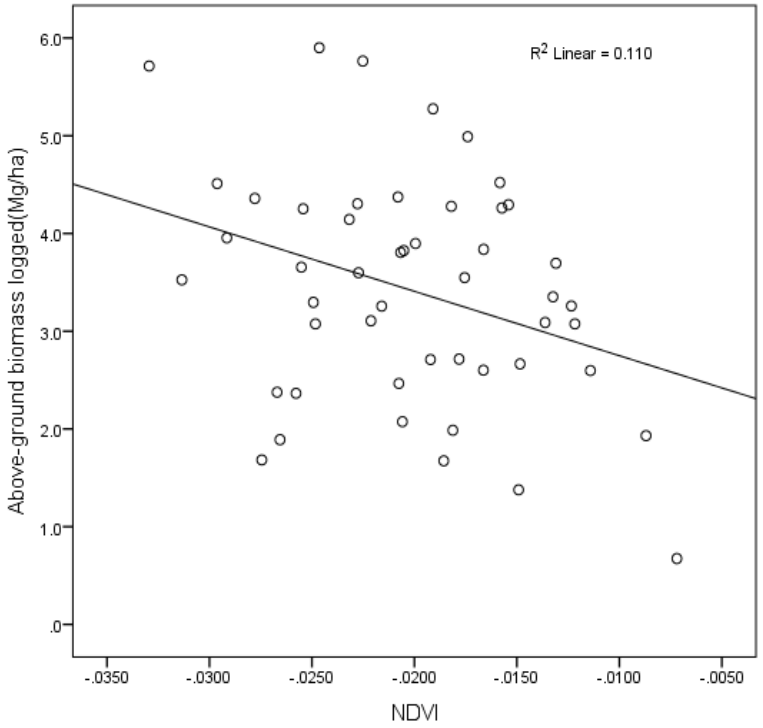




Total above-ground biomass affected by selective logging compared with the initial above-ground biomass

Results cont….





$$Y = 0.835 + 64.882\ X$$ 66 %

$$Y = -0.095 + 62.851X_1 - 0.005021X_2$$ 73%

Logging roads & NDVI as proxies to determine AGB logged

Conclusions

- Selective logging causes a reduction in above-ground biomass stock & the magnitude of the impact varies with the various selective logging activities investigated.

- Though the study reveals low impact per unit area, the cumulative impact of selective logging in the Congo Basin is considerable due to the large area that is under selective logging concessions

- Ground-based measurements facilitated by GIS tools generated quantitative information on the impact of selective logging on above-ground biomass that can support the design of forest management policies beneficial to the REDD+ process in Cameroon

- The density of logging roads and NDVI values from MODIS 250 m are good proxies for indirect estimation of above-ground biomass in selectively logged forest concessions; thus can be considered in the establishment of a system for monitoring forest degradation caused by selectively logging

Thank you for your kind attention!!!

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