

Carbon stock in smallholder chocolate forests in southern Cameroon

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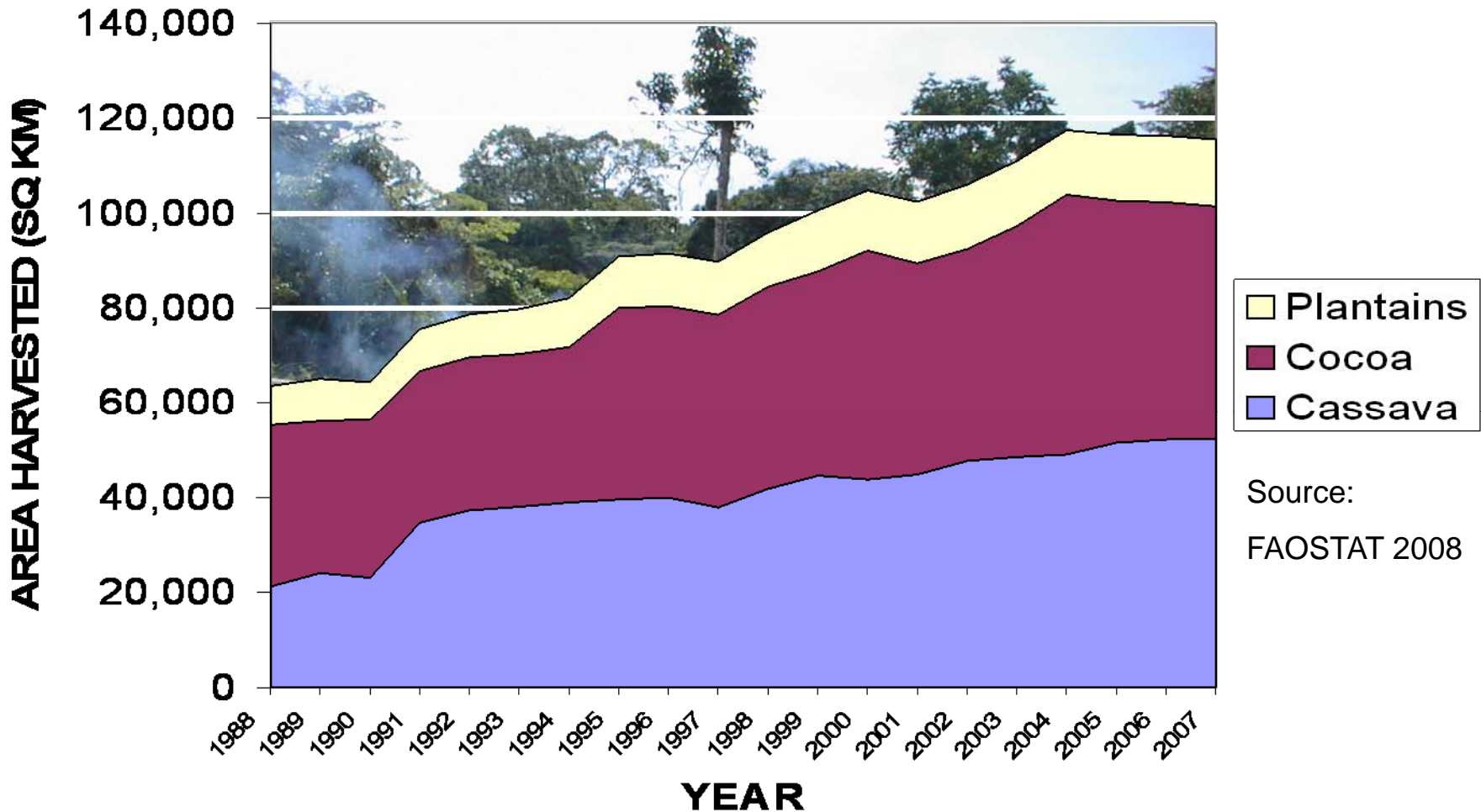
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Why smallholder forestry?

- Smallholder forestry systems constitute one of the main management options of forest resources outside natural forest stands.
- Some smallholder forestry systems (ex cocoa agroforests) may be considered as forest under UNFCCC definition of forest
- It is part of production cycle taking place at the margin forest of the Congo Basin

Since 1988 a 56,300 sq km increase in area harvested (in Ghana, Nigeria, Cameroon, Cote d'Ivoire)



Agricultural practices for livelihood are contributing to deforestation and installation of agriculture-forest mosaics in forest margins

A What-If Scenario

Total deforestation and emission that would have been avoided (1988 to 2006) with increasing agricultural productivity

Yield growth addition to trend	Avoided deforestation (sq km)	Avoided Emissions (millions T)	Value (billions US\$)
Plus 1%	20, 155	171	2.6
Plus 2%	36, 990	322	4.8
Plus 3%	51, 051	455	6.8
Plus 4%	62, 796	573	8.6

Complex structure of Cocoa Agroforest in Southern Cameroon: a Forest-like Structure



Result of a gradual modification of forest by introducing cocoa

But also

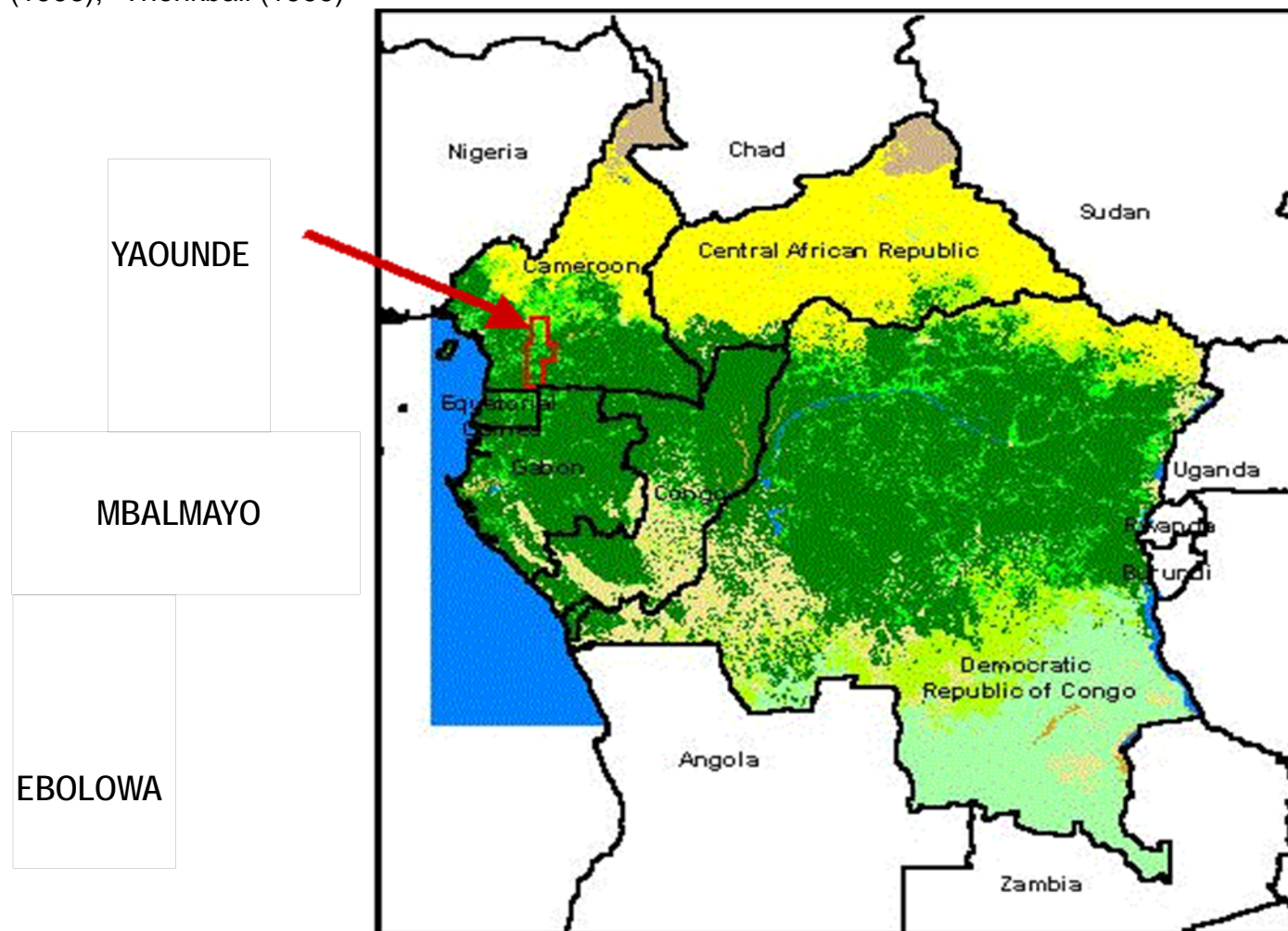


introduction and nurturing of preferred indigenous forest and exotic trees

Forest margins in Southern Cameroon

	Yaoundé	Mbalmayo	Ebolowa
Population Density (Persons/Km²)	80	10 - 41	5
Fallow length (years)	3.9	5.4	7.5
Forest (% land)*	25	39	59

Source: Gockowski (1996), *Thenkbail (1999)



Carbon Stock of Cocoa Agroforests along an Intensification Gradient (Mg ha^{-1})



Zone	-----Carbon pool-----					Total
	Associated plants	Cocoa tree	Litter	Root	Soil	
Ebolowa	173	11 b	4	18	38	243
Mbalmayo	170	11 b	4	18	35	238
Yaoundé	168	17 a	5	19	39	247
HFZ	170	13	4	18	37	243
<i>P</i>	0.10	0.00	0.36	0.10	0.48	0.98

P: Probability; HFZ: Humid forest zone

Means not sharing a common letter in a column are significantly different at 0.05 probability

Associated plants stored:

*70 % of the total carbon stock of the plantation.

* 13 times the carbon found in cocoa trees

The soil under trees stored around 15% of the total carbon stock of the cocoa agroforest

Carbon Stored by Plants Associated with Cocoa According to their Main Use (Mg ha⁻¹)

Plant Group	Ebolowa	Mbalmayo	Yaounde	HFZ	P
Exotic edible	3.4 b	1.1 b	13.3 a	5.9	0.00
Edible NWFP	22.0 a	20.7 a	8.3 b	17.0	0.00
Musa spp	0.0 b	0.0 b	0.2 a	0.1	0.02
Oil palm	0.1 b	0.0 b	0.1 a	0.1	0.00
Medicinal plants	9.5	12.3	9.1	10.3	0.84
High value timber	46.6	41.3	61.8	49.9	0.78
Low value timber	46.4	41.1	35.0	40.8	0.87
Others	44.1	47.6	40.4	44.0	0.46
Total	172	164	168	170	0.97

P: Probability; HFZ: Humid forest zone

Means not sharing a common letter in a column are significantly different at 0.05 probability

Increasing land-use intensity at the landscape level tend to change the species contribution to carbon storage

Timber trees store more than half of the carbon stock found in associated trees

Why invest on cocoa agro-forest for climate change mitigation?

- The associated forest trees that they host help in mimicking the original forest structure and its ecological services
- Forest trees associated with cocoa are providing food, medicines, fire-wood, cash incomes, etc...
- Cocoa AF provide employment and income that is used for basic need such as health care, school fees, house construction, etc.
- Cocoa AF hosts forest trees that contribute to carbon storage besides their role in local livelihood and market.

Why invest in cocoa agro-forest for climate change mitigation?

- Most of the edible products (fruits, nut, oil, etc...) can be harvested with negligible impact on the carbon stock of the system.
- Being managed generally for a long rotational time, chocolate forest offers a long lasting carbon stock
- Others smallholder forestry systems exist in the Congo Basin with characteristics similar to the chocolate forests
- Smallholders systems in which forest trees are associated with the perennials (i.e. cocoa) offer a good opportunity for smallholders, conservation societies, and carbon investors.

What to do?

- Improve productivity of agriculture/agroforestry systems to avoid deforestation/degradation of remnant forests/agroforest in tropical forest landscapes
- Increase farmer access to forest resources and ameliorate the on-farm right to plant/harvest timber
- Develop PES (Payment for Environmental Services) for smallholder forestry systems that include carbon storage and others ecological services (i.e. Biodiversity conservation, etc..)
- Improve technical tools to establish and manage perennial smallholder forestry systems

Thank You Merci Danke



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