Addressing climate change concerns in tropical agroforestry

Torquebiau E[1*], Rapidel B[2,3], Jagoret P[2], Harmand JM[4,5], Vaast Ph[4,6]

* emmanuel.torquebiau@cirad.fr

[1] CIRAD, UR AIDA, 34398 Montpellier, France
[2] CIRAD, UMR SYSTEM, 34060 Montpellier, France
[3] CATIE, Turrialba 30501, Costa Rica
[4] CIRAD, UMR ECO&SOLS, 34060 Montpellier, France
[5] ICRAF, PO Box 16317 Yaounde, Cameroon
[6] ICRAF, UN Avenue, PO Box 30677, Nairobi, Kenya

Agroforestry is relevant for both adaptation to climate change and mitigation of climate change

- *Increased soil carbon and biomass stocks*
- *Better resilience to climate-related stress*
- *Coffee and cocoa agroforestry provide good examples*
- *Mainstreaming agroforestry in the agricultural sector still required*
- *Agroforestry needs to be included in the policy agenda*

Climate change adaptation

Coffee cultivation under shade trees in Nicaragua shows a clear niche differentiation in the exploration of soil by the roots of coffee and the roots of trees (Figure 1). This supports the hypothesis of complementarity between roots of trees and crops for water use.

In the case of cocoa agroforestry, positive effects were found on household income and diversification in Central America and in Cameroon (Figure 2). In the savanna zone of Cameroon, the association of cocoa with trees allows growing cocoa in areas beyond its climatic tolerance, an important asset under a possibly future drier climate in Africa (Jagoret *et al.* 2012). Shade trees create favorable microclimatic conditions reducing cocoa transpiration and increase top soil carbon.

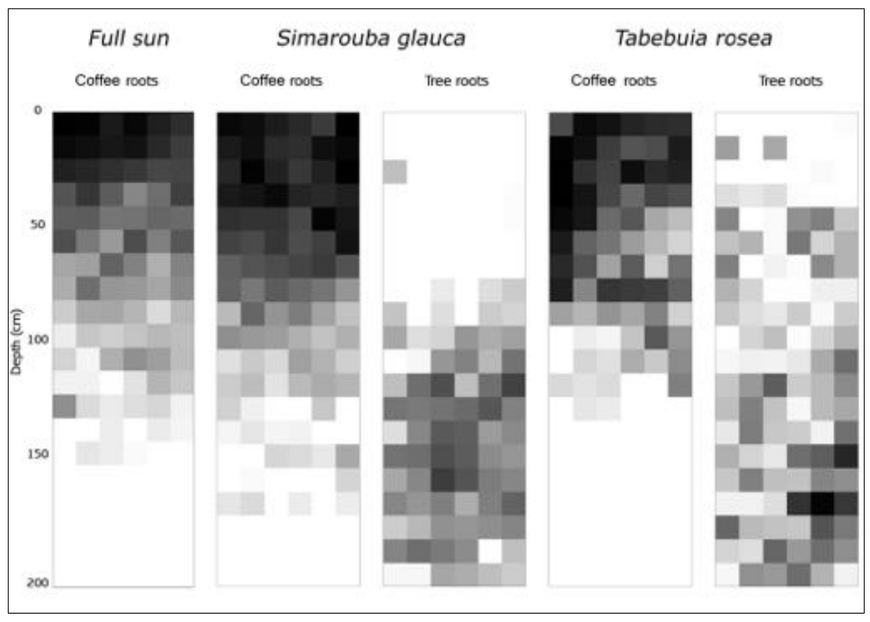


Figure 1. Fine root density of coffee and shade trees. Full sun coffee plantation (left column); Coffee agroforestry (other columns) with two different timber tree species. Root impacts / dm², from 50 (black) to 0 (white). Nicaragua (Padovan *et al.* 2015)

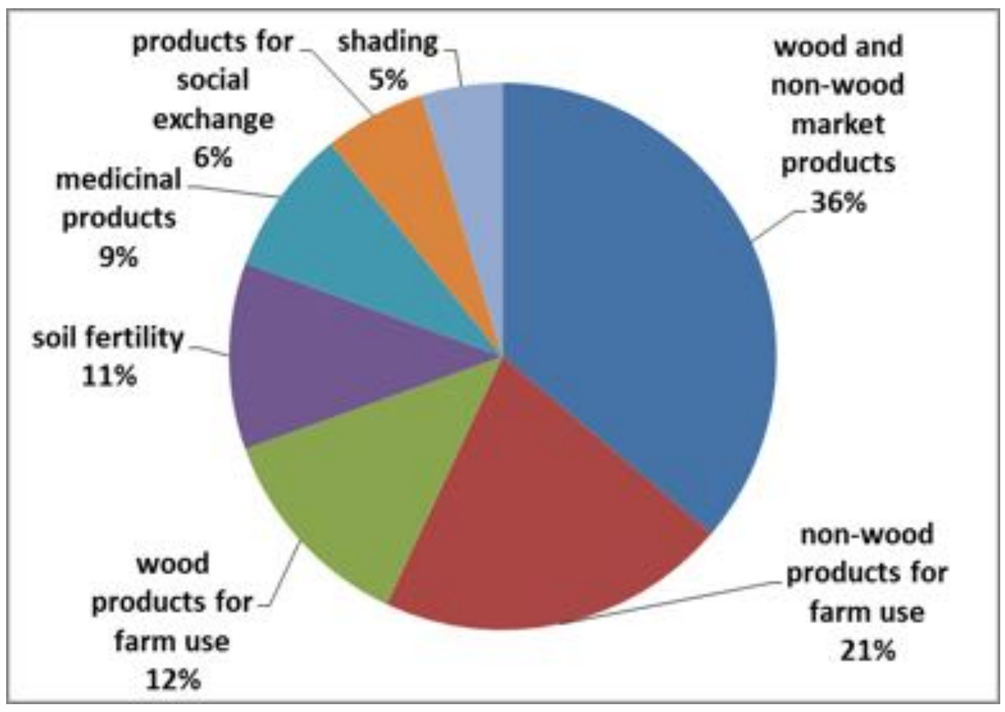


Figure 2. Use values of cocoa agroforests in Cameroon (Jagoret *et al.* 2014)

Climate change mitigation

Arabica coffee grown under native trees in the Western Ghats region of India maintained carbon stocks at levels equivalent to those in surrounding forests.

In Latin America, a meta-analysis of carbon stocks in coffee agroforestry plantations showed that 10 years after planting, the carbon stock in agroforestry associations ranged from 15 to 30 t C/ha while it was only 8.5 t C/ha in monocrop coffee (Figure 3).

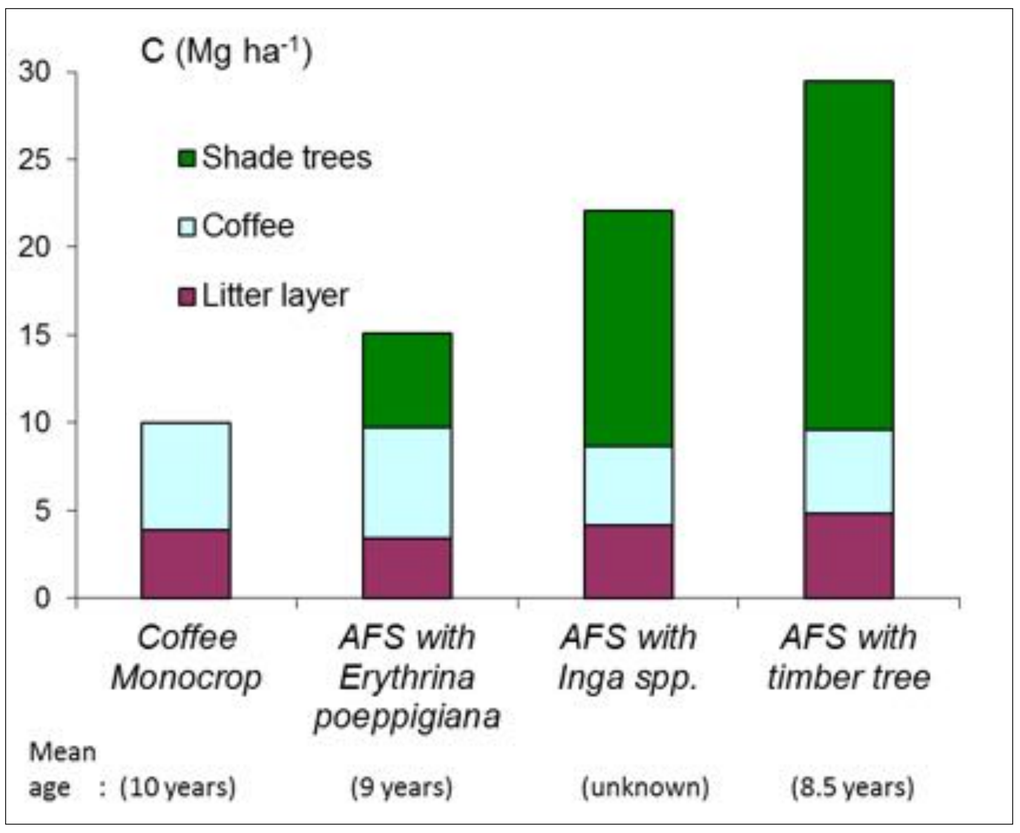
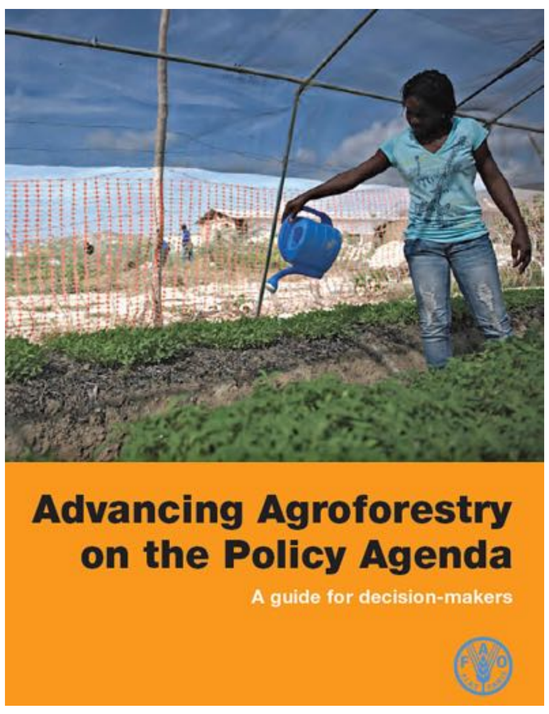


Figure 3. Mean carbon accumulation in aboveground biomass and litter in 10 years old coffee monocrops and agroforestry associations (AFS: agroforestry system) (Harmand *et al.* 2007; Hergoualc'h *et al.* 2012)

Mainstreaming agroforestry still required

Despite a high potential, many barriers to agroforestry still hinder its development.

Critical conditions are necessary to encourage agroforestry: (1) there should be clear immediate benefits for farmers, (2) skill development is required at all levels, (3) land and tree tenure conditions must be clarified, (4) germplasm should be adapted to agroforestry, (5) innovative governance is essential.



Innovative policies could cover: (1) better information about agroforestry in the global society, (2) improved regulations for a better inclusion of land multifunctionality and ecosystem services, (3) development of agroforestry-targeted incentives and (4) promotion of agroforestry markets (FAO, 2013).

References

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Top left picture: Measuring tree growth in a robusta coffee agroforestry plot in the Western Ghats Region, India (© Ph Vaast / CIRAD)

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