Agroforestry: a community-based initiative for adaptation and mitigation of climate change

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Introduction

- Agroforestry is a traditional system developed in tropical as well as temperate regions;
- Agroforestry is one of the Climate Smart Agriculture options that is being promoted due to its several functions in the climate change context;
- The multifunctional role of shade trees for farmers' livelihoods has been established;
- Emphasis on shade trees' roles in agroforestry systems enhance functional biodiversity, carbon sequestration, soil fertility, drought resistance, and weed and biological pest control (Somarriba et al. 2012; Deheuvels et al. 2014).
- A more comprehensive understanding of the short and long-term effects of shade removal on yield over a wide range of contexts, in terms of both socioeconomic and ecological conditions.

Agroforestry : Opportunities

Agroforestry is the intentional integration of trees or shrubs with crop and animal production / deliberate management of trees on farms.

As a result?

- A more diverse agricultural operation, boosted profits, and conservation gains.

Through:

- Protected topsoil, livestock, and wildlife habitat.
- Increased crop yields and profits.
- Reduced energy and chemical inputs.
- Improved water quality and increased water-use efficiency.
- Carbon stock
- Etc.

Agroforestry: Opportunities

- Five popular practices to consider in agroforestry: Windbreaks, Riparian forest buffers, Silvopastoralism, Alley cropping, and Forest farming.

However, Nair (1985) has restricted all the possible types of agroforestry into 03 types:

✓Agrosylviculture: Association of trees and crops;

✓ Silvopastoralism: Association of trees and livestock;

✓Agrosilvopastoralism: Association of trees, crops, and livestock.

Typology of Agroforestry

Agrosylviculture with *Faidherbia albida*

Agrosylviculture with *T. cacao*

Sylvopastoralism with *Mango species and caw*

Agrosylviculture with *Coffea sp.*

Sylvopastoralism with *Cashew*

Agroforestry as a strategy to Climate Change Adaptation

- Drought: tree components through their deep roots explore a large soil volume of water and nutrients which help to maintain production during drought seasons

- Rainfall variability: Pumping excess water out of the soil profile more rapidly by high evapotranspiration and maintaining aerated soil conditions

Agroforestry as a strategy to Climate Change Adaptation

- Temperature: increased soil cover and multi-strata cropping pattern system utilizes the light resource efficiently and buffer the soil and store crops against direct sunlight which leads to a reduction in soil temperature.
- Socio-economy: Few inputs of fertilizer, fewer costs, high diversity of food crops, quality food crops

Agroforestry as an Option for Climate Change Mitigation

Agroforestry offers a high potential for carbon sequestration in all the pools (shade trees, litter, soil, etc)

- Direct role: Carbon sequestration rates ranging from 1.5 to 350 Mg C ha -1 in agroforestry systems (depending on the type of the systems)

- Indirect role: agroforestry sequesters Carbon indirectly by helping reduce pressure on natural forests through increased production of on-farm timber and fuelwood (frontline drivers of forest degradation)

Example Agroforestry in REDD-plus implementation: case studies

Five activities that are included in REDD+ are:

- Reducing emissions from deforestation
- Reducing emissions from forest degradation
- Conservation of forest carbon stocks
- Sustainable management of forest
- Enhancement of forest carbon stocks

VS

Agroforestry

Author: Thangata et al.,2012

Carbon stock and sequestration potential of agroforestry systems in smallholder agroecosystems of sub-Saharan Africa: Mechanisms for 'reducing emissions from deforestation and forest degradation

- Household survey and biophysical data from central Malawi are modeled to test whether farm incentives would lead to more improved fallow adoption, and therefore an increase in carbon sequestered on farms.
- Baseline scenario would sequester on average 3.94 Mg C ha−1. The overall annual mean amount of C sequestered is 103 Mg per year, of which 12% is from soil C.
- Second scenario, the annual mean was 239 Mg C translating to 3.92 Mg C ha−1, of which 62% is a contribution from agroforestry.
- Third scenario, the annual mean C was 393 Mg, translating to 4.17 Mg C ha−1, of which agroforestry's contribution was 39%.
- Agroforestry can increase C sequestration on farms, and smallholder farmers can benefit from the REDD+ mechanism.

Author: Jagoret 2012

Afforestation of savannah with cocoa agroforestry systems (CAFS): a small-farmer innovation in central Cameroon

- Farmers have planted cocoa agroforestry systems on *Imperata cylindrica* grasslands, a soil-climate zone generally considered unsuitable for cocoa cultivation.
- A survey to understand the agricultural and ecological bases of this innovation. Age, cropping history, and marketable cocoa yield were assessed;
- Marketable cocoa yields were similar for the two types of cocoa plantations, regardless of their age: 321 kg ha-1 in cocoa plantations on grasslands and 354 kg ha-1 in cocoa plantations in gallery forests with increased soil fertility.
- The fruit tree and forest tree densities respectively averaged 223 and 68 trees ha-1 in plantations under 10 years old, and 44 and 27 trees ha-1 in plantations over 40 years old, whereas the cocoa tree density remained stable at 1,315 trees ha-1. No statistically significant difference in diversity.
- Occupation of grasslands by CAFS is both an important example of ecological intensification and a significant farmer innovation in the history of cocoa growing that can be implemented in REDD plus.

Author: Asare et al.,2017

Cocoa agroforestry for increasing forest connectivity in a fragmented landscape in Ghana

- The purpose of this study was to develop a multi-disciplinary strategy to increase forest connectivity using cocoa agroforest corridors to reduce deforestation and degradation ;
- Biophysical assessments involving satellite images for vegetation patterns, and expert data from a decision support system were used to select suitable sites for the corridor within a GIS framework.
- timber trees planted within cocoa agroforests settings help offset the yield losses in cocoa shade-yield relationships compared to full sun-production systems, however the on-farm benefits of cocoa agroforestry alone are insufficient to justify the adoption.
- Cocoa agroforestry could be an implementation option for REDD-plus, however Paying farmers premium prices for cocoa and substantial off-farm environmental and ecosystem services under agroforestry systems can tip the balance toward adoption

Agroforestry as a pathway to agricultural yield impacts in climate-smart agriculture investments: Evidence from southern Malawi

- Analysis of maize yield effects of agroforestry within a large CSA project,
- A survey data from 808 households across five districts, with a double hurdle specification using a control function approach to account for the endogeneity of CSA program participation and the intensity of agroforestry fertilizer trees (as a proxy for agroforestry adoption) in the study area.
- Statistically significant yield effect of CSA program participation and the intensity of agroforestry fertilizer trees: maize yields increased, on average, by 20% for participation, and 2% for the intensity of fertilizer trees
- Incorporating agroforestry into CSA interventions could enhance agricultural yields among smallholder farmers in the face of climate change — a crucial aspect of sustainable development goals on hunger and climate adaptation

Challenges of Agroforestry (in REDD+)

- Land use policy (guarantee rights and ownership of trees, their products, and services);
- Increasing food demands;
- Farm management / Fewer yields
- Market price
- Adequation between farmers' needs and policy recommendations;
- Investments costs
- Justice in the payments (carbon incentives)
- Benefit sharing
- Market infrastructure: certification
- Etc.

Summary

- REDD+ is potentially a significant source of monetary benefits or revenues for developing tropical forest countries;
- Overall, the case studies provide an encouraging example of how agroforestry practices may help forest communities or farmers engage with REDD+ in a way that benefits both their livelihoods and the global climate change agenda;
- However, enabling market infrastructure, policies on tree rights and ownership, and safeguards would be necessary for agroforestry as well as other tree-based systems in the landscape to effectively contribute to the goals of REDD+.

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Thank you

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