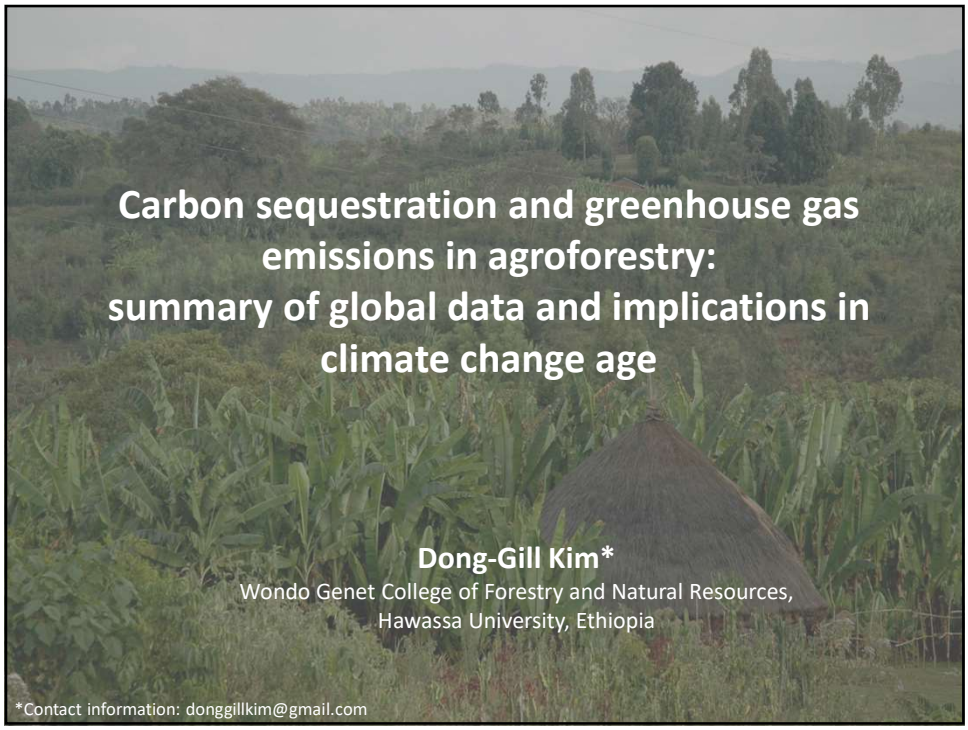


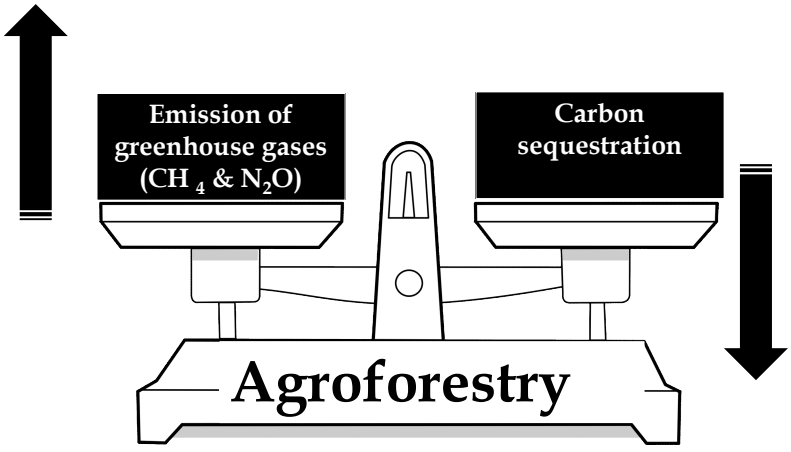
Carbon sequestration and greenhouse gas emissions in agroforestry: summary of global data and implications in climate change age

Dong-Gill Kim*
Wondo Genet College of Forestry and Natural Resources,
Hawassa University, Ethiopia

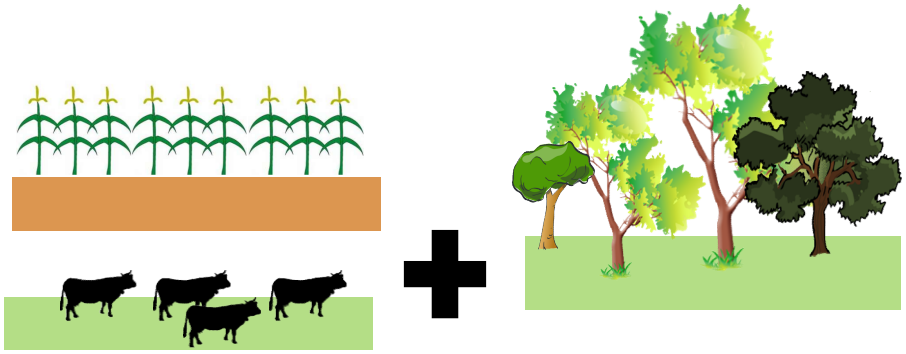
*Contact information: donggillkim@gmail.com

Working question:

Is agroforestry sink of greenhouse gas?



What is agroforestry?



Agriculture + **Forestry**

Agriculture + Forestry = Agroforestry

Ethiopian home garden agroforestry

- Grow crops with various tree species & animals
- Provide food, fuel & cash income
- Protect soil & biodiversity

Source: Kaonga and Bayliss-Smith, 2009; Beedy et al., 2010

Types of Agroforestry

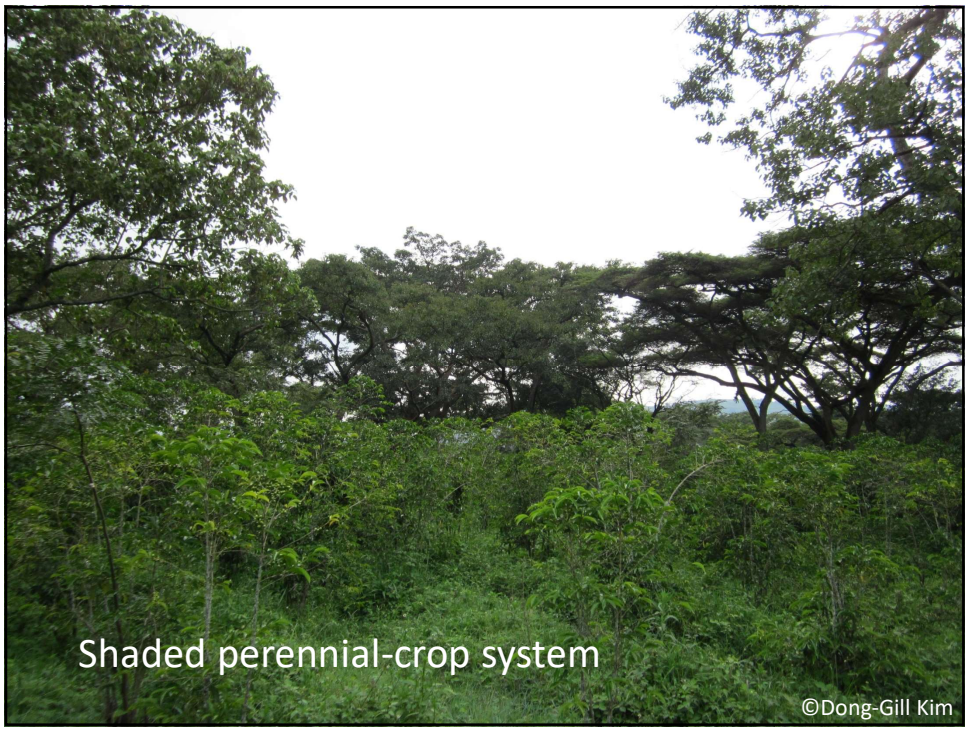
It is actually complicated!

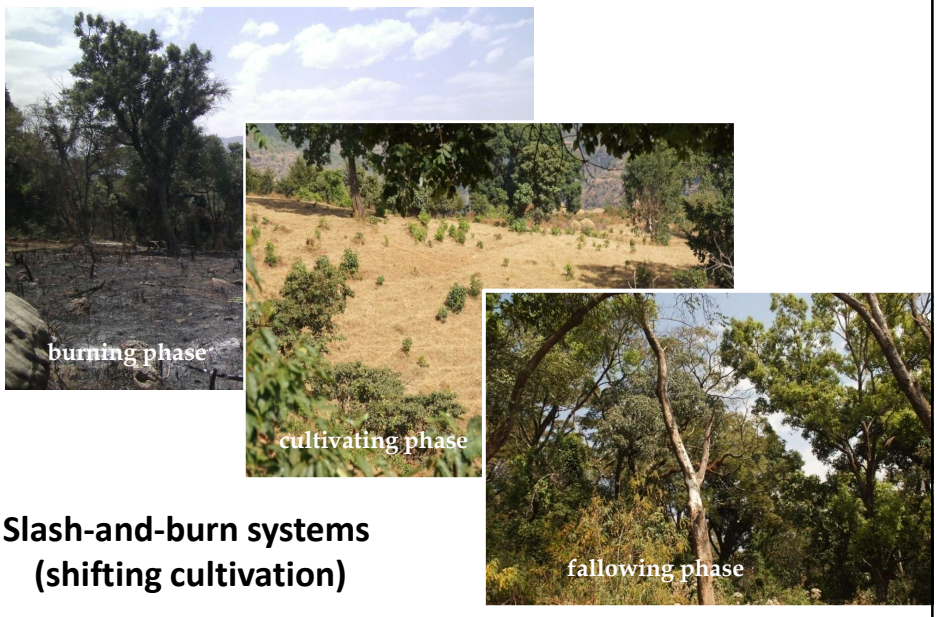
- Home gardens
- Improved fallow
- Intercropping
- Live fences
- Parklands
- Riparian buffer
- Rotational woodlots
- Shaded perennial-crop system
- Shelterbelts
- Silvopasture
- Slash-and-burn systems (shifting cultivation, swidden)
- Tree plantations on arable land
- to be continued…..

Different structure & functions

Adapted from Kim et al., 2016

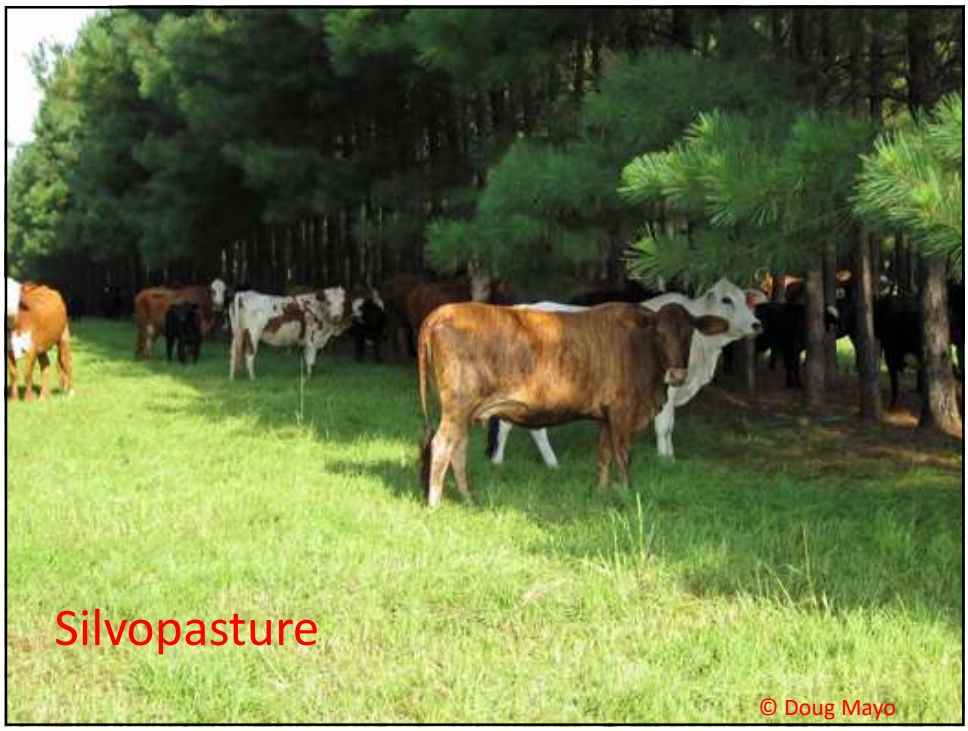

Home garden
©Dong-Gill Kim


Shaded perennial-crop system
©Dong-Gill Kim

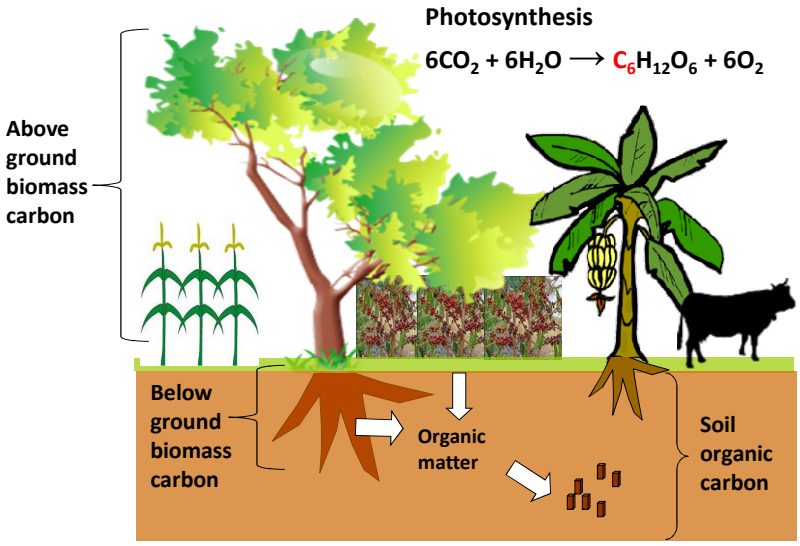


Slash-and-burn systems (shifting cultivation)


Riparian buffer
©Richard C. Schultz

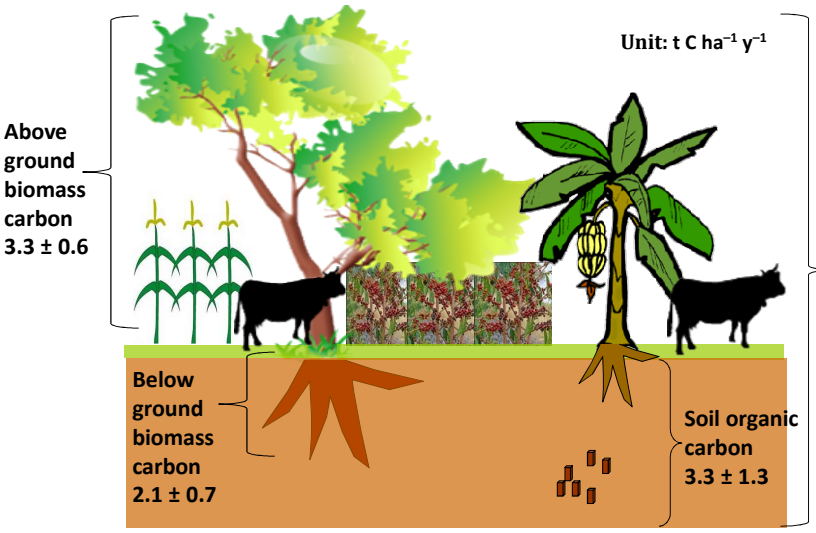

Silvopasture
© Doug Mayo

Carbon (C) sequestration in agroforestry



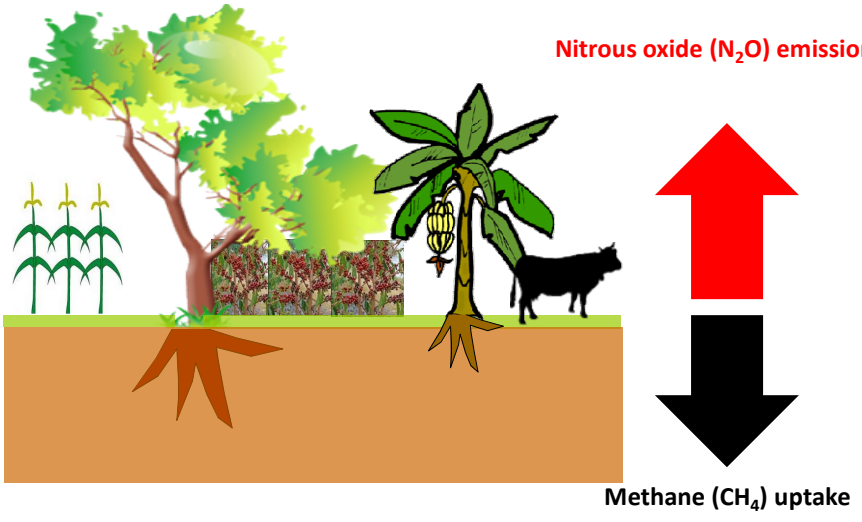
Source: Kaonga and Bayliss-Smith, 2009; Beedy et al., 2010

Carbon sequestration in agroforestry



Data from 109 studies world wide (Kim et al. 2016)

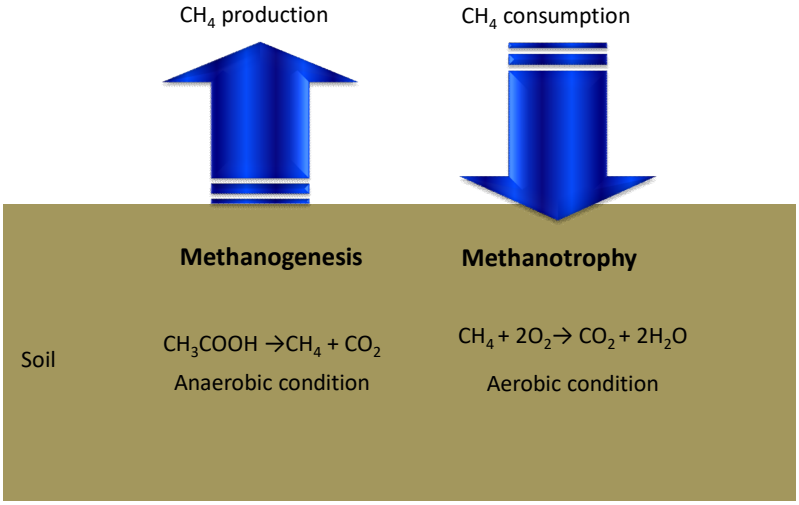
Greenhouse gas (GHG) emissions in agroforestry



Data from 27 studies world wide (Kim et al. 2016)

Soil methane (CH_4) flux

The second-largest radiative forcing of the long-lived GHG;
25 times the global warming potential of carbon dioxide (Forster et al., 2007)

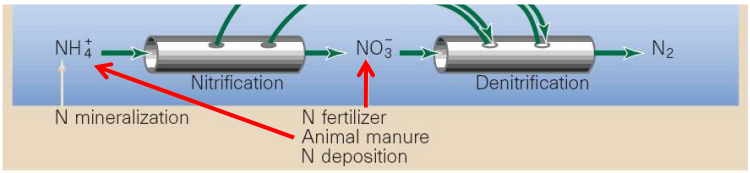


Le Mer and Roger, 2001; Dutaur and Verchot, 2007

Soil nitrous oxide (N_2O) flux

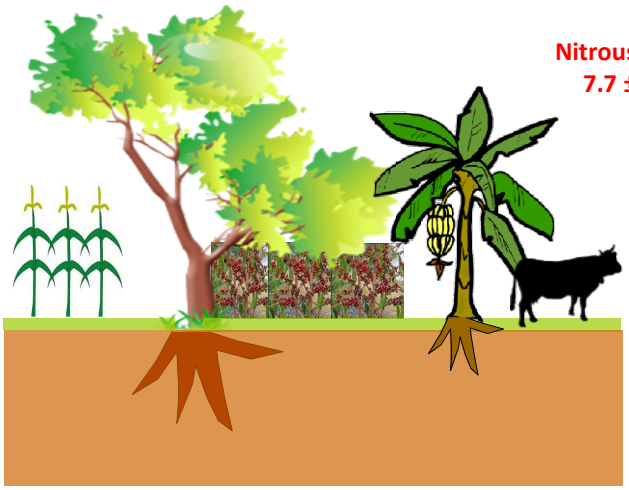
The global warming potential of N_2O = 296 times that of CO_2 (IPCC 2007)

Ozone depletion by N_2O (Crutzen 1970; Liu et al. 1977)



Bouwman AF.1998. Nitrogen oxides and tropical agriculture. Nature 392. 866-867.

Greenhouse gas emissions in agroforestry



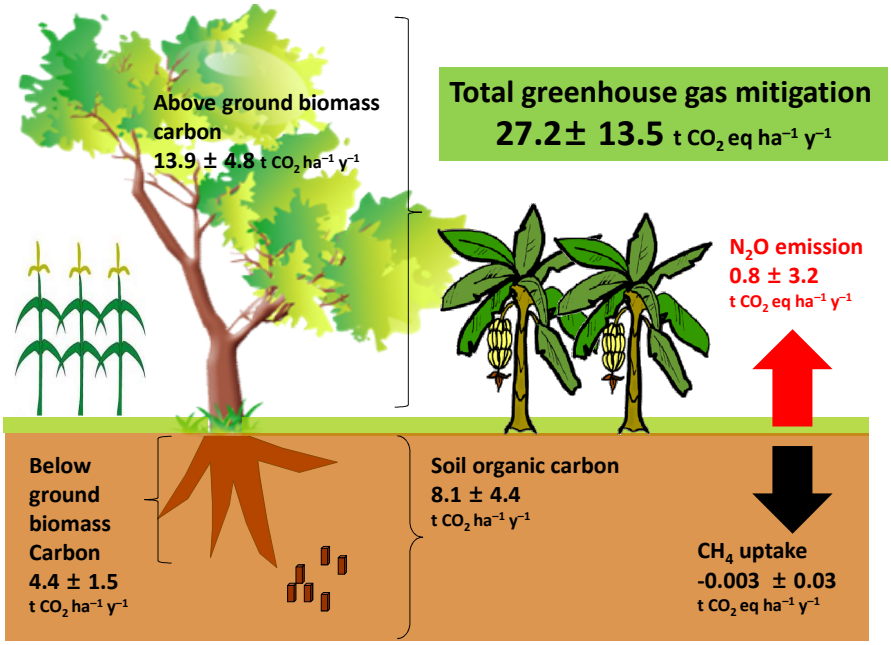
Nitrous oxide (N_2O) emission
7.7 ± 1.7 kg N_2O ha^{-1} y^{-1}

N fixing trees, Crop residues, Litter fall, Manure,

Less soil compaction, More soil aeration

Methane (CH_4) uptake
-1.6 ± 0.5 kg CH_4 ha^{-1} y^{-1}

Data from 27 studies world wide (Kim et al. 2016)



Kim et al. 2016

Global potential of mitigation in agroforestry

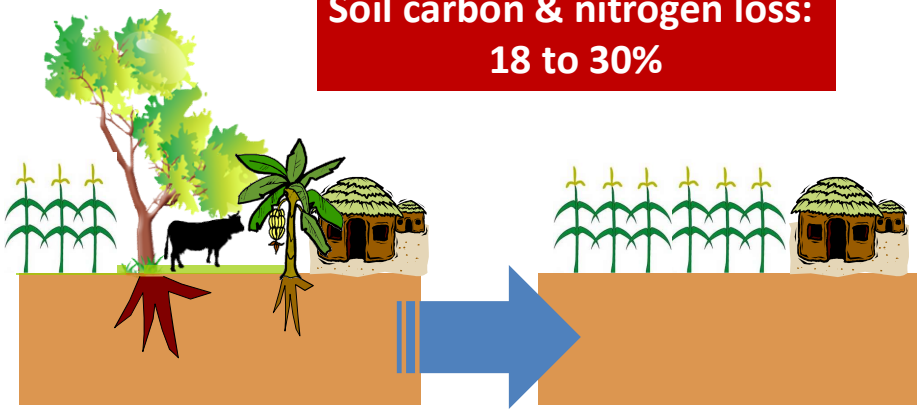
- Unproductive agricultural lands which can be converted to agroforestry worldwide: 630 million ha (Watson et al., 2000)

- Mitigation of greenhouse gas from new agroforestry worldwide : 19 billion t CO_2 eq y^{-1} (Kim et al., 2016)

39 % of global GHG emissions in 2010

Converting agroforestry to mono-cropping

Soil carbon & nitrogen loss: 18 to 30%



Home garden

Mono cropping

Source: Kim et al. (2016)

Take home messages

1. Agroforestry has potentials to mitigate greenhouse gas.
2. Agroforestry can provide benefits: carbon trading opportunity with restoration and increasing agricultural productivity.
3. Agroforestry practices are converted to mono-cropping: losing carbon and soil fertility

Thanks for your attention!