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# Greenhouse Gas Mitigation Potentials in Agroforestry Practices: A Global Synthesis

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

*Contact information: donggillkim@gmail.com

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# Greenhouse Gas Mitigation Potentials in Agroforestry Practices: A Global Synthesis + Ethiopian case studies

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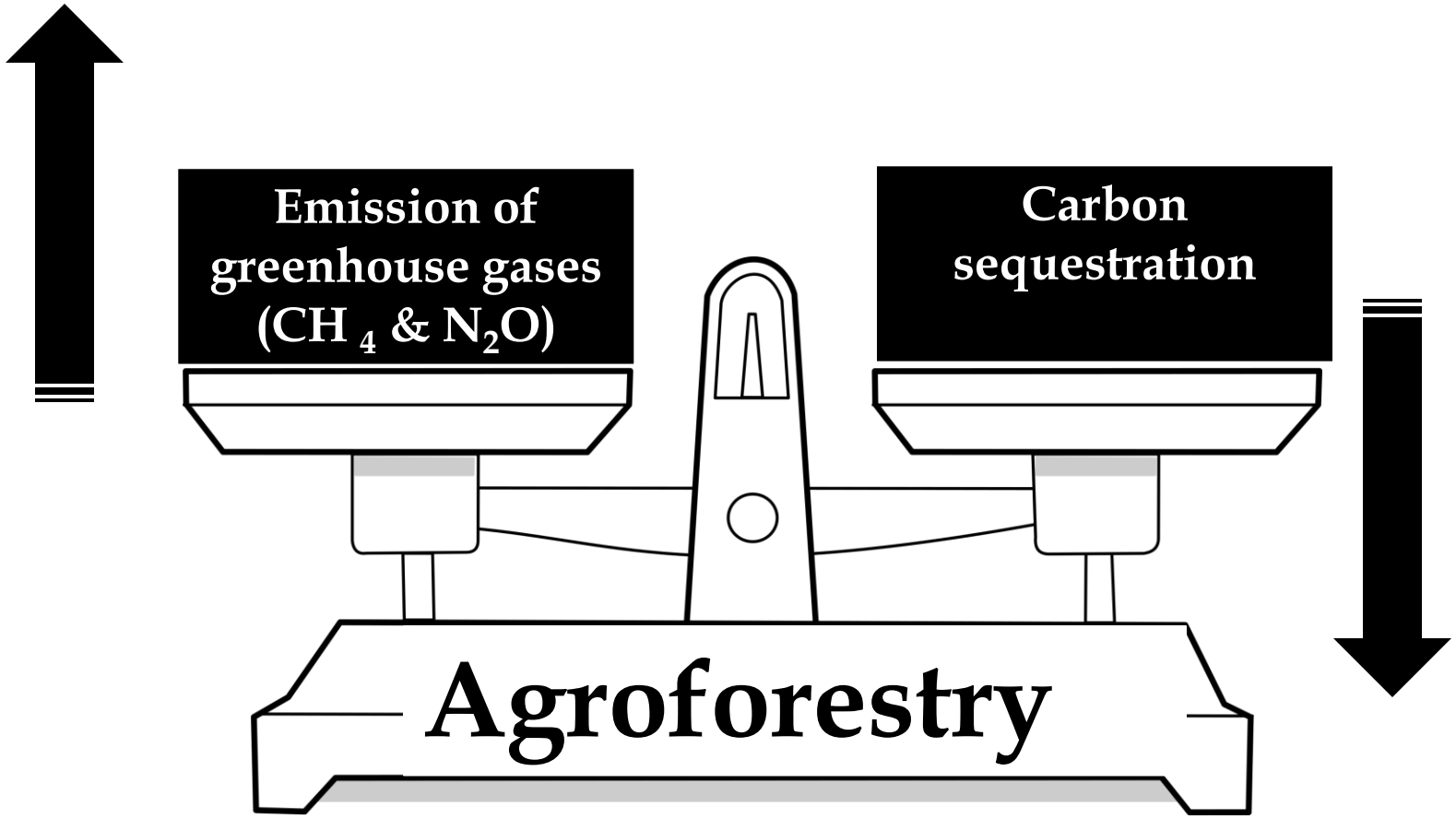
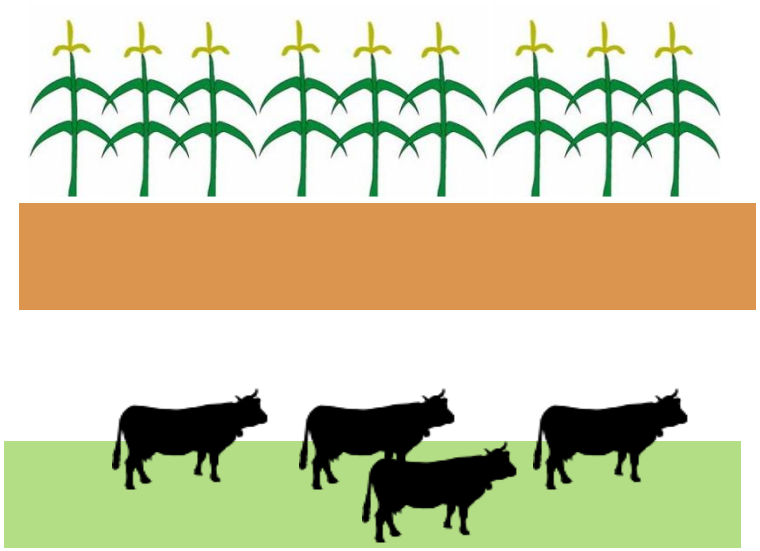
## Working question:

# Is agroforestry sink of greenhouse gas?



# What is agroforestry?

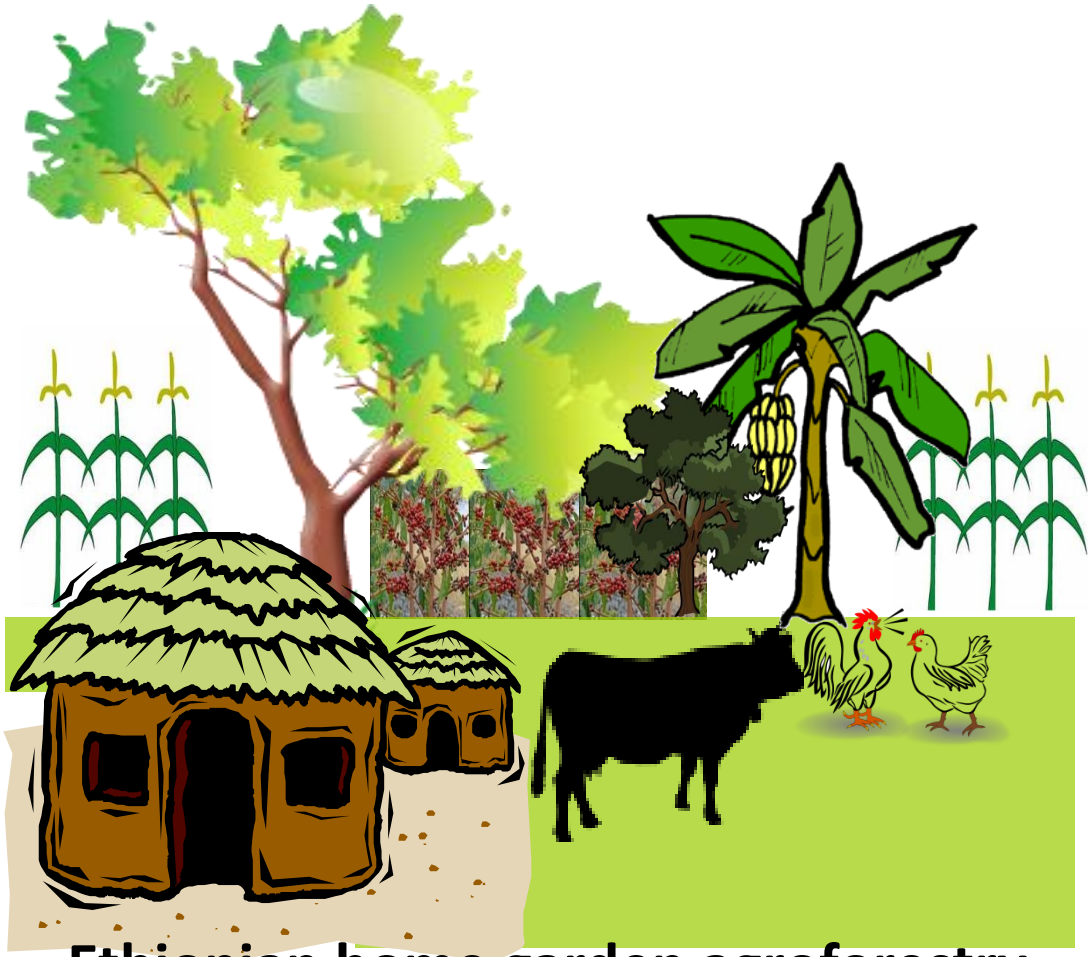


+

**Agr**iculture

**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

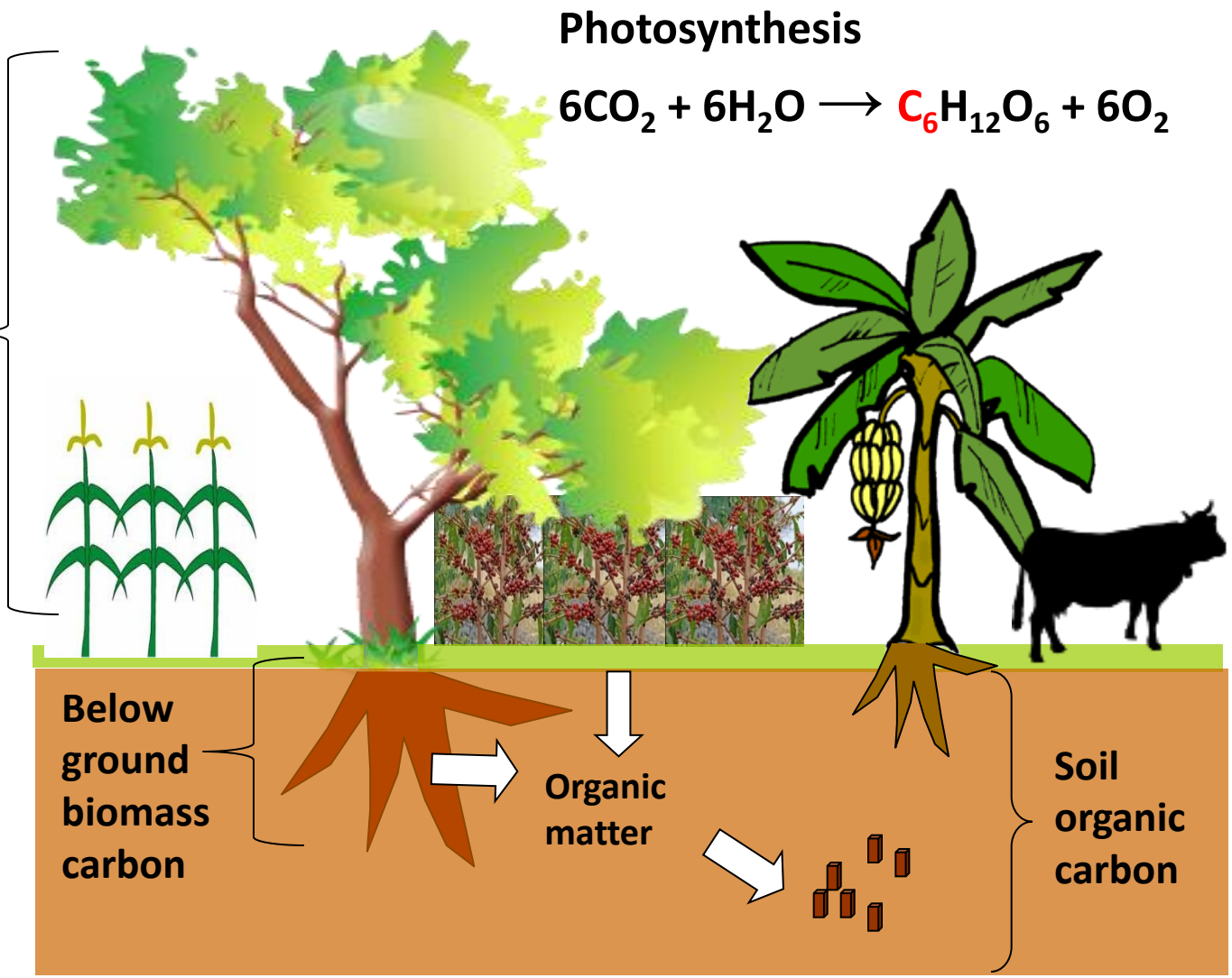
It is actually complicated!

- 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**

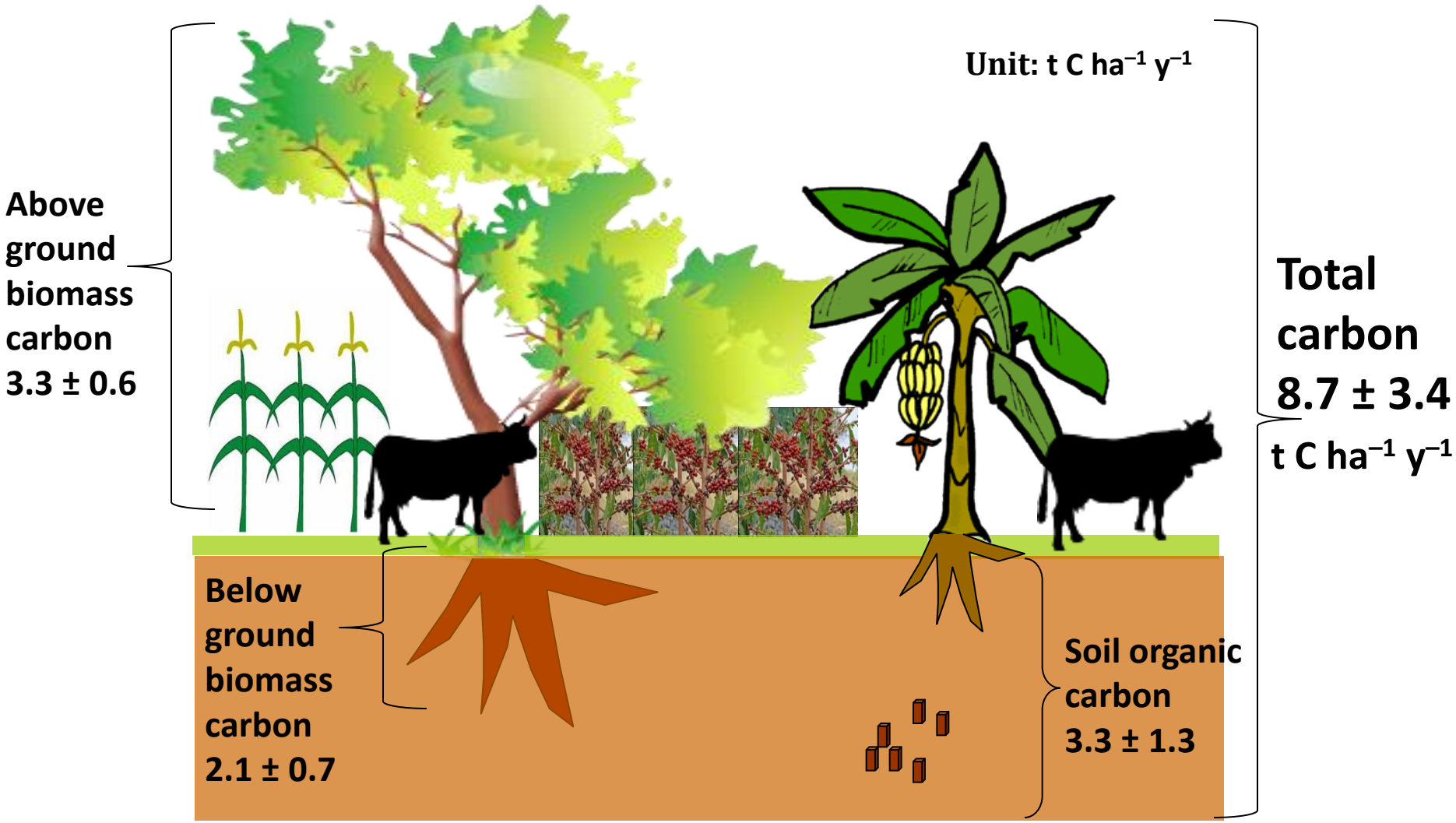
Adapted from Kim et al., 2016

# Carbon (C) sequestration in agroforestry



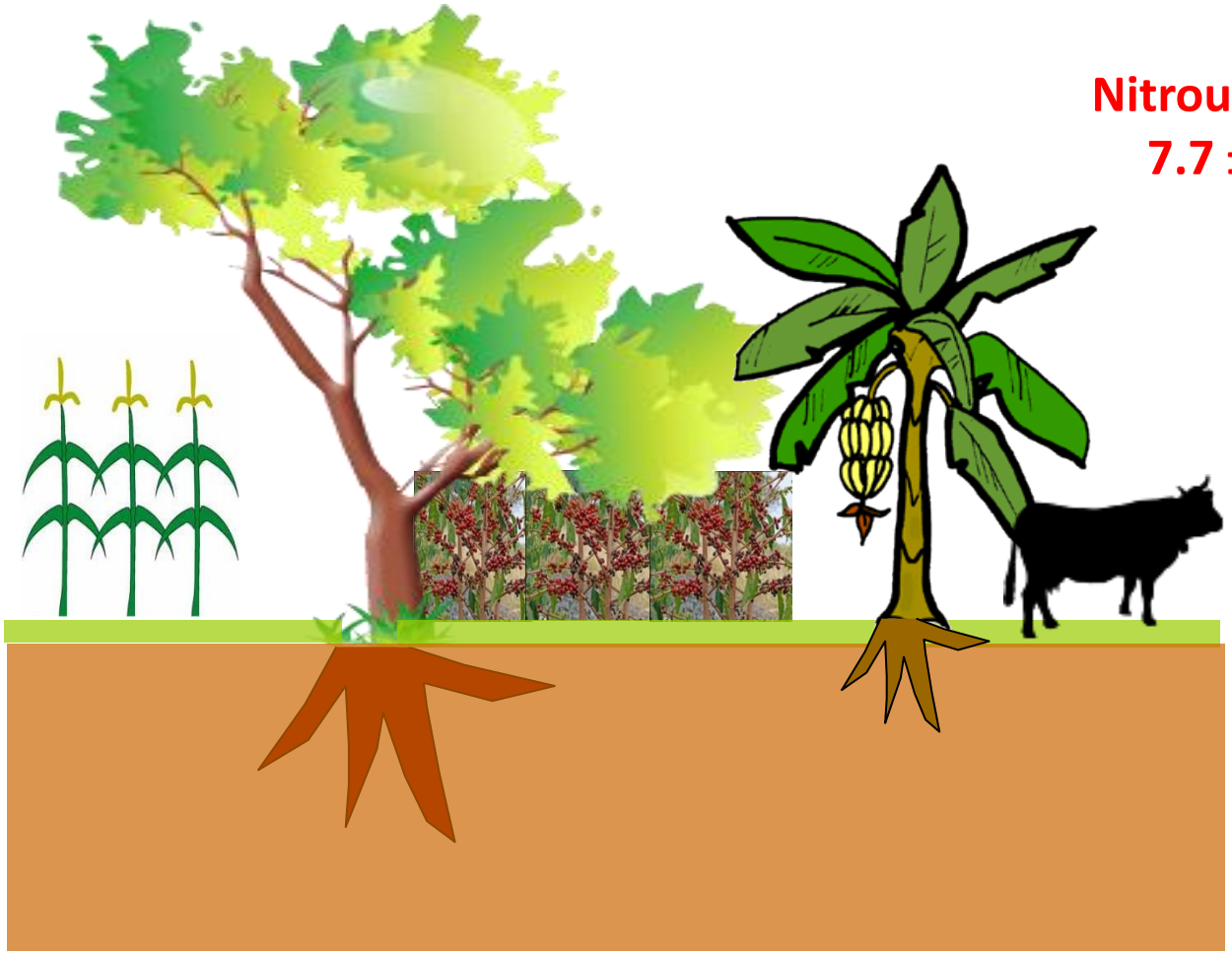

Source: Kaonga and Bayliss-Smith, 2009; Beedy et al., 2010

# Carbon sequestration in agroforestry




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

# Greenhouse gas emissions in agroforestry



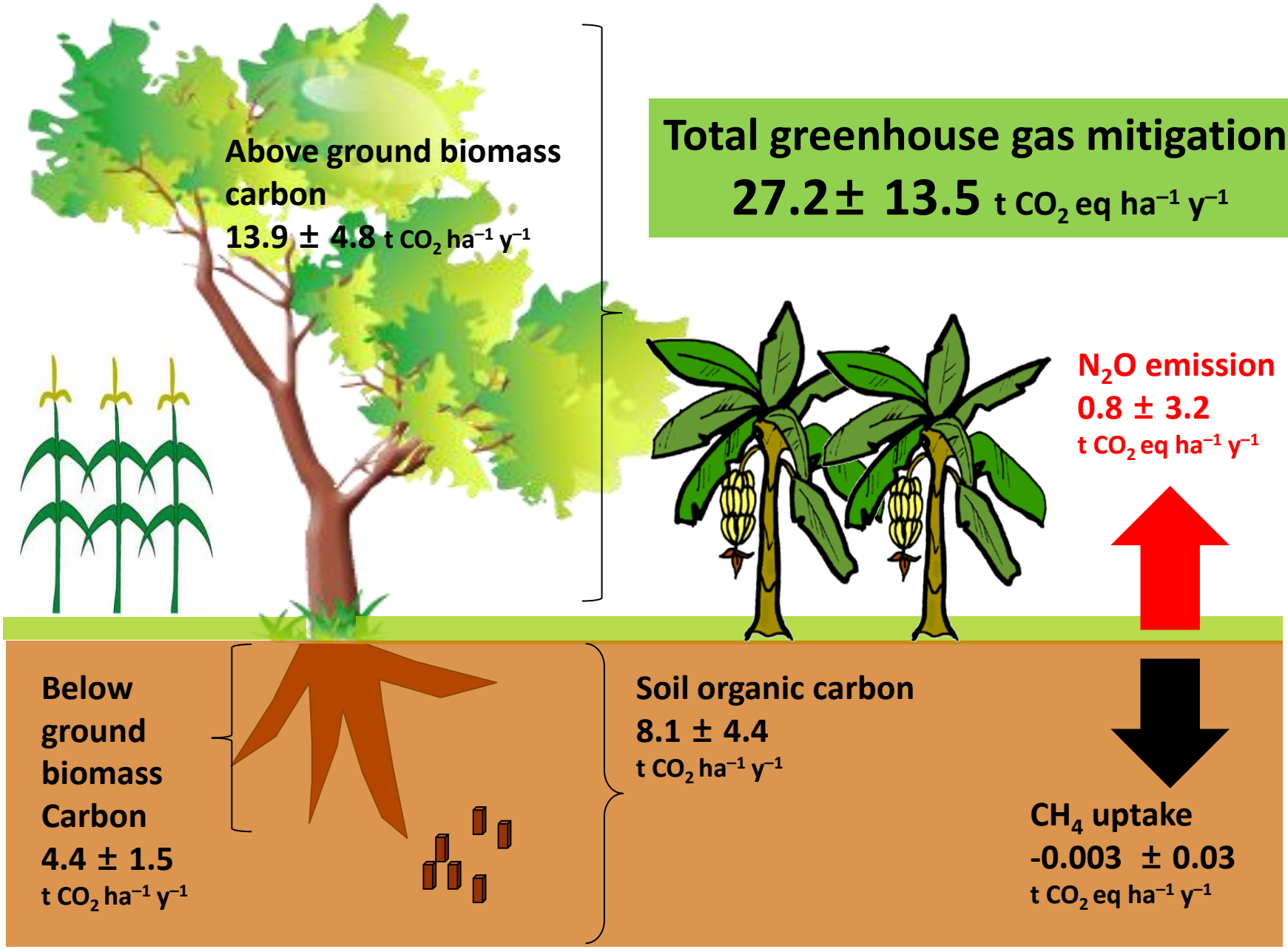
**Nitrous oxide ($N_2O$) emission**
**7.7 ± 1.7 kg $N_2O$ $ha^{-1}$ $y^{-1}$**

**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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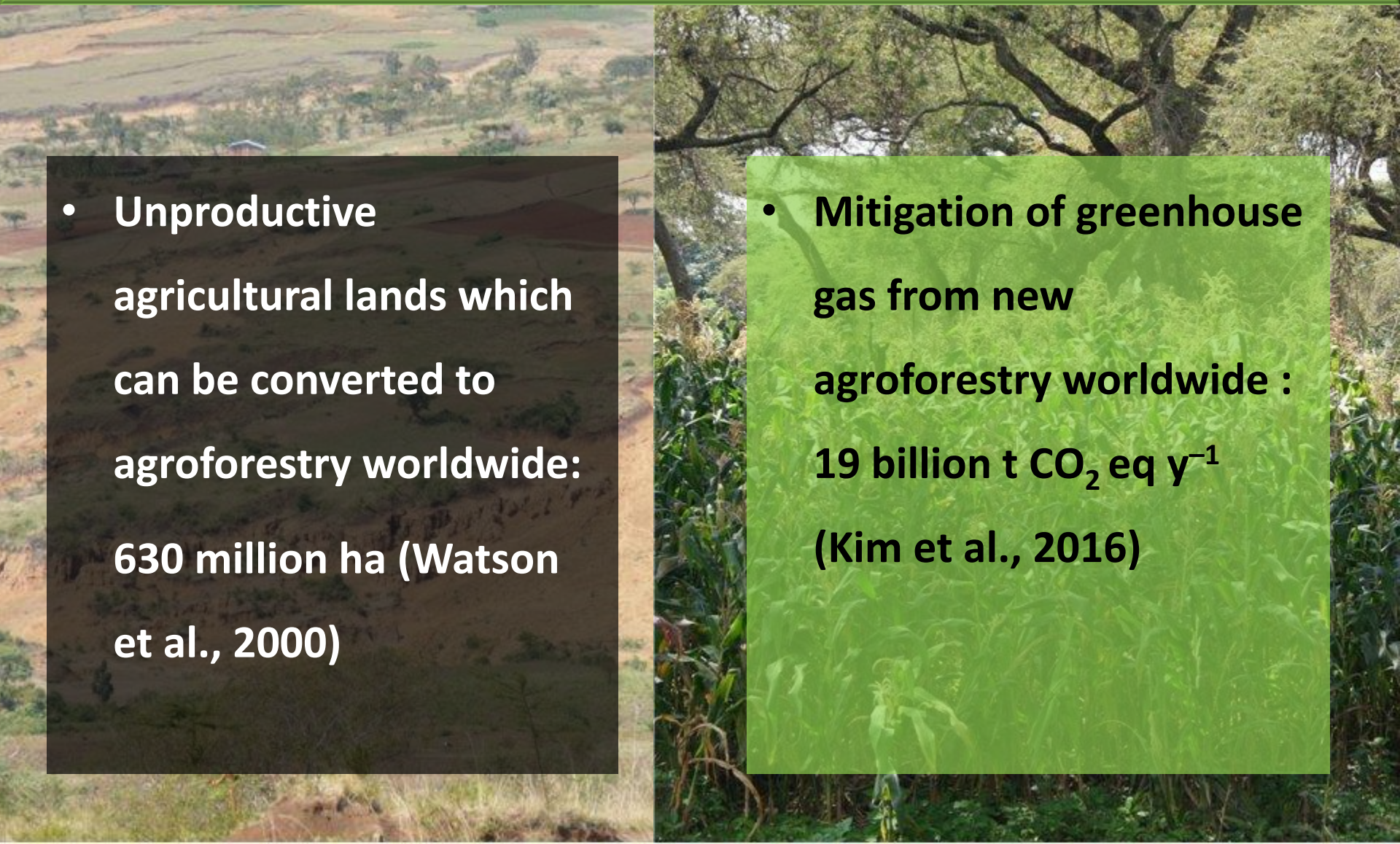
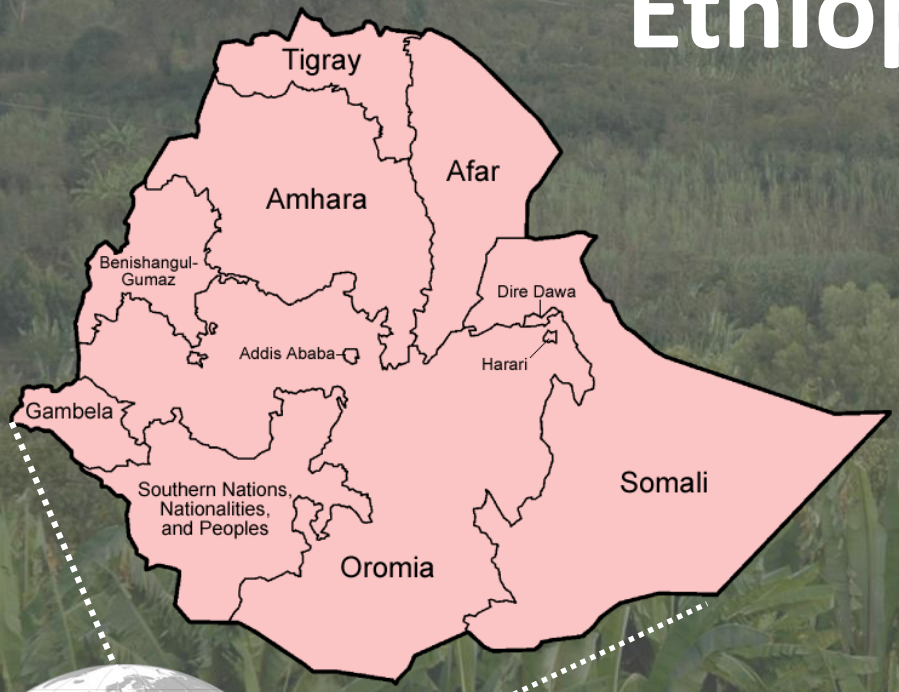
# Global potential of mitigation in agroforestry



- 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)

# Ethiopian case studies

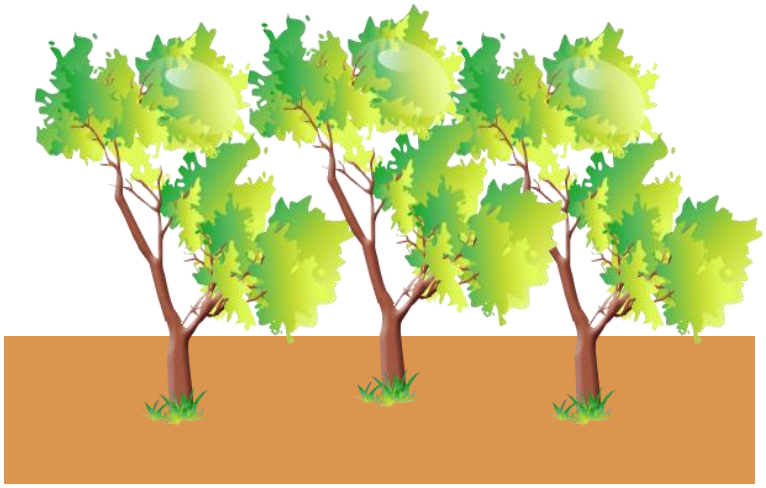



http://en.wikipedia.org/wiki/Ethiopia

# Ethiopian case 1: Converting forest to coffee agroforestry

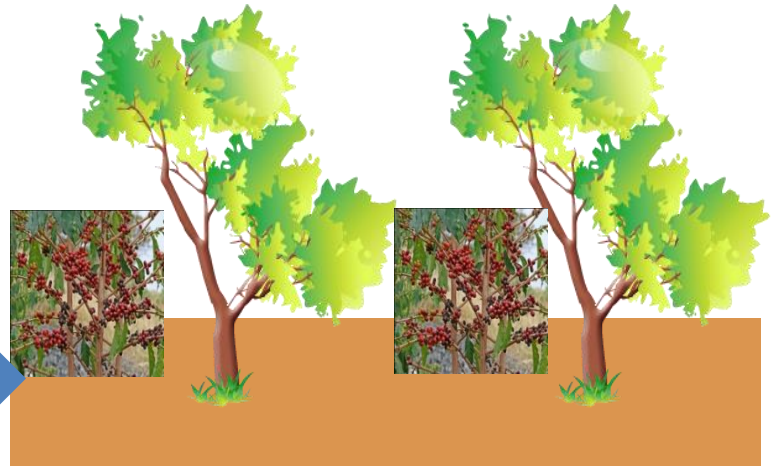
**No significant change in soil carbon**

**147.6 ± 16.5 Mg C ha$^{-1}$**



**Forest/woodland**

**145.0 ± 28.7 Mg C ha$^{-1}$**

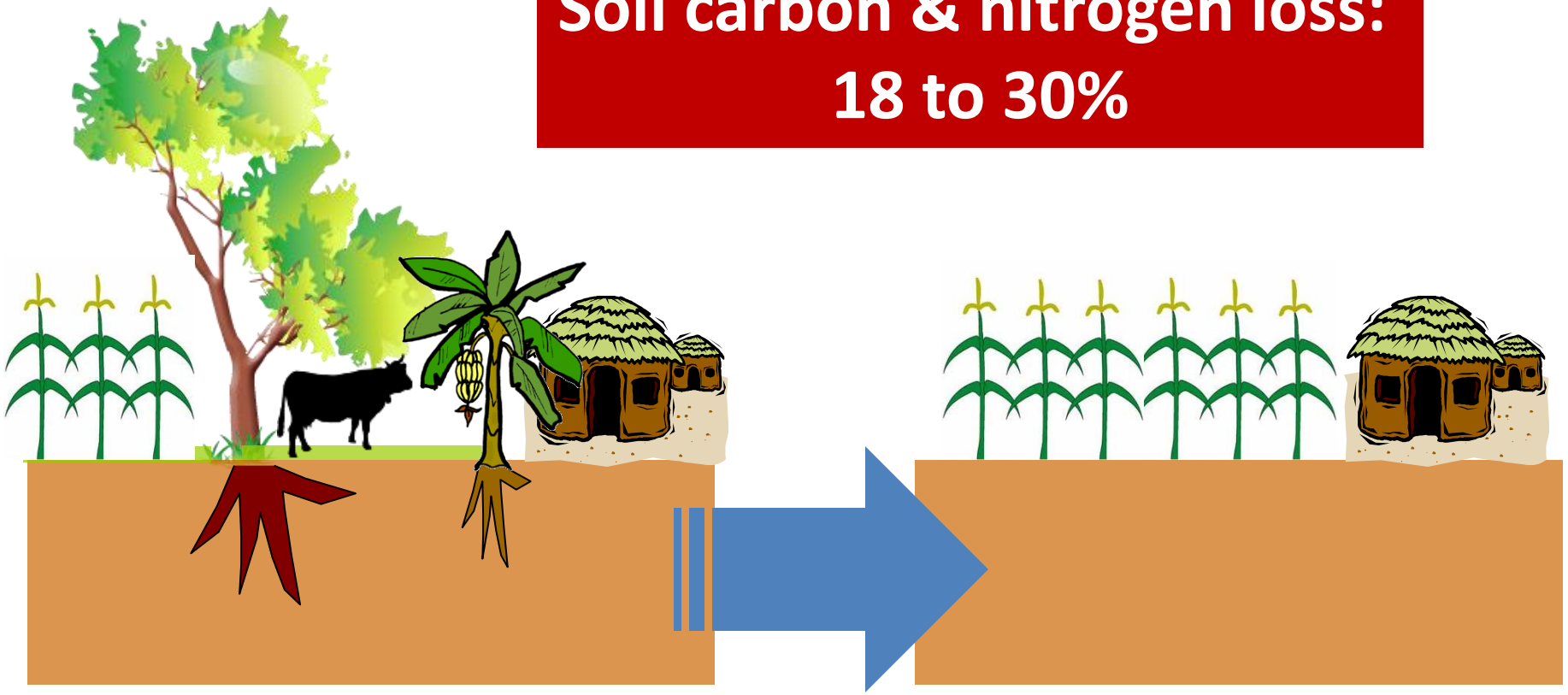


**Coffee agroforestry**

Source: Biazin et al. (in review)

# Ethiopian case 2:
# Converting home garden to mono-cropping

**Soil carbon & nitrogen loss:**
**18 to 30%**

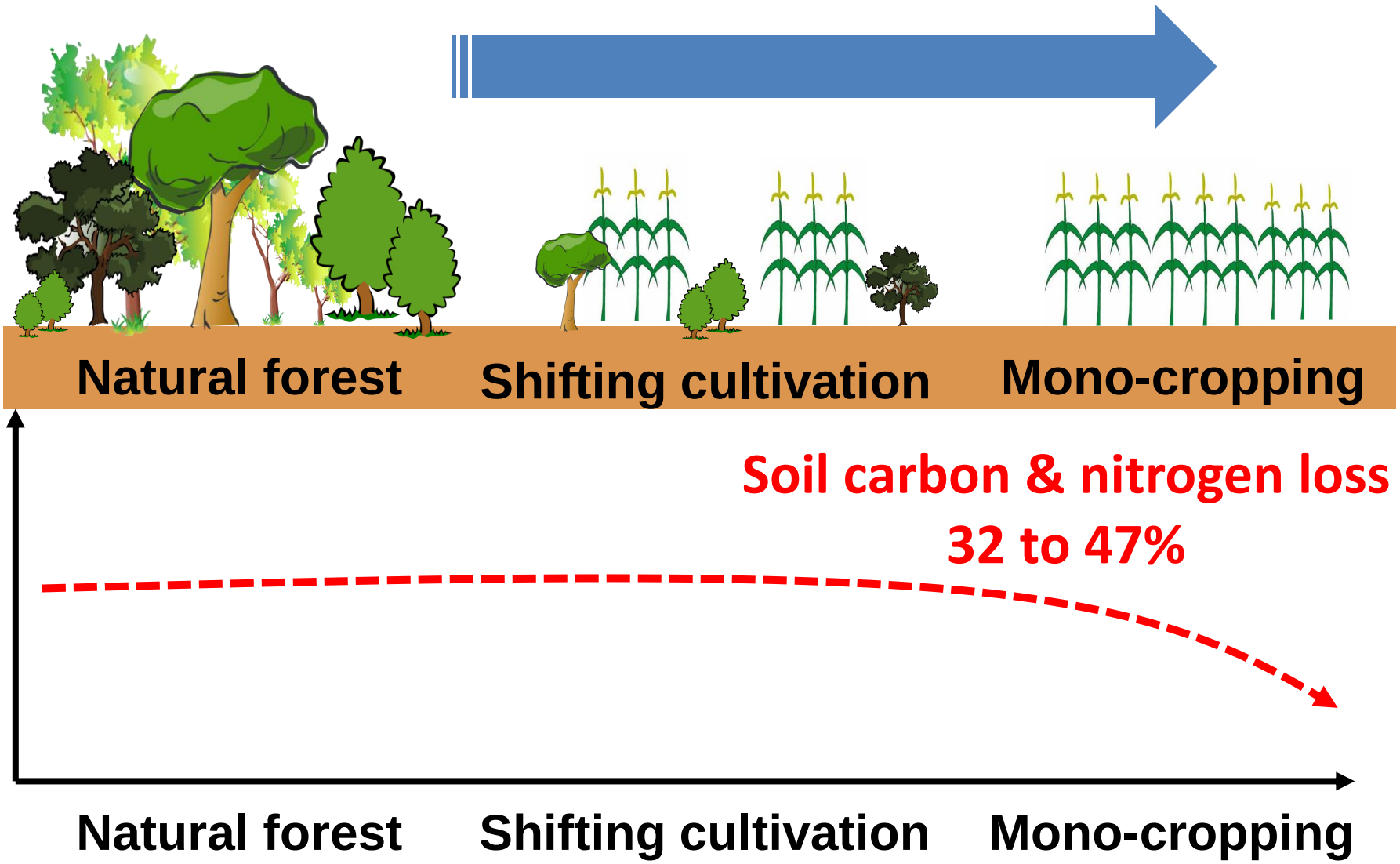


**Home garden**

**Mono cropping**

Source: Kim et al. (2016)

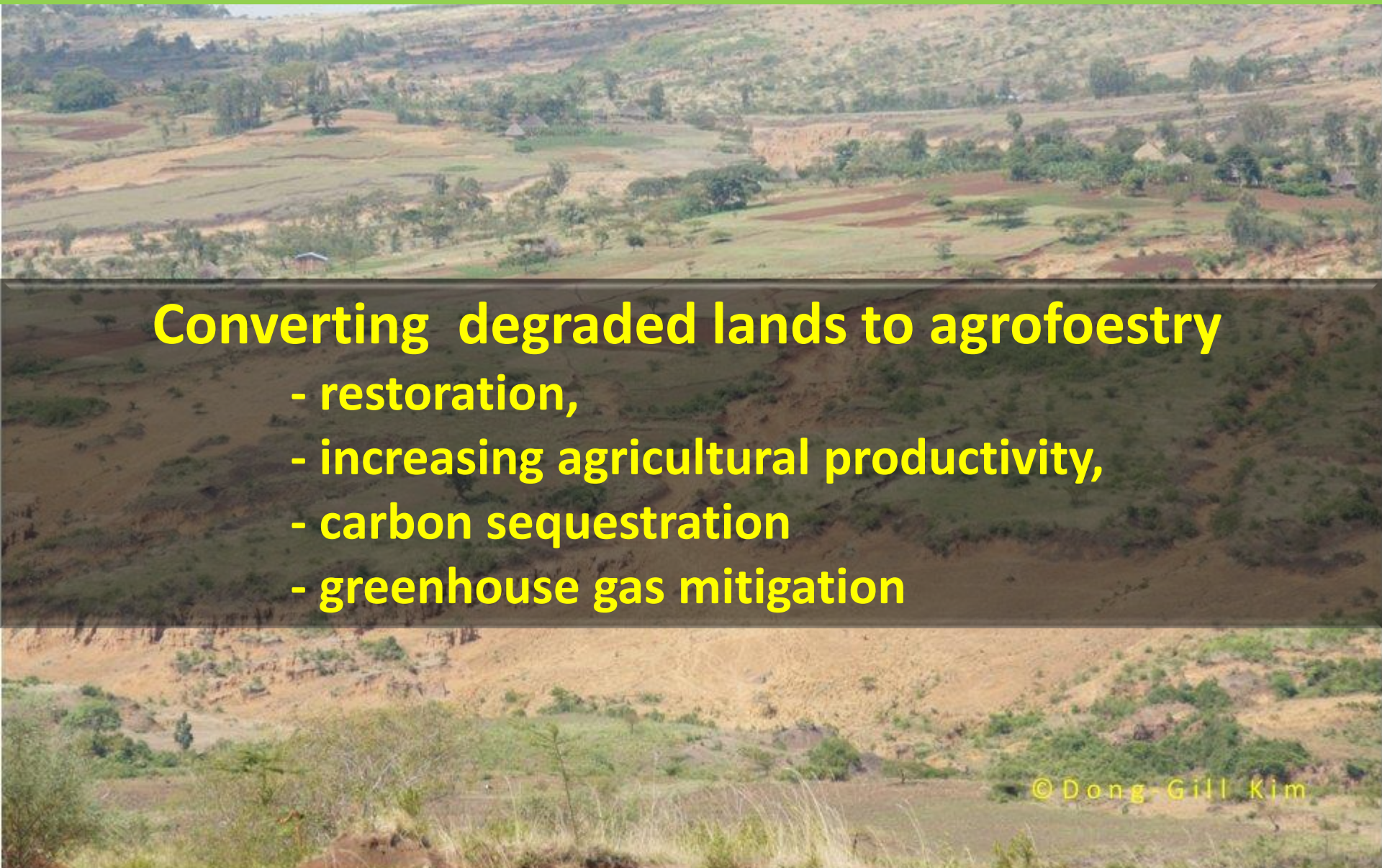
# Ethiopian case 3:
# Converting shifting cultivation to mono-cropping




Source: Kim et al. (unpublished)

# Implication (1)

# Implication (2)



# Implication (3)

# 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.

**Thanks for your attention!**