Agroforestry - an option to mitigate GHG emissions in the European Union?

Gerry Lawson (1,2) & Nathan De Baets (3)

1. Centre for Ecology and Hydrology, Edinburgh
2. European Agroforestry Forum, Montpellier
3. Écoressources, Quebec

UK Farm Woodland Forum Annual Meeting, Ballyhaise, Co Cavan, 21-23 June, 2016

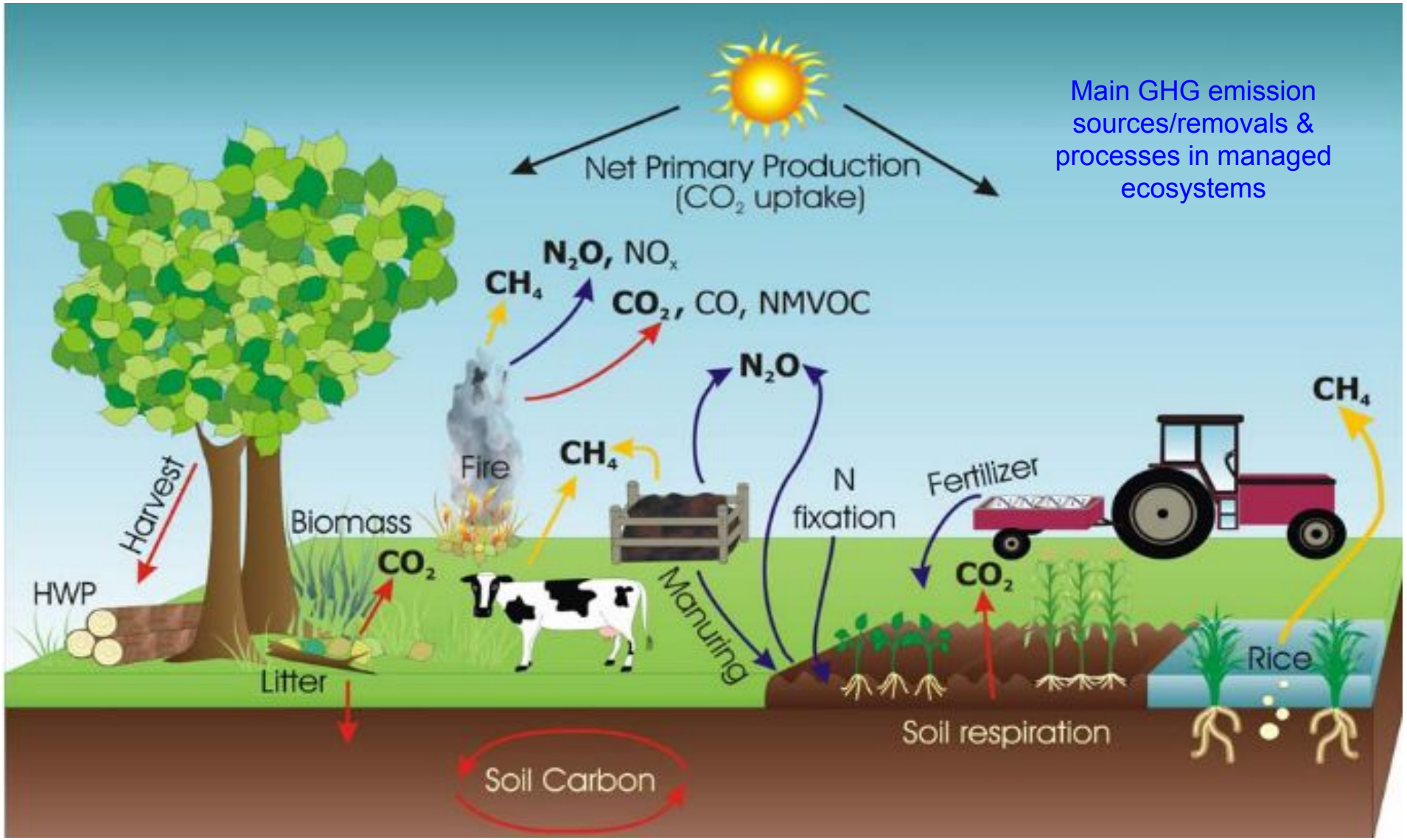
COP 21

- Containing global temperature **increase to below 2C** (and "energetic efforts" to keep below 1.5C)
- "**Global emissions ceiling**" in the shortest possible time & emissions neutrality in the second half of the century, with national emissions strategies published asap.
- "**Green Fund**" devoted to adaption and a "Technology Transfer Mechanism" for LDCs.
- All countries share responsibility but in different proportions - determined by historic level of responsibility and current level of development.
- Collective goal for 2020 onwards of **$100 billion in loans and donations** to fund projects to enable most seriously affected countries to adapt to climate change and/or reduce emissions.
- **Mechanism for monitoring commitments every 5 years from 2025 onwards (with initial meeting in 2018).**
- Desirability of a **carbon pricing framework** to encourage stakeholders to reduce emissions… and recognition of the carbon pricing initiative for 60+ states.
- Must be **ratified by 55+ countries**, representing at least 55% of GHG emissions.
- EU Intended Nationally Determined Contribution (INDC) "binding target of **at least 40% domestic reduction in greenhouse gas emissions by 2030** compared to 1990

COP 21: Forestry & Agriculture

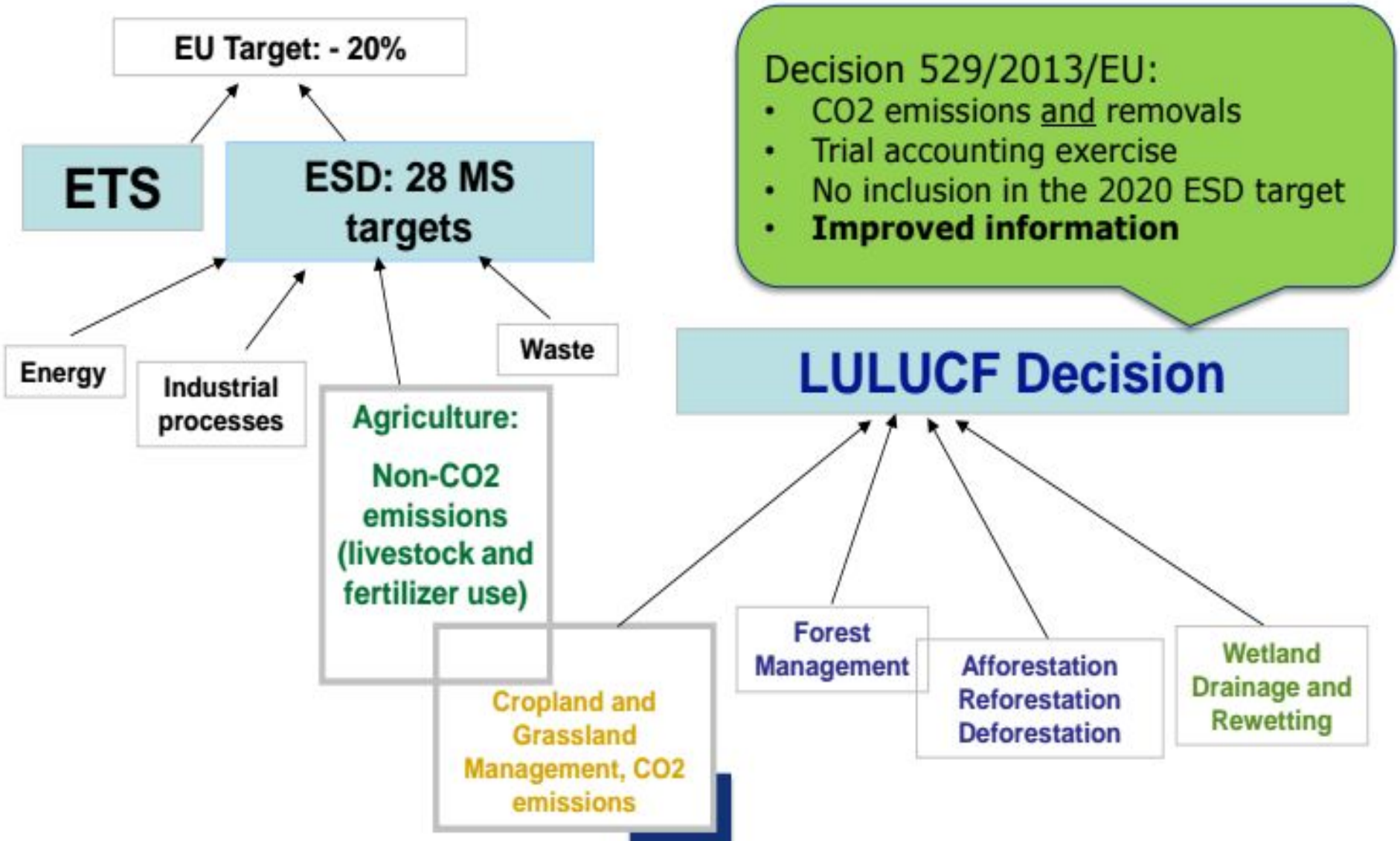
- Article 55. “Recognizes the importance of adequate and predictable financial resources, including for **results-based payments**, as appropriate, for the implementation of policy approaches and positive incentives for reducing emissions from **deforestation and forest degradation**, and the role of conservation, **sustainable management of forests** and enhancement of **forest carbon stocks**; as well as alternative policy approaches, such as joint mitigation and adaptation approaches for the **integral and sustainable management of forests**; while reaffirming the importance of non-carbon benefits associated with such approaches; encouraging the coordination of support from, *inter alia*, public and private, bilateral and multilateral sources, such as the Green Climate Fund, and alternative sources in accordance with relevant decisions by the Conference of the Parties.”
-
- **NO MENTION of agriculture in COP21 Statement!** Although it does includ “food security”

Can´t separate CO2 emissions from other GHGs



From 2006 IPCC GHG Inventory Guidelines Volume 4: Agriculture, Forestry and Other Land Use (AFOLU)

But the **current** policy framework for emissions reporting/accounting does make this separation



So, why is LULUCF/AFOLU so important

part of the cause

Globally LULUCF + Agriculture ~30% current emissions and future mitigation potential

At EU level, LULUCF offsets 8% of total emissions, while Agriculture represents 10% of total emissions

part of the solution

The mitigation options of LULUCF may include:

1. **C removals/sink** (new forests, increased C stocks in existing forests)
2. **Reduction of emissions** (reduce deforestation and forest degradation)
3. **C substitution** (renewable source of energy replacing fossil fuel, wood replacing more carbon-intensive products) – links with other sectors

LULUCF offers potential synergies between mitigation, adaptation, biodiversity ...

LULUCF has always been a key element in climate policy debate

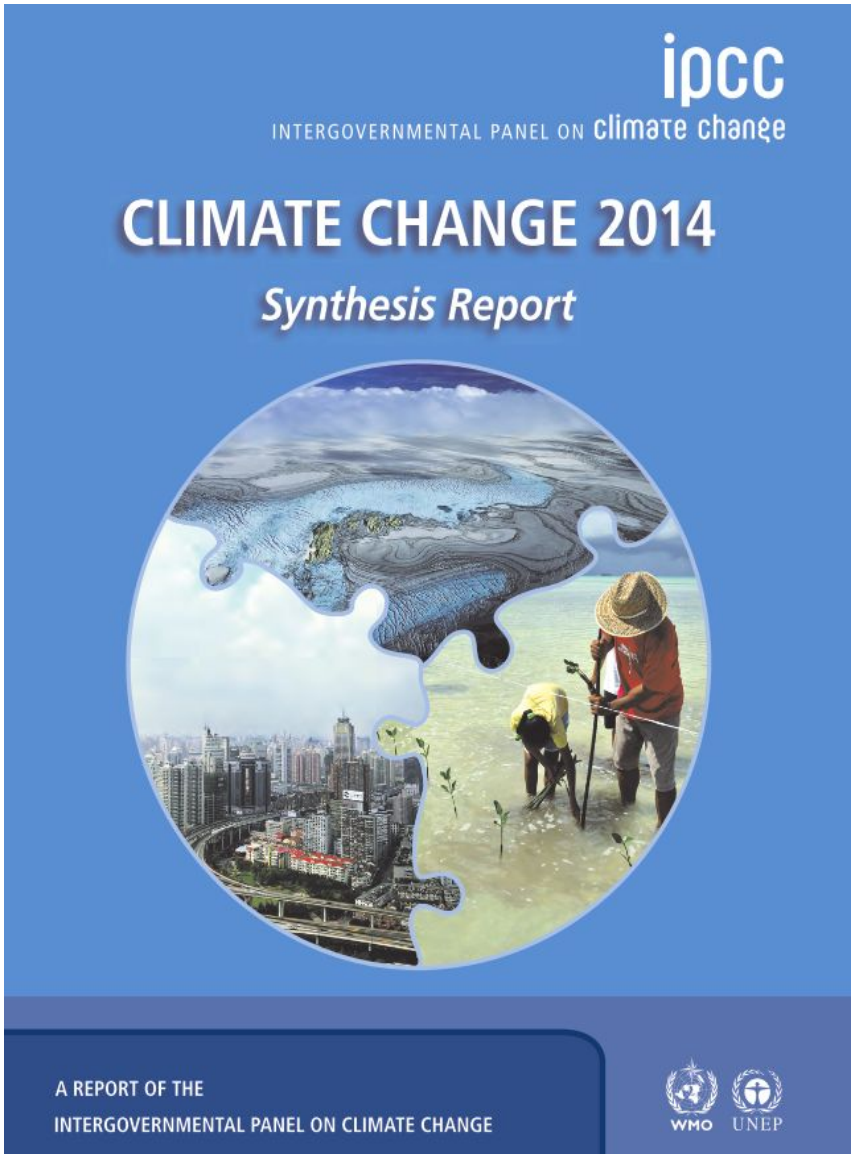
Giacomo Grassi, JRC, ISPRA, 2010

The 5th Assessment Report uses AFOLU not LULUCF

IPCC AR4 (IPCC WGIII, 2007)
Agricultural and forestry mitigation were dealt with in separate chapters

IPCC AR5
First time - the terrestrial land surface, comprising agriculture, forestry and other land use (AFOLU), is considered together in a single chapter.

- Ensure all land based mitigation options can be considered together
- Minimise the risk of double counting or inconsistent treatment (e.g. different assumptions about available land)
- Consider systemic feedbacks between mitigation options related to the land surface



But many environmental NGO´s and forestry organisations oppose the AFOLU "Single Land Use Pillar"

DG Clima Consultation June 2015

- **Option 1** — separate "LULUCF pillar" (the status quo) - i.e. maintain non-CO_2 agriculture sector emissions and LULUCF in two separate pillars; (**32 votes**)
- **Option 2** — Report using a single "Agriculture, Forestry and Other Land Use" pillar (AFOLU). This merges LULUCF and non-CO_2 emissions from agriculture into a new pillar in the EU's climate policy; (**21 votes**)
- **Option 3** — including the LULUCF (or AFOLU?) sector in a potential future Effort Sharing Decision. This would would increase flexibility for Member States to achieve a given overall target, but would increase complexity of accounting and raise methodological issues (**12 votes**)
- **Option 4** - a mixture of the above. (**18 votes)**
- **Option 5** - unable to make a recommendation (**41 votes**)

Comments:
"Why should forestry meet the climate change bill for agriculture?"
"Option 2 is a dangerous dilution of emissions reduction targets"

Emissions Reporting and Accounting

The following general **principles** should be followed:

Transparency: all the methodologies should be clearly explained and documented.

Consistency: the same methodologies and consistent data sets should be used along time.

Comparability: countries should follow the methodologies /formats provided by the IPCC.

Completeness: estimates should include all the agreed categories, gases and C pools.

Accuracy: estimates should be systematically neither over nor under the true value, so far as can be judged, and that uncertainties are reduced so far as is practicable.

EU Climate and Energy Framework (2014)

So where are the reductions from the EU Land Use Sector to come from?

European Council

Brussels, 24 October 2014

EUCO 169/14

CO EUR 13
CONCL 5

Target: 40% Reduction in emissions by 2030 compared to 1990

Statement from EU Ministers: (2030 Climate and Energy Policy Framework)

"The multiple objectives of the agriculture and land use sectors, with their lower mitigation potential, should be acknowledged, as well as the need to ensure coherence between the EU's food security and climate change objectives. The European Council invites the Commission to examine the best means of ***encouraging the sustainable intensification of food production, while optimising the sector's contribution to greenhouse gas mitigation and sequestration, including through afforestation****."*

EURAF View:

Agroforestry is one of the few land uses which can deliver all THREE of the above requirements: a) 'sustainable intensification of food production', b) 'optimised GHG mitigation' and c) 'afforestation'.

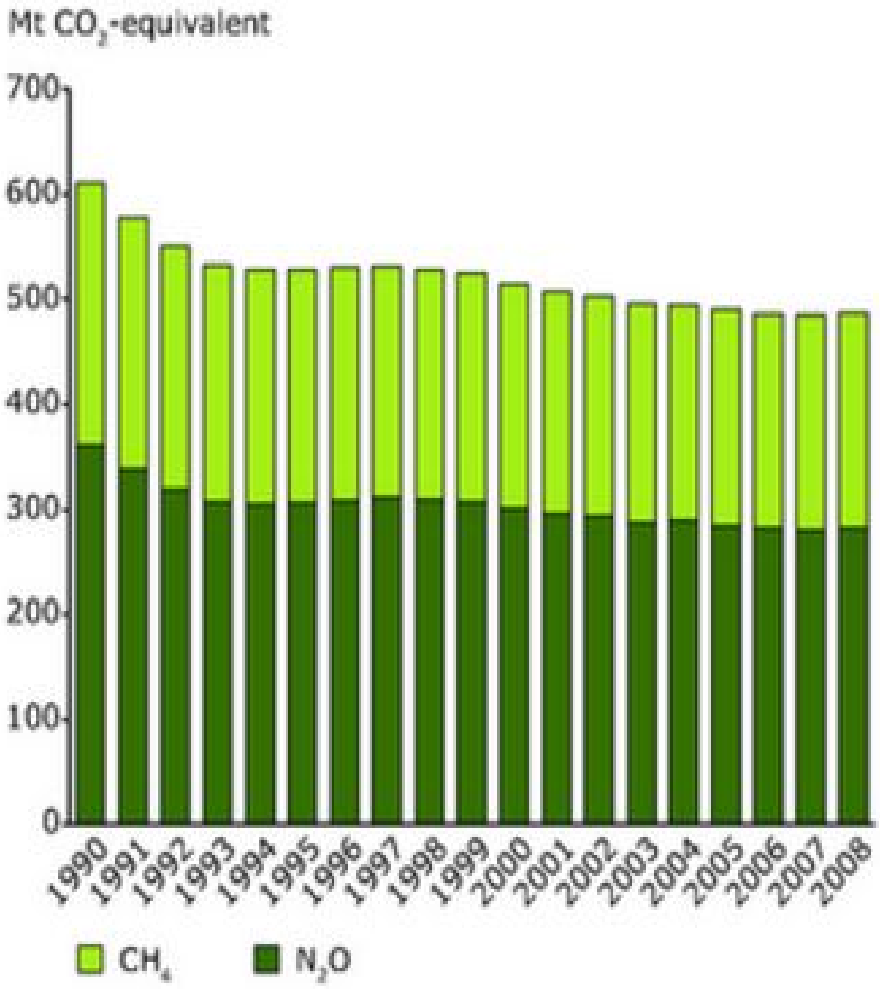
Reporting v Accounting & UNFCCC v Kyoto (2000)

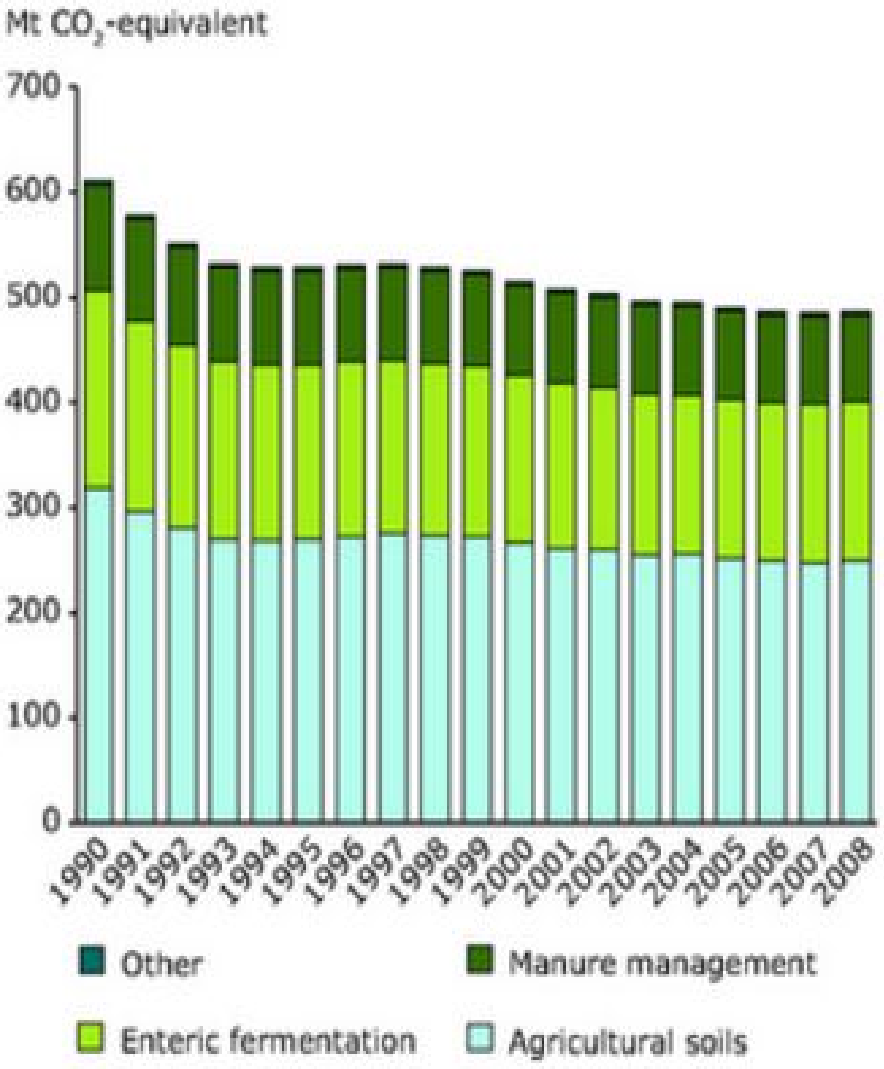
	UNFCCC	KP	
	Reporting	**Reporting**	**Accounting**
AGRI CULTURE	CH4 and N20 from soils, livestock, manure	= UNFCCC	relative to 1990 (net-net)
LULUCF	GHG from 6 **land uses** (all managed lands) FL Forest land CL Cropland (CO2) GL Grassland (CO2) WL Wetland S Settlements O Other	GHG only from direct human induced **activities** AR Aff/Reforestation D Deforestation FM Forest management CM Cropland manag. (CO2) GM Grazing land manag. (CO2) RV Revegetation	very complex Mandatory, gross-net → Voluntary, gross-net + cap Voluntary, relative to 1990 (net-net)

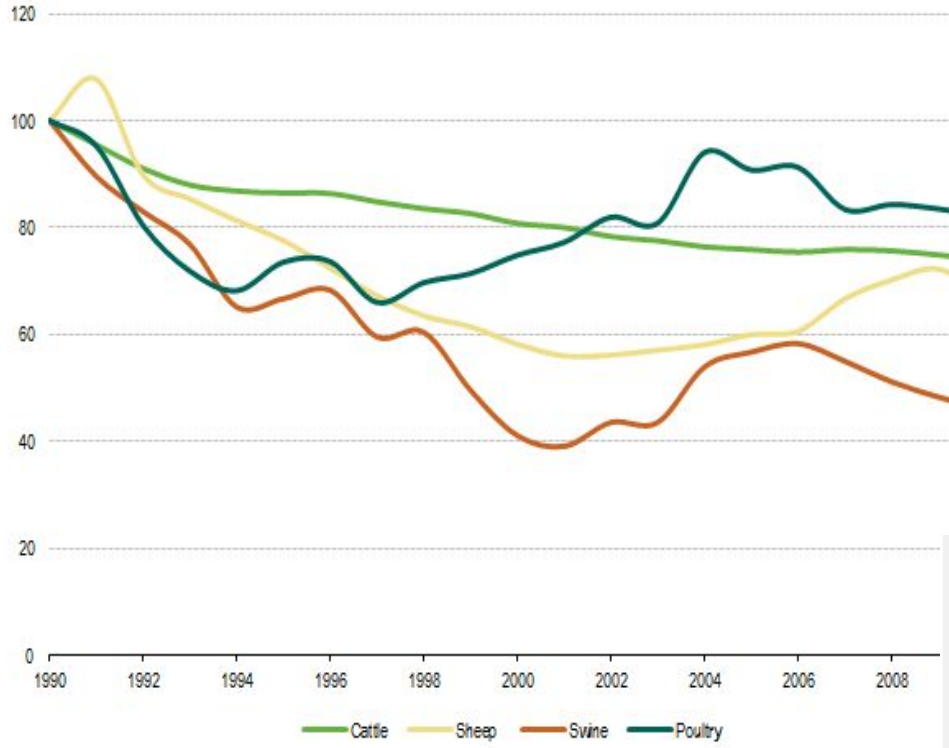
Total GHG in a country
GHG reported under UNFCCC
GHG accounted for under KP

Giacomo Grassi,
JRC, ISPRA, 2010

EU non-CO2 emissions from agriculture have decreased by 22% since 1990 but have stabilized at around 470 Mt/yr.







EU emissions have declined by 22% since 1990 - mainly because of decline in ruminants (26% cattle, 33% sheep). But numbers stabilising

And predictions of non-CO2 agric emissions show no significant reductions

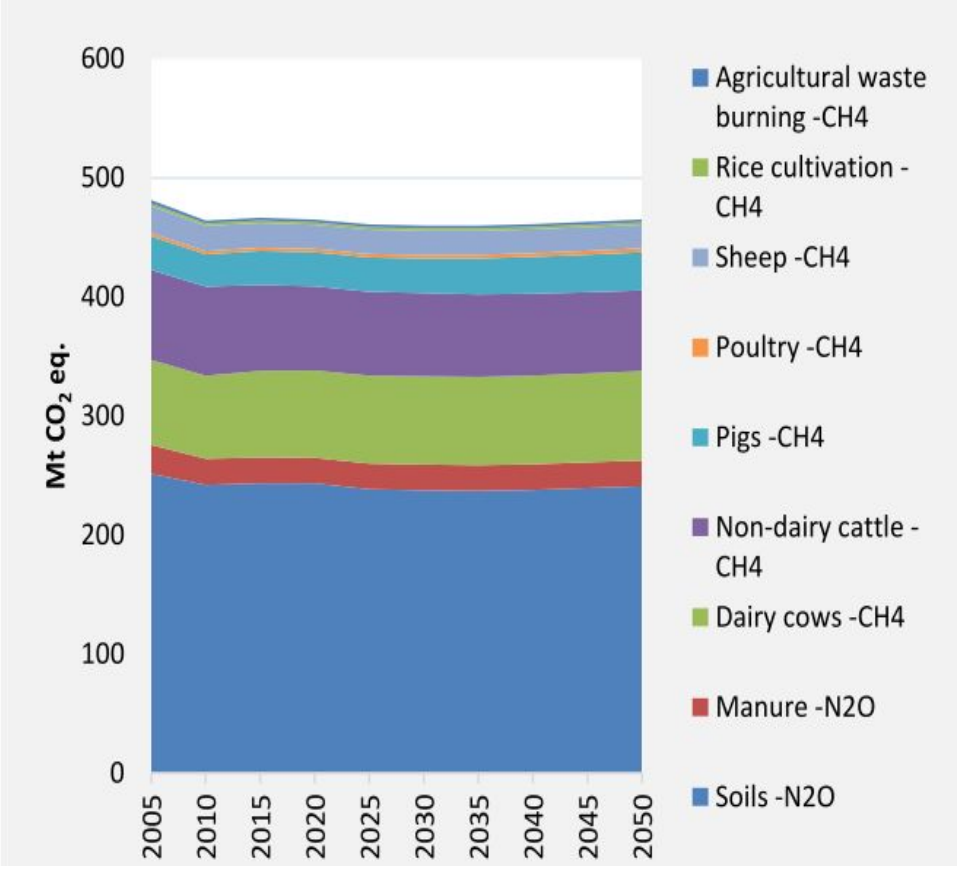
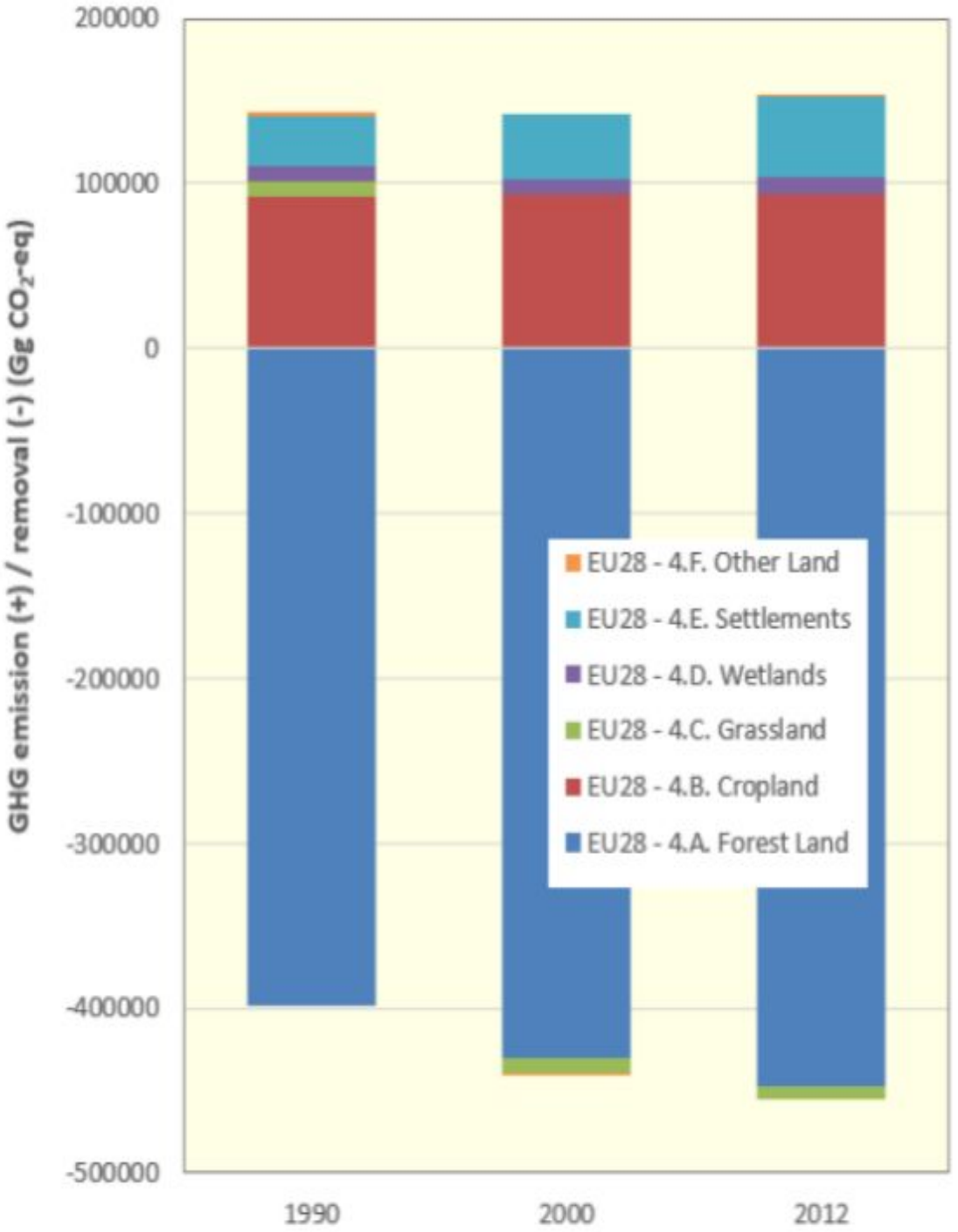


Figure 47 in EH28 LULUCF emissions until 2050 in Mt CO2. In “EU Energy, Transport and GHG Emissions, Trends to 2050, Reference scenario 2013”

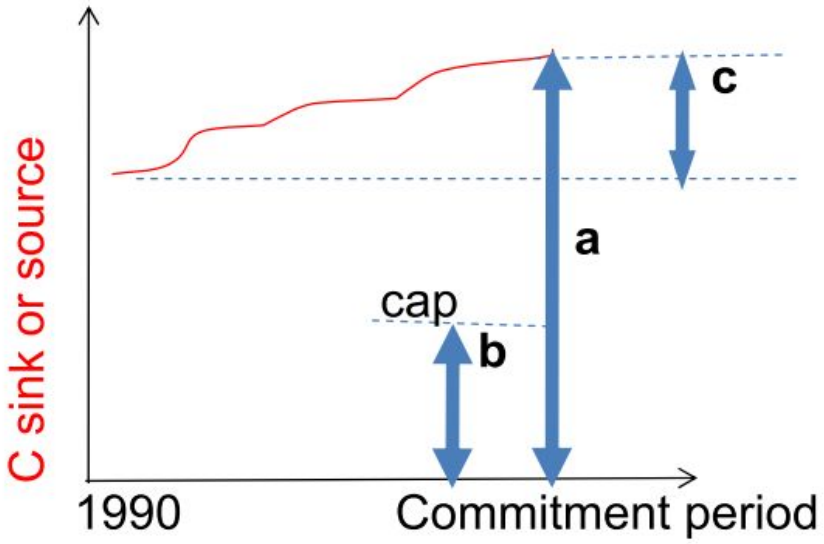
Land Use Land Use Change and Forestry (LULUCF) is a net sink of around 300 Mt CO2/yr.

But will the LULUCF contribution to GHG accounting (post 2020) be CAPPED because of combined forest sector and NGO pressure?



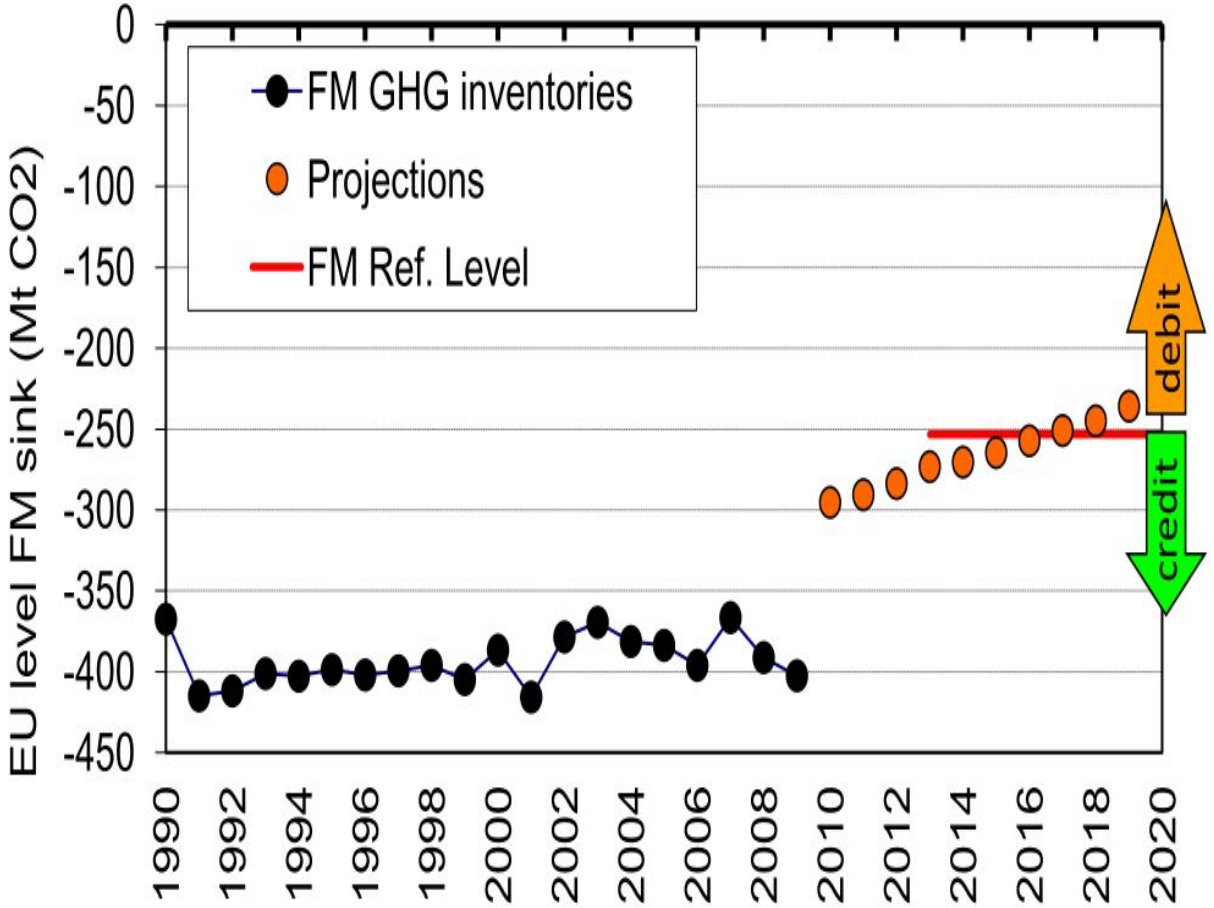
How do the accounting rules work?

Activity	Accounting rule	What is accounted as credit (debit) ?
AR, D	Gross-net	the absolute sink (source) during commitment period (**a**)
FM	Gross-net with CAP	the absolute sink (source) during commitment period, up to a certain country-specific "cap" (**b**)
CM, GM, RV	Net-net compared to 1990	the difference between the sink (source) during commitment period and the sink (source) in 1990 (**c**)



Giacomo Grassi,
JRC, ISPRA, 2010

Forest Management Reference Level (FMRL)



But the LULUCF and Forest Management (FM) sinks are declining

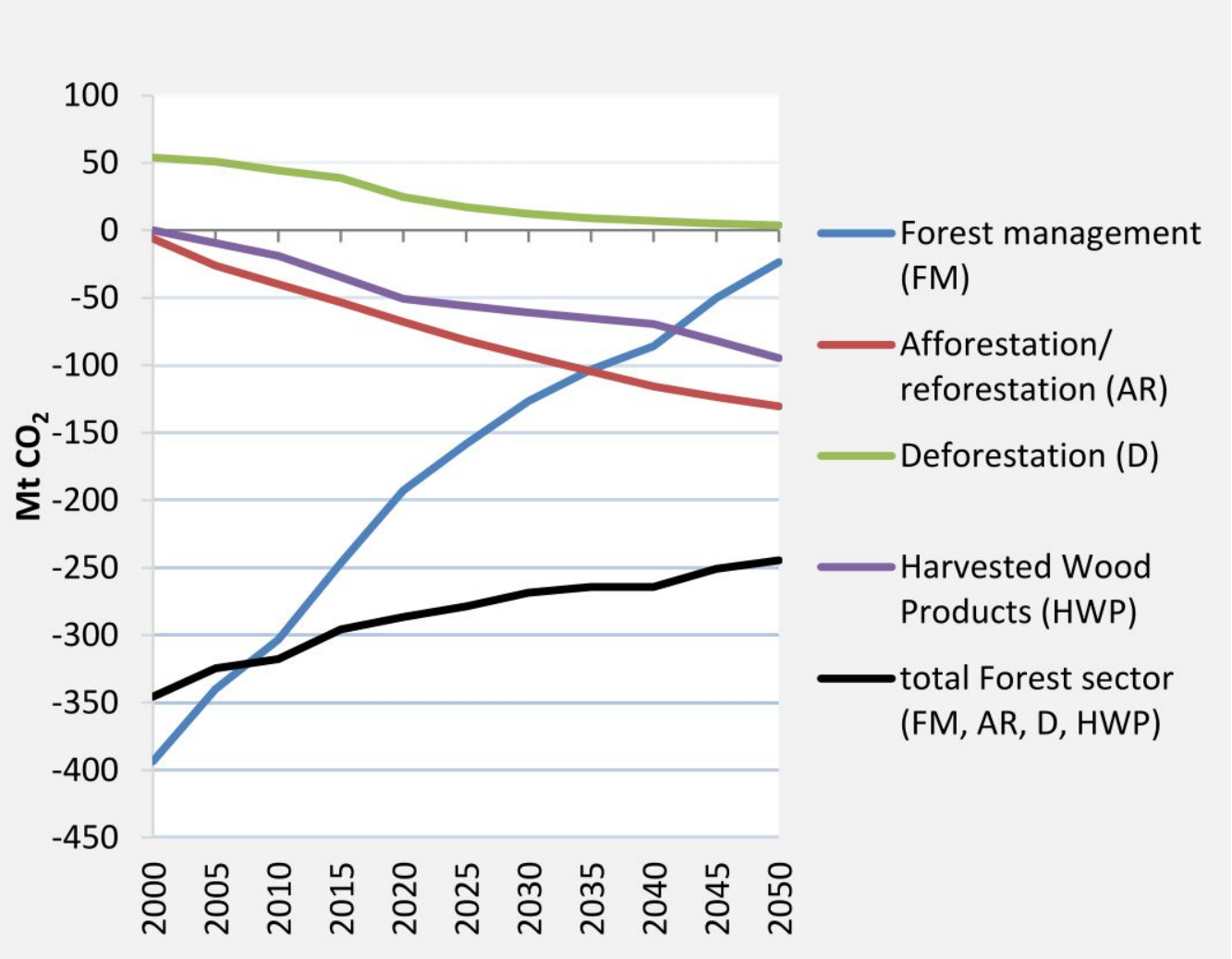
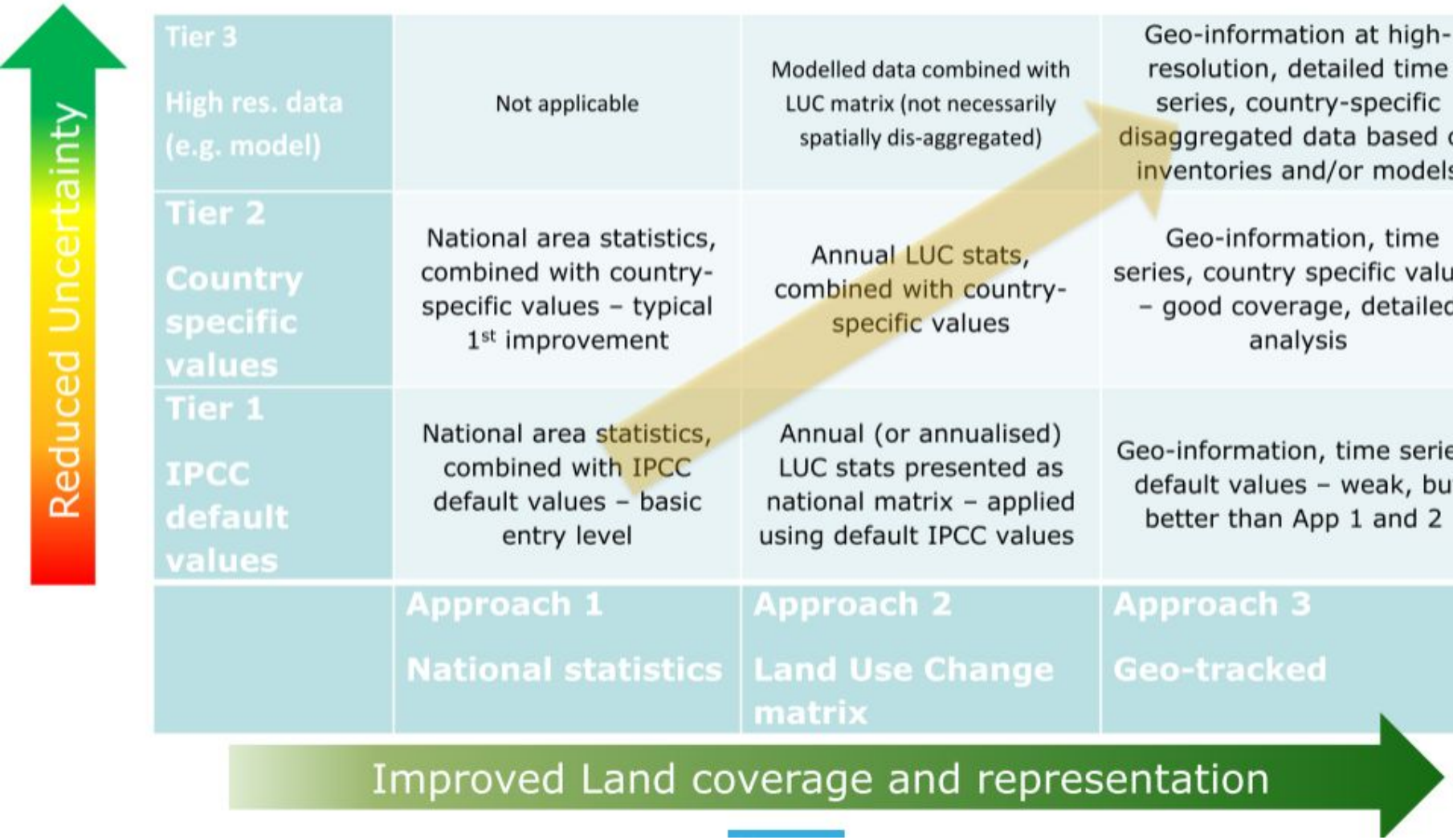


Figure 54: EH28 LULUCF emissions until 2050 in Mt CO2. In “EU Energy, Transport and GHG Emissions, Trends to 2050, Reference scenario 2013”

Tier 3 & Approach 3 must come for UNFCCC Reporting

Improving the accuracy and robustness of estimates



Climate Change Mitigation/Adaptation & Agroforestry

DG-CLIMA consultation on EU Policy & Mitigation

"Win-wins" in the agriculture sector:

- better **manure management**, in particular through biogas production;
- improvements to **fertiliser efficiency** and greater use of natural sources of fertiliser;
- increased **livestock efficiency**, including health improvements;
- synergies from agricultural land measures (e.g. the use of cover crops or catch crops) mentioned below; and
- **farm carbon audits** and climate advisory services that can inform farmers about mitigation options available at farm level.

"Opportunities" in the LULUCF sector:

- addressing **hotspots** of cropland emissions .. eg cultivation and draining of peatlands
- using **cover or catch crops** by retaining crop residues to increase soil organic matter and carbon
- establishment of **agroforestry systems**, which can sequester carbon while maintaining high agricultural production
- **afforestation** particularly in MS with marginal agricultural land, and better constraints on deforestation
- improved **forest management activities** .. e.g. protection against fire, soil conservation techniques and better use of the incremental growth of existing forests

Carbon fixation in agroforestry plots

- Vézénobres, Gard (sandy loam soil in a Mediterranean climate) where 13 year old poplars at 140 stems ha^{-1} (I-214 Clone) had on average sequestered 540 kg C $tree^{-1}$ in the trunk and 60 kg C $tree^{-1}$ in the root system. **Totalling 6.5 tonnes C $ha^{-1}yr^{-1}$.**
- Les Eduts, Charente-Maritime. Under an atlantic climate, in a parcel with black walnut (*Juglans nigra*) at 70 trees ha^{-1} on a shallow clay loam soil with a high stone content, a typical tree had, over a 30-year period, sequestered 190 kg C in its above-ground tree-parts and 100 kg C in its root system, or 20.3 tonnes C ha^{-1} over the 30 year period plus an estimated 10 tonnes per ha of soil-carbon enrichment, or **1 tonne C $ha^{-1}yr^{-1}$** (Gavaland and Burnel 2005)
- Restinclières, Montpellier (Fig 6.20), where a 14 year field experiment with 80 hybrid walnut trees per ha (*Juglans regia* × *nigra*) had sequestered **3.1 to 3.5 tonnes C $ha^{-1}year^{-1}$**, of which 3 tonnes a year is in the trees and 0.1 to 0.5 is a net gain in the soil.
- Hamon et al. (2009), averaging other French results found **1.5 to 4 tonnes C $ha^{-1}yr^{-1}$ for tree densities of 50 to 100 ha^{-1}**, which is double the yearly sequestration of an average hectare of forest, and 5 to 10 times higher than agricultural land.

Ricardo/AEA Mitigation Potential (for DGCLIMA)

Table 70: Mitigation actions in groups of greatest potential, large regional potential, and low potential

Mitigation potential group	Mitigation action
Greatest potential	Conversion of arable land to grassland to sequester carbon in the soil
	New agroforestry
	Woodland planting
	Preventing deforestation and removal of farmland trees
	Management of existing woodland, hedgerows, woody buffer strips and trees on agricultural land
	Leaving crop residues on the soil surface
	Ceasing to burn crop residues and vegetation
	Use cover/catch crops
	Use of nitrification inhibitors
	Biological N fixation in rotations and in grass mixes
	Carbon auditing tools
Large regional potential	Zero tillage
Low potential	Wetland/peatland conservation/restoration
	Reduced Tillage
	Livestock disease management
	Use of sexed semen for breeding dairy replacements
	Breeding lower methane emissions in ruminants
	Feed additives for ruminant diets
	Optimised feeding strategies for livestock
	Soil and nutrient management plans
	Improved nitrogen efficiency
	Improved on-farm energy efficiency

This report for the EU CLIMA Directorate General will be published next month, but shows new agroforestry (spaced trees). protecting farmland trees and management of trees in hedgerows as some of the best options for sequestering carbon.

Aertsens et al. (2013) used **2.75 t C ha^{-1} yr^{-1}**, and multiplied by **90 M ha** for potential silvoarable area and **50 M ha** for potential silvopasture (Reisner *et al* 2007). Giving 486 Mt C yr^{-1} in new agroforestry systems or 1.5 Billion tonnes of CO_2 equivalent yr^{-1}, which represents **37% of EU CO_2 emissions**

Conclusions

- GHG reporting and accounting is best done within a single integrated land use **AFOLU pillar** (i.e NOT a separate LULUCF pillar)
- Methods require to be "**harmonised**" in the European Union following the IPCC principles of transparency, consistency, comparability, completeness and accuracy.
- The Land Parcel Identification System (**LPIS**) provides a very high resolution common platform for accurate (Approach 3) identification of **forest and agriculture parcels** AND for trees on boundaries.
- Scattered trees in parcels (silvopastoral and silvoarable systems) will be reported on separately to **trees on boundaries**.
- Better measurements and models are needed for integrated reporting of **GHG fluxes** (Tier 3).
- Farm-scale reporting can incentivise farmers and allow "agri-environment-climate" payments in Pillar II "**by results".**
- Political pressure may introduce a "**cap"** on the extent that **LULUCF** can "offset" GHG emissions in agriculture. However agroforestry trees will be reported on to UNFCCC using **net-net methodology** in Cropland Management (CM) and Grassland Management (CM) and won't be capped.
- **The political limit on accounting for forestry sinks may be a reason for Ireland to consider reclassifying agroforestry as "agricultural land"?**

Hot off the press

Commissioner Canete of DGCLIMA outlined to COMAGRI on 20.6.16 the fundamentals of the upcoming LULUCF proposal. It will be published in late July, and will:.

1. set LULUCF as a **separate pillar**
2. simplify the **accounting rules**
3. introduce a post-Kyoto emissions governance system
4. enhance flexibilities under the ESD to allow for offsetting of both ETS and LULUCF credits within each Member State's reduction targets, determined through the EU Effort Sharing Decision. He confirmed that forestry credits would be allowed to offset emissions in other sectors 'to a limited extent'.

LULUCF Proposal Received.

The above proposal was published on 20.7.16 Up to 280 Mt CO2 equivalent can be transferred from LULUCF to meet a Member States' commitment in the Emissions Sharing Regulation over the decade 2021-2030. This averages 6% of total agricultural non-CO2 emissions in the EU. 4 countries (**IE**, DK, LT, LV) are allowed to transfer 15%, 13 countries 7.5%, and 11 countries (including the **UK**) 3.75%.

A further analysis is available here

Additional Slides

Many reports appearing on LULUCF/AFOLU reporting Accounting

European Commission

JRC TECHNICAL REPORTS

LULUCF MRV

Analysis and proposals for enhancing Monitoring, Reporting and Verification of greenhouse gases from Land Use, Land Use Change and Forestry in the EU.

FINAL REPORT

Raúl Abad Viñas
Viorel Blujdea
Sandro Federici
Roland Hiederer
Roberto Pilli
Giacomo Grassi

2014

Institute for European Environmental Policy

THÜNEN

umweltbundesamt

February 2015

Guidance on reporting and accounting for cropland and grassland management in accordance with Article 3(2) of EU Decision 529/2013/EU

A joint project by:
The Institute for European Environmental Policy
Environment Agency Austria
Thünen Institute

Supported by:
Environmental Agency, Portugal
Institute for Forest Ecosystem Research, Czech Republic
Agrifood Research, Finland
Zoltan Somogyi, independent expert

11

Agriculture, Forestry and Other Land Use (AFOLU)

Agriculture and LULUCF in the 2030 Framework

Final Report

Submitted by ICF Consulting Limited, Alterra, COWI, Ecologic Institute and Umweltbundesamt GmbH

Date: 3 May 2016

Job Number 30300708

umweltbundesamt

eco logic

ALTERRA WAGENINGEN UR

COWI

ICF INTERNATIONAL

Use of IACS / LPIS for LULUCF reporting

Marco BERTAGLIA

JRC technical workshop on LULUCF reporting

Stresa, 2-3 May 2016

The EU should stop talking about “LULUCF”

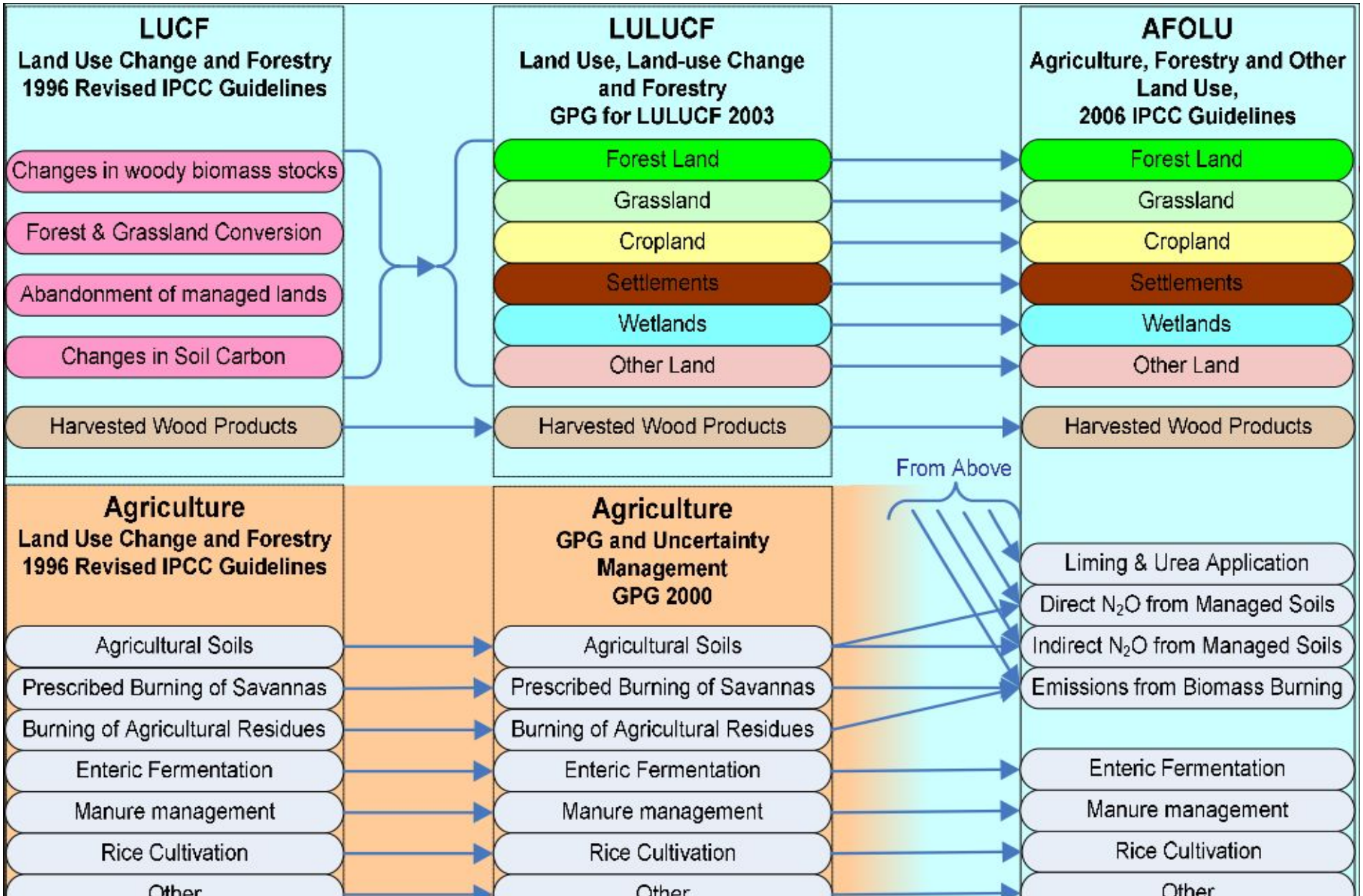


Table 3-4: Management Activities[5] and Other Factors Within Agroforestry Practices That May Alter Carbon Sequestration and GHG Emission Amounts

Practice	Management Activities
Windbreaks	▪ Establishment disturbance to soil during site preparation ▪ Deposition of wind- and water-transported sediments, nutrients, and other agricultural chemicals into the planting ▪ Windbreak renovation (removal of dead and dying trees over time)
Riparian forest buffers	▪ Establishment disturbance to soil during site preparation ▪ Deposition of wind- and water-transported sediments, nutrients, and other agricultural chemicals into the planting ▪ Harvesting of herbaceous materials planted in Zone 3 (zone closest to crop/grazing system) and of woody materials planted in Zone 2 (middle zone)
Alley cropping	▪ Establishment disturbance to soil during site preparation ▪ Weed control (mechanical or chemical) ▪ Pruning, thinning, and harvesting of woody material (amount and frequency vary greatly depending on short- and long-term objective of practice) ▪ Fertilization for alley crop and occasionally needed for trees in rows ▪ Tillage in alleys (frequency and intensity) ▪ Crop species used in alley production ▪ Complex harvesting schedules stratified in space and time
Silvopasture	▪ Establishment disturbance to soil during site preparation ▪ Weed control (mechanical or chemical) ▪ Pruning, thinning, and harvesting of woody material (amount and frequency vary greatly depending on short- and long-term objective of practice) ▪ Fertilization of forage component ▪ Tillage in forage component (frequency and intensity) ▪ Crop species used in forage component ▪ Grazing management (timing, intensity, frequency) ▪ Complex harvesting schedules stratified in space and time

Similar issues in N America

USDA Tech Bulletin 1939, "Quantifying Greenhouse Gas Fluxes in Agriculture". Climate Change Programme Office

Chapter 3
Quantifying Greenhouse Gas Sources and Sinks in Cropland and Grazing Land Systems

Authors:

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Paul R. Adler, USDA Agricultural Research Service

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Michele Schoeneberger, USDA Forest Service

Johan Six, University of California, Davis; Swiss Federal Institute of Technology, ETH-Zurich

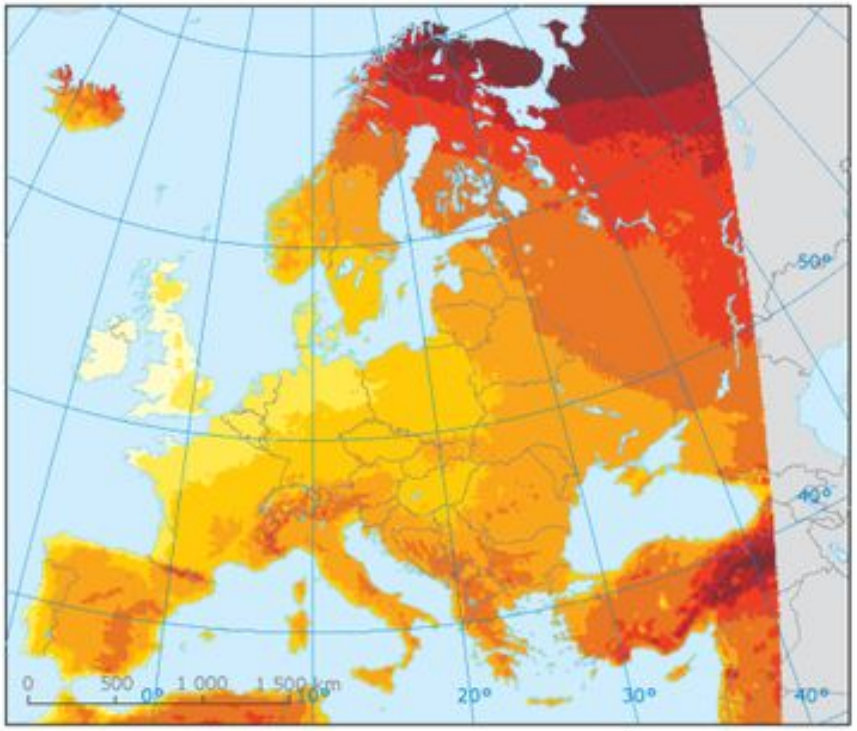
Chris van Kessel, University of California, Davis

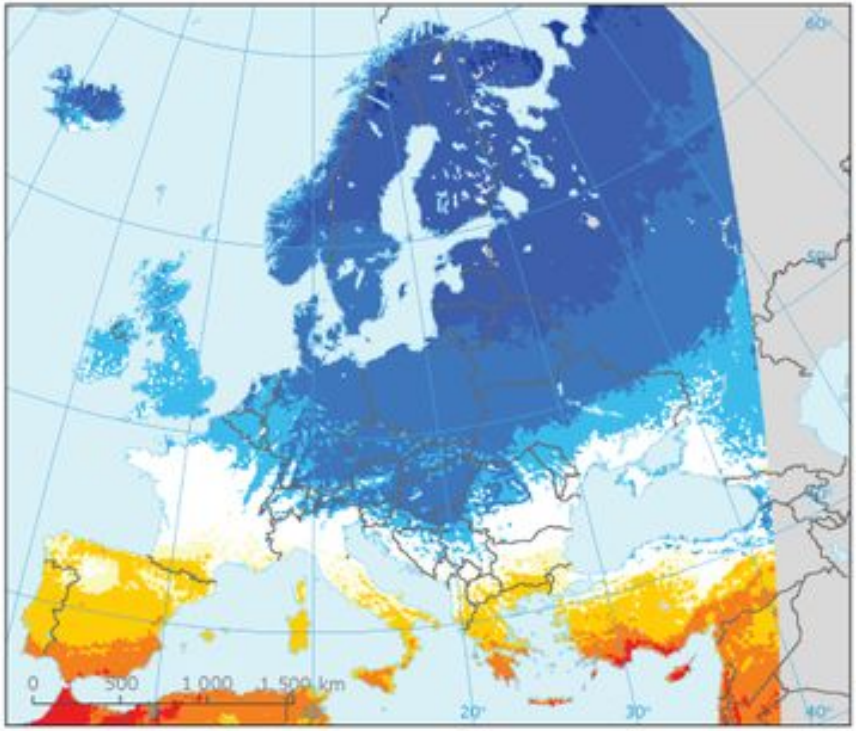
Rod Venterea, USDA Agricultural Research Service

Tristram West, Pacific Northwest National Laboratory

Predicted Climate Change by 2100

Based on multi-models and RCP8.5
high emissions scenario (EEA 2014)





Projected changes in annual mean temperature (left) and annual precipitation (right)

°C: < 3 | 3 – 3.5 | 3.5 – 4 | 4 – 4.5 | 4.5 – 5 | 5 – 5.5 | 5.5 – 6 | > 6

Outside coverage

%: < -40 | -40 to -30 | -30 to -20 | -20 to -10 | -10 to -5 | -5 to 5 | 5 to 10 | 10 to 20 | 10 to 30 | > 30