



Thematic event: Agriculture

Agricultural activities with climate and sustainable development benefits

Early action: what role for agriculture?

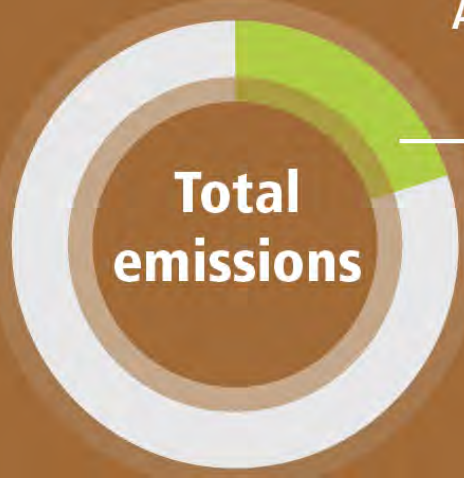
Martial Bernoux and Alexandre Meybeck
FAO

No 2°C pathway is possible without agriculture :
Global emissions need to peak and sharply decrease.
It is urgent to address mitigation in agriculture.

This share **will increase** if
other sectors decrease
their respective emissions.



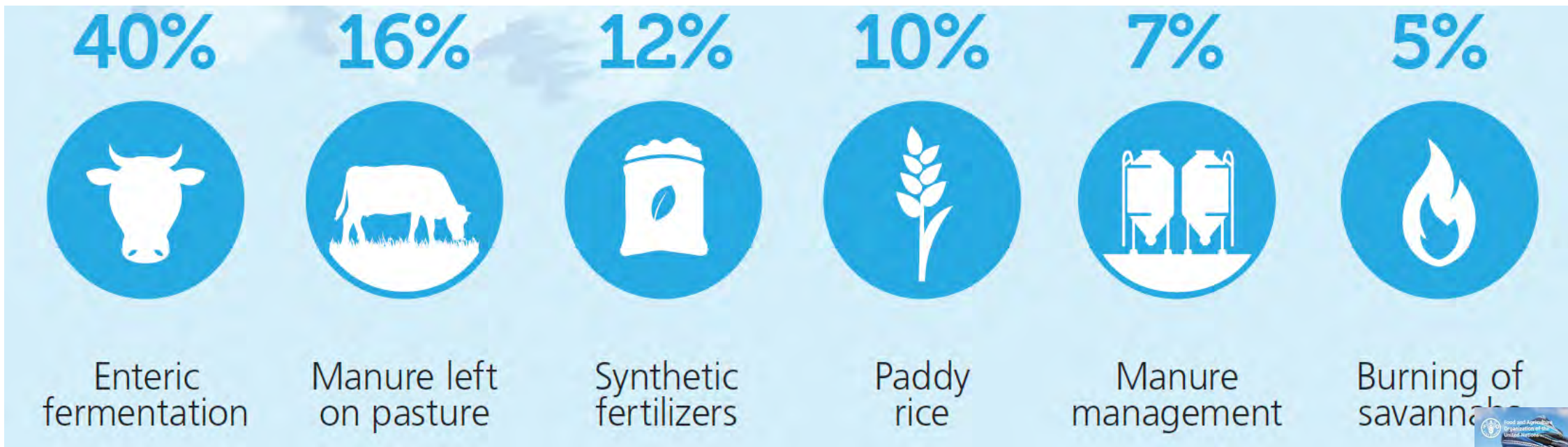
Agriculture
sectors



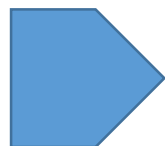
Total
emissions

Taken together, agriculture, forestry and
land-use account for at least 20% of total
emissions, mainly from the conversion of
forests to farmland and from livestock
and crop production

The largest sources in agriculture (without deforestation and forest degradation)

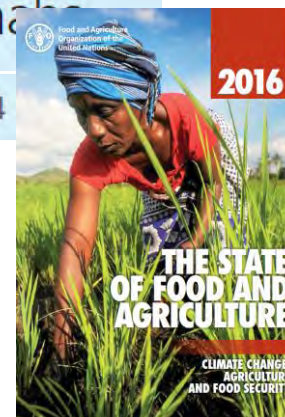


Figures are averages for the period 2005-2014



There are ways to reduce GHG emissions while addressing food security, having more productive, sustainable and resilient systems.

Adapted from FAO, 2016 - www.fao.org/publications/sofa/2016/en/



The Agriculture sectors can substantially contribute to mitigation of GHG increase

2 broad categories

Resource use and
production efficiency



Carbon pools storage
and replenishment



The Agriculture sectors can substantially contribute to mitigation of GHG increase

2 broad categories

Resource use and production efficiency

Nutrient efficiency

Animal health and husbandry

Animal & Plant breeding

Land use efficiency (yield)



Water use efficiency

Manure management

Avoiding residue burning

Carbon pools storage and replenishment

Soil carbon sequestration

Addressing land degradation

Biomass increase (agroforestry)

Reduce deforestation



Resource use and
production efficiency



Animal health

Peste des petits ruminants (PPR), also known as sheep and goat plague, is a highly contagious animal disease affecting small ruminants.

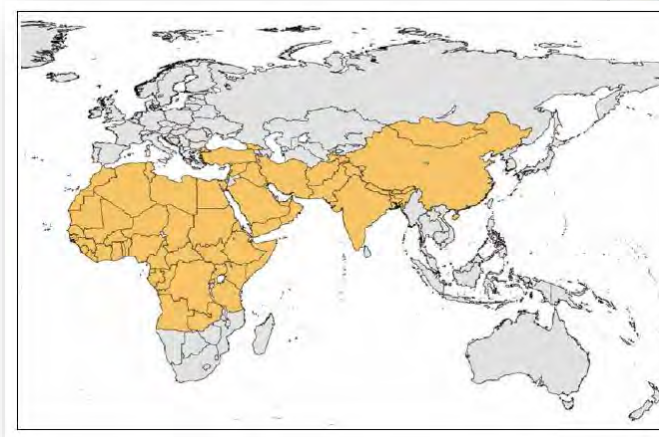
PESTE DES PETITS RUMINANTS GLOBAL ERADICATION PROGRAMME

Contributing to food security, poverty alleviation and resilience

Five years (2017–2021)

Sheep and goats are two of the major livestock species kept and cared for by many of the world's poor.

PPR threatens about 80 percent of the global small ruminant population of nearly 2 billion animals.



<http://www.fao.org/ppr/en>

Carbon pools storage
and replenishment

Soil carbon sequestration



Food and Agriculture
Organization of the
United Nations

21 - 23 | MARCH 2017 | FAO - ROME, ITALY

GLOBAL SYMPOSIUM ON

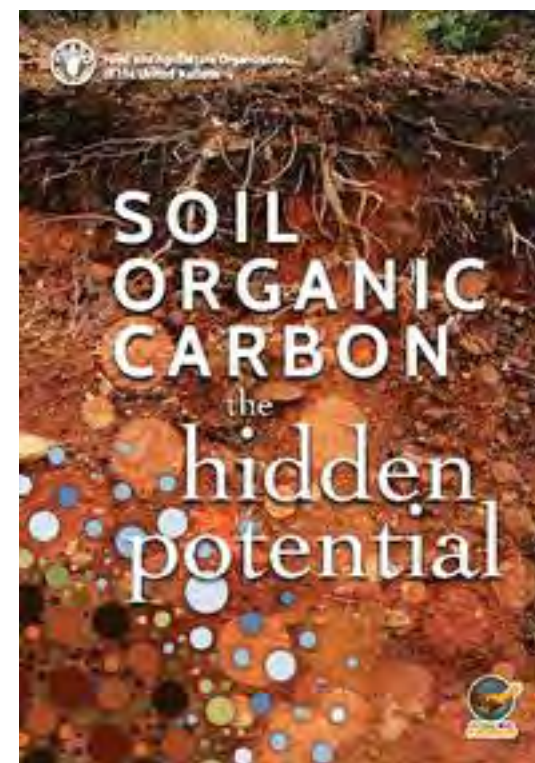
SOIL ORGANIC CARBON

UNLOCKING THE POTENTIAL OF MITIGATING
AND ADAPTING TO A CHANGING CLIMATE

#GSOC17



United Nations
Convention to Combat
Desertification

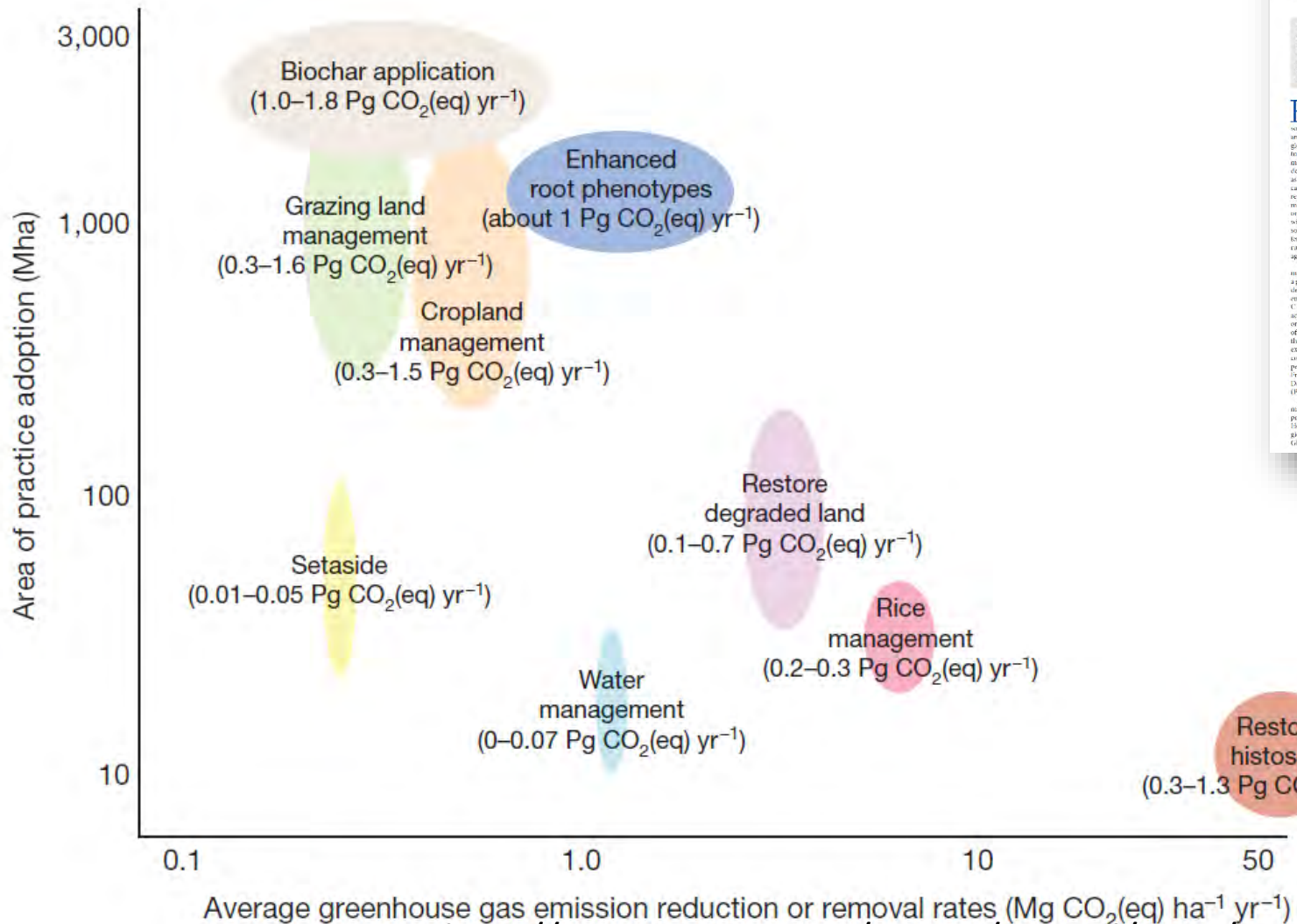


<http://www.fao.org/3/a-i6937e.pdf>

Carbon pools storage and replenishment



Soil carbon sequestration



PERSPECTIVE

Climate-smart soils

Kelth Paustian^{1,2}, Johannes Lehmann³, Stephen Ogle⁴, David Rötter⁵, G. Philipp Kobuszewski⁶ & Peter Smith⁷

Soils are integral to the function of all terrestrial ecosystems and to food and fibre production. An overlooked aspect of soils is their potential to mitigate greenhouse gas emissions. Although proven practices exist, the implementation of soil-based greenhouse gas mitigation activities are at an early stage and accurately quantifying emissions and reductions remains a substantial challenge. Emerging research and information technology developments provide the potential for a broader inclusion of soils in greenhouse gas policies. Here we highlight 'state of the art' soil greenhouse gas research, summarizing mitigation practices and potentials, identify gaps in data and understanding and suggest ways to close such gaps through new research, technology and collaboration.

Future points to agriculture as the first instance of human-induced increases in greenhouse gases (GHGs), several thousand years ago¹. Agricultural and associated land use change remain a source for all three major biogenic GHGs: carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). Land use comprises ~25% of total global anthropogenic GHG emissions, 10%–14% directly from agricultural production, mainly via GHG emissions from soils and livestock manure, and another 12%–17% from land cover change, including deforestation^{2,3}. Although soils contribute a major share (37% mainly as N₂O and CH₄) of agricultural emissions⁴, improved soil management can substantially reduce these emissions and sequester some of the CO₂ removed from the atmosphere by plants, as carbon (C) in soil organic matter (in this Perspective, our discussion of soil C refers solely to organic C). In addition to decreasing GHG emissions and sequestering C, wise soil management that increases organic matter and lightens the soil nitrogen (N) cycle can yield potential synergies, such as enhanced fertility and productivity, increased soil biodiversity, reduced erosion, runoff and water pollution, and can help buffer crop and pasture systems against the impact of climate change⁵.

The inclusion of soil-centric mitigation practices within GHG effect markets^{6,7} and new initiatives to market 'low-carbon' products⁸ indicate a growing role for agriculture GHG mitigation⁹. Moreover, interest in developing aggressive soil C sequestration strategies has been heightened by recent assessments, which project that substantial terrestrial C sinks will be needed to complement large cuts in GHG emissions to achieve GHG stabilization levels of 450 parts per million CO₂ equivalent or below, consistent with the goal of a global temperature increase of less than 2°C (ref. 10). SoC sequestration is one of a few strategies that could be applied at large scales and potentially at low cost; an example, the French government has proposed¹¹ to increase soil C concentration in a large portion of agricultural soils globally by 0.4% per year in conformance with the Conference of the Parties to the UN Framework Convention on Climate Change (UNFCCC) negotiations in December 2015. This would produce a Clark increase of 1.2 petagrams (Pg) C per year (ref. 10).

An extensive body of field, laboratory and modelling research over many decades demonstrates that improved land use and management practices can reduce soil GHG emissions and increase soil C stocks. However, implementing effective soil-based GHG mitigation strategies on a large scale will require the capacity to measure and monitor GHG emissions with acceptable accuracy, quantifiable uncertainty and

at relatively low cost. Targeted research to improve predictive models, expanded observational networks to support model validation and uncertainly bounds, Big Data approaches to integrate land use, manure management and environmental drivers, and technologies will be used to engage actively with land users at the grass-roots level, and all key elements in realizing the potential GHG mitigation from climate-smart agricultural soils.

Process controls and mitigation practices
Soils constitute the largest terrestrial organic C pool (~2,500 PgC, to a depth of 1 m; 2,400 PgC to 2 m depth¹²), which is three times the amount of CO₂ currently in the atmosphere (~800 PgC) and 2.6 times the current annual fossil fuel emissions (~310 Gt¹³). Thus, increasing soil C storage by even a few per cent represents a substantial C sink potential.

Temperate cropland soils C balance include the rates of C addition as plant residue, manure or other organic waste, minus the losses from C₁ (microbial decomposition). Hence, C stocks can be increased by increasing organic matter inputs or by reducing decomposition rates. For example, reducing soil disturbance, or both, leading to net removal of C from the atmosphere¹⁴. However, soil C accretion rates decrease over time as stocks approach a new equilibrium. Therefore, net CO₂ emissions are of limited duration, often alternating after loss in the decade¹⁵.

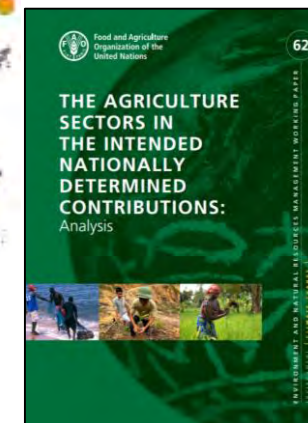
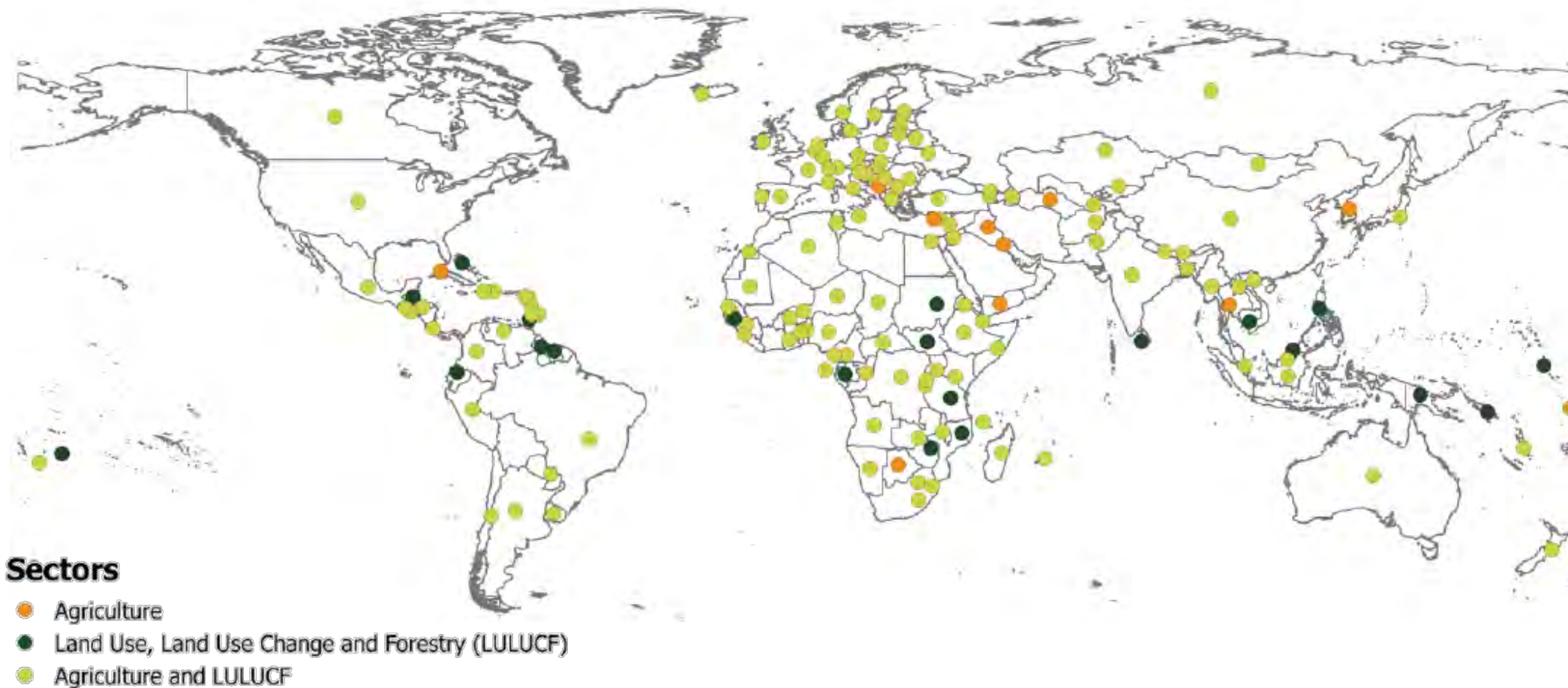
Climate-smart cropland and grasslands typically advance a large fraction of their biomass production belowground and store soil C more effectively, especially in semi-arid and arid ecosystems, usually support much higher soil C stocks than their agricultural counterparts, and soil C stores typically 0.5 to >2 megagrams (Mg) of C per hectare (per year) following land conversion to cropland has been extremely decelerating^{16,17}. Total losses since the soil approaches a new equilibrium are typically ~80%–90% of input (for example, 0–30 cm depth) C stocks¹⁸. Hence, avoiding conversion and degradation of native ecosystems is a strong mitigation alternative. Conversely, restoration of marginal or degraded lands to potential forest or grassland increases soil C storage (Fig. 1), although results at a slower rate than the original conversion loss¹⁹.

Restoring wetlands that have been drained for agricultural use reduces ongoing decomposition losses, which can be as high as ~20 Mg C ha⁻¹ yr⁻¹ (ref. 18), and can also restore C sequestration (Fig. 1), though methane emissions may increase²⁰. Land use conversions may, however, conflict with agricultural production and food security objectives, creating the need for a broad-based accounting of net GHG implications (Table 1)²¹.

Paustian et al., 2016 - Nature

<http://www.nature.com/nature/journal/v532/n7597/abs/nature17174.html>

INDCs/NDCs recognize the potential for mitigation lying in the Agriculture sectors

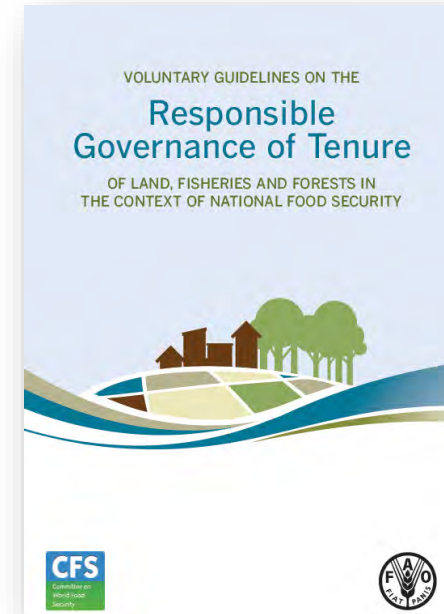


From FAO, 2016 - www.fao.org/3/a-i5666e.pdf

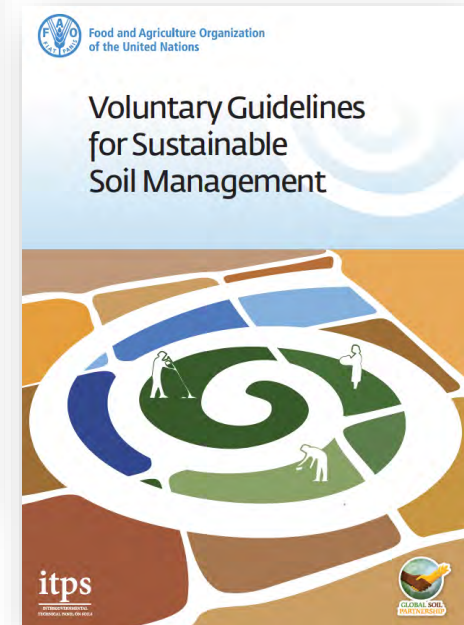
Mitigation options generally bring other sustainable development benefits



- Realization of the SDGs
- Improving ecosystems services
- Biodiversity
- Social and economic dimensions
- ...



www.fao.org/docrep/016/i2801e/i2801e.pdf



www.fao.org/3/a-bl813e.pdf

Mitigation options generally bring other sustainable development benefits



A holistic approach:
Covering all agricultural sectors,
food security and nutrition,
Social, economics and other environmental issues,
to improve effectiveness by
addressing multiple challenges as one

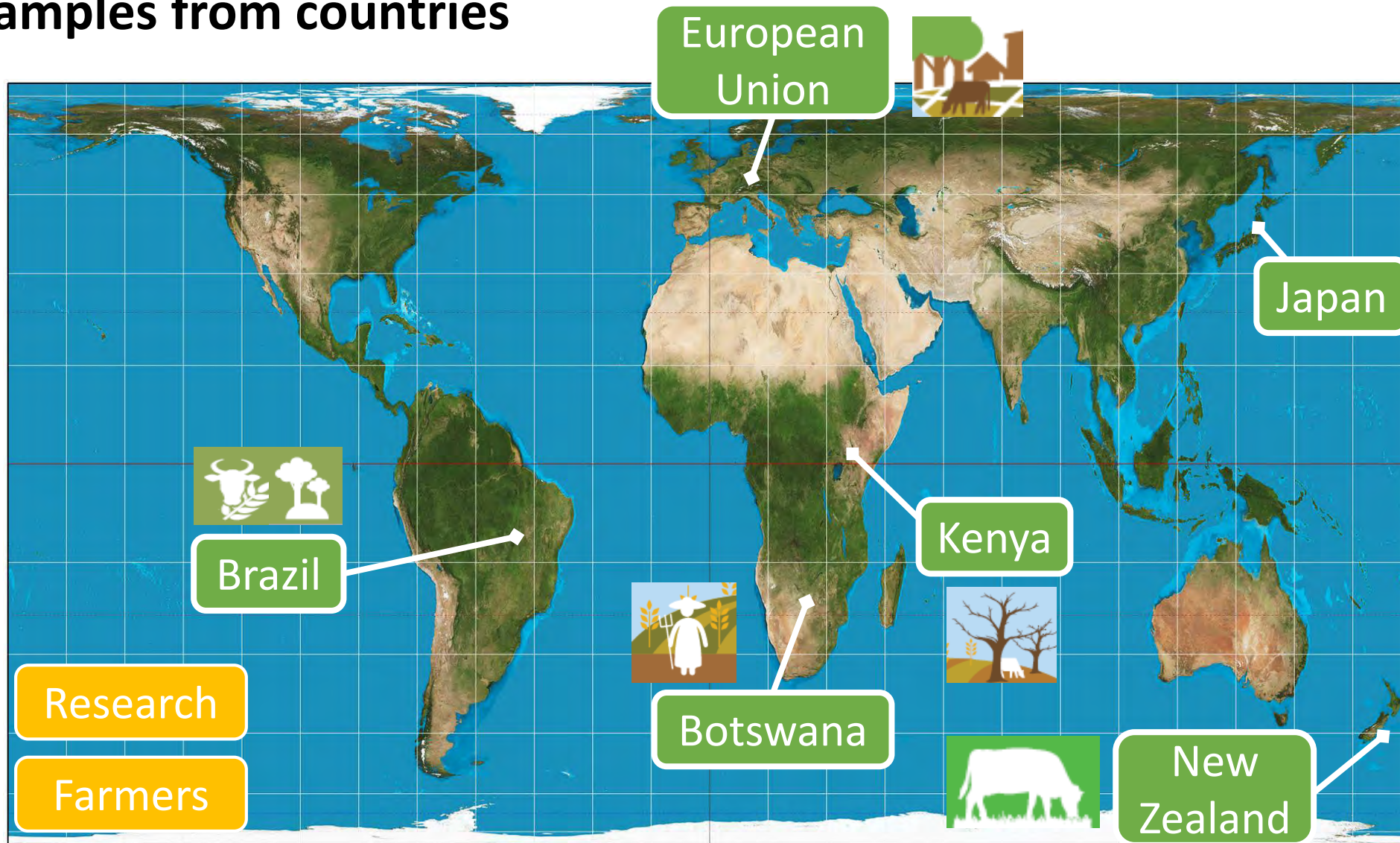
Resource use and
production efficiency



Carbon pools storage
and replenishment



Concrete examples from countries



Resource use and production efficiency

Carbon pools storage and replenishment