Organic Agriculture & Climate Change

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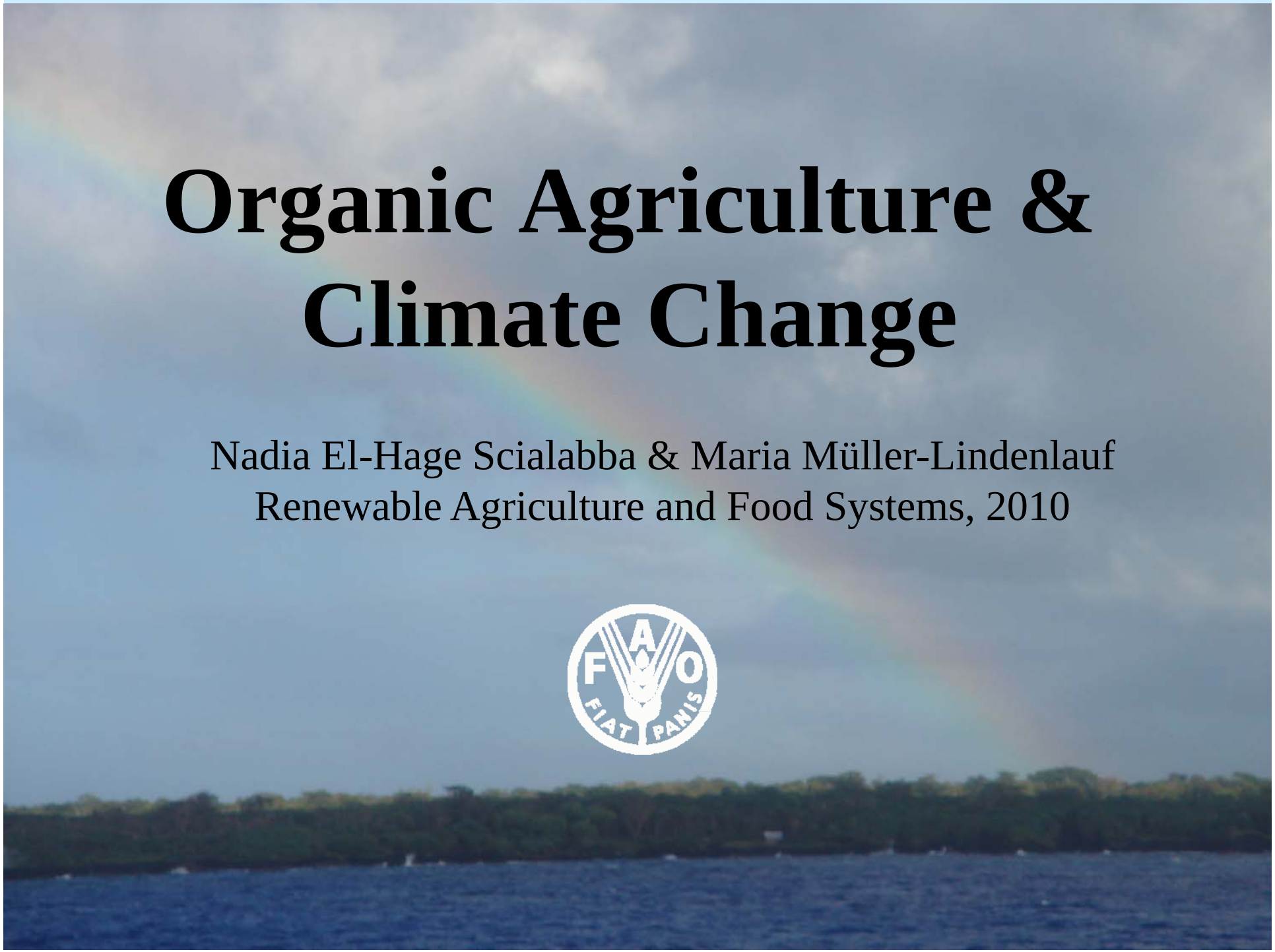
Renewable Agriculture and Food Systems, 2010



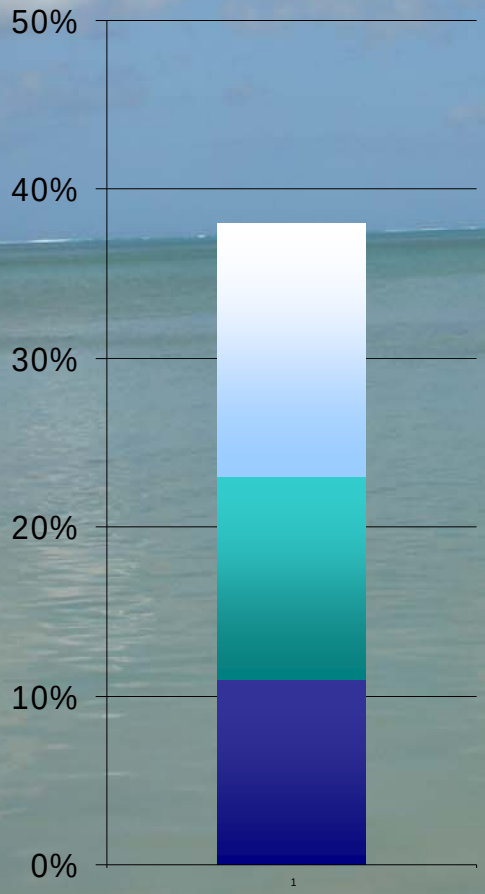
Outline
(from a review of 113 papers)

- Mitigation and adaptation potential of organic agriculture
  - Farming system design
  - Cropland management
  - Pasture, livestock and manure management
  - Food chain and organic lifestyle
- Conclusions

- Post-Copenhagen information on mitigation (miscellaneous)

Agricultural GHG emissions

Agriculture share of total anthropogenic GHG emissions



food chain

changes in carbon stocks
(e.g. forest clearing)

direct emissions from agriculture

Organic Farming System Design

Limited inputs

- avoidance of emissions from mineral fertilizer production
  - ~ 10% of global agricultural GHG emissions
- avoidance of emissions from pesticide production
- partly higher energy demand for mechanical weed control
  - but: less then energy savings (Williams, 2006)

Total: ~15% energy savings by organic production

Crop Diversification

- diversification of crops in time and space
  - risk splitting
  - resilience to economic constrains
- use of local and traditional breeds:
  - conservation of genetic diversity
- integration of food for household consumption
  - food sovereignty of rural households

Integrated Livestock Production

- harmonious balance between plant and animal production (IFOAM/IBS)
- livestock density is limited (no landless systems) (EU-Regulations: 2 LU per hectare)
  - manure input tailored to plant uptake:
    - reduced risk of N_2O emissions
    - efficient use of manure nutrients
  - avoidance of overgrazing: reduced carbon losses by degradation

Multifunctional Landscapes

- recommended as adaptation strategy by IPCC
- integration of landscape elements in different standards (IFOAM, East African Standard, Pacific Standard)

Mitigation and adaptation effects:

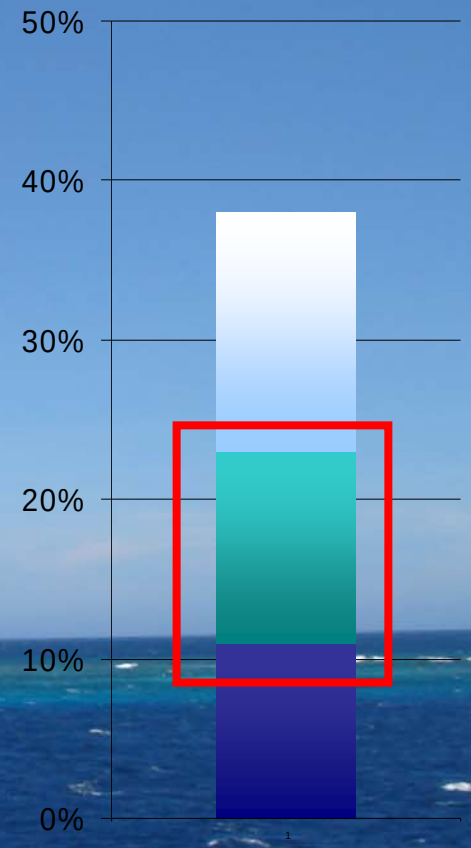
- reduced erosion
- carbon sequestration in plant biomass
- habitats for wildlife

Biomass Burning and Deforestation

Organic standards

- restrict the preparation of land by burning
- restrict the certification of recently cleared primary ecosystems

(IFOAM Standard,
Pacific Standard,
East African Standard)



- **reduction of emissions caused by deforestation**

(12% of global GHG)

Restoration of Degraded Land

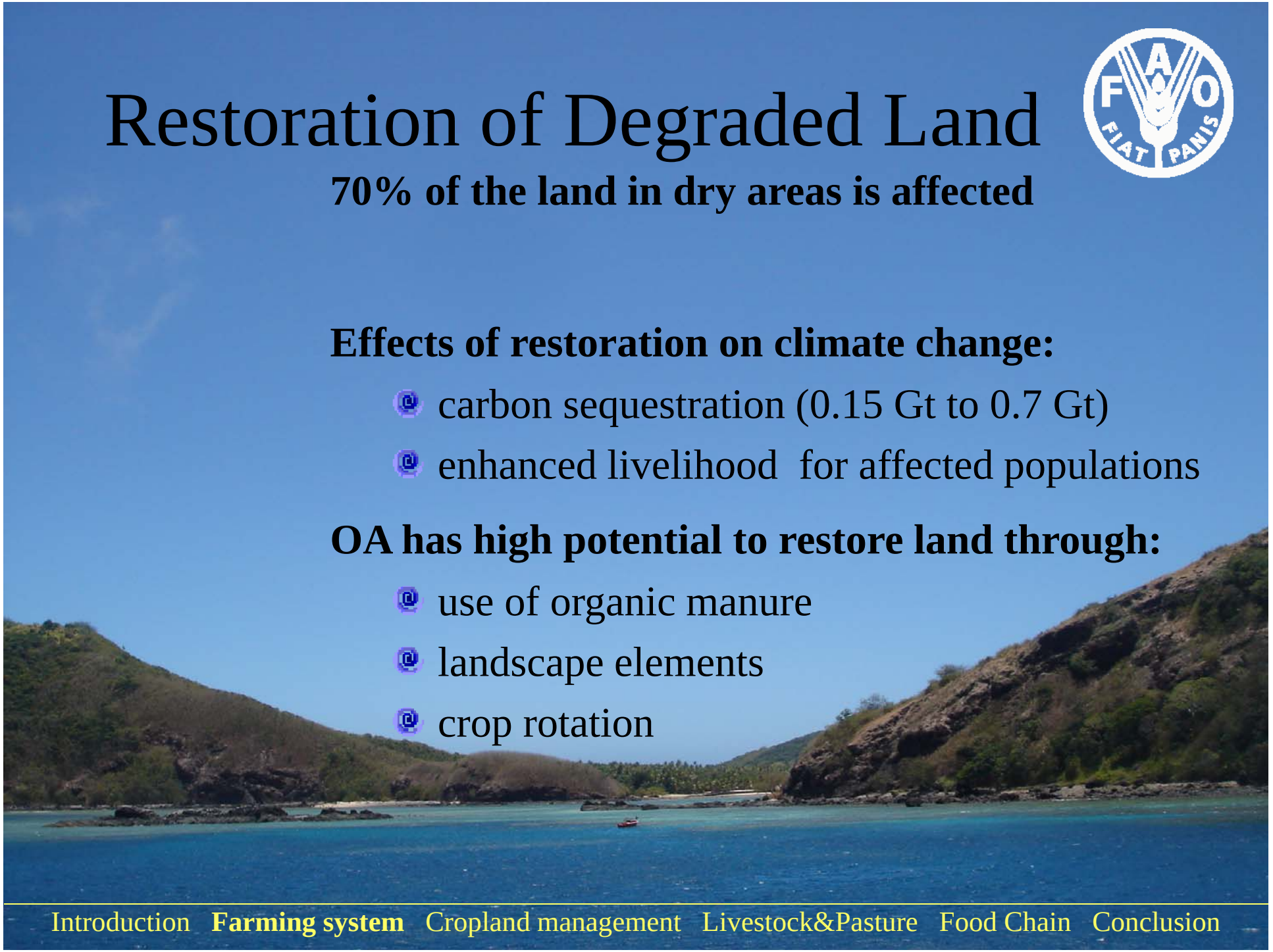
70% of the land in dry areas is affected

Effects of restoration on climate change:

- carbon sequestration (0.15 Gt to 0.7 Gt)
- enhanced livelihood for affected populations

OA has high potential to restore land through:

- use of organic manure
- landscape elements
- crop rotation



Cropland Management

N_2O Emissions from Soils

- most important single source of agriculture GHG (38%)
- main influence factors: fertilization, soil conditions

Mitigation potential of OA:

- incorporation of legumes increases N_2O emissions BUT
- lower fertilization rate, catch crops
- higher aeration (better rooting etc.)

⇝ emission reduction!

Lower fertilization + N_2O efficiency = 10% less of agricultural GHG

Carbon Sequestration in Croplands

Organic agriculture enhances soil carbon

Long term field trials:

- Switzerland: stable carbon content in biodynamic system compared to 15% carbon loss in conventional system (Fliessbach, 2007)
- USA: fivefold higher carbon sequestration in organic system (Pimentel, 2005)

Preliminary estimate of mitigation potential of OA:
15-47% of annual agricultural GHG emissions (Niggli et al., 2009)

Carbon Sequestration and Permanence

<u>To be considered:</u>

- soil carbon sequestration is limited (to 21-51 Gt C globally)
- soil carbon can be released by changes in soil management

<u>Observation</u>

- higher permanence of sequestered carbon in organic systems compared to no-tillage systems (Stockfisch, 2007)
  (labile quality of carbon compounds in no-till systems)

Assessing soils anf GHG: carbon sequestration + N_2O emissions

Paddy Rice Production

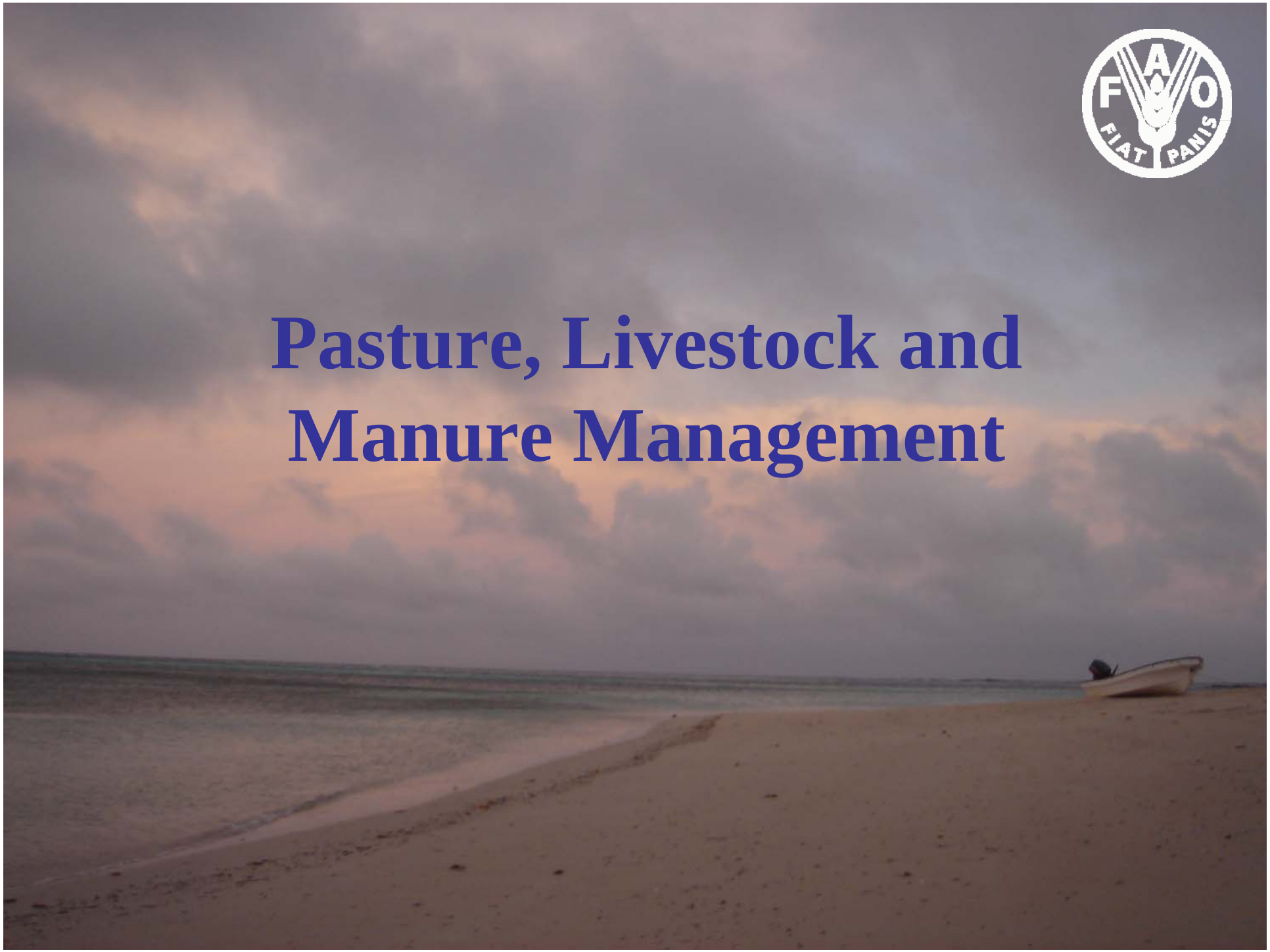
Background

- accounts for 11% of direct agricultural GHG emissions
- influence factors: drainage, cultivars, organic amendments...

Effects of organic production

- more organic amendments → higher emissions
- but emissions can be lowered by
  - adding organic amendments in times of drainage (SRI)
  - organic weeds (Inbushi et al., 2001)

Research needed to quantify and recommend CC practices



Pasture, Livestock and Manure Management

Enteric Fermentation

Background

- 32% of direct agricultural GHG emissions
- influencing factors: diet, performance, breed

Effects of organic production

- roughage based diets → emissions higher than concentrates diets

But:

- feeding grains is a challenge for food security
- roughage production contributes to carbon sequestration

Enteric Fermentation

Organic strategies to reduce emissions

- reduced animal replacement rate (up to 10% less methane in EU)
- enhanced breeds (stress resistance, longevity)
- use of double use breed
- enhanced roughage quality

Research is needed to advance organic livestock strategies

Manure Management

- accounts for 7% of direct agricultural GHG emissions
- includes N_2O and CH_4 emissions
- practices reducing N_2O may increase CH_4 and vice versa
- methane can be reduced by fermentation in biogas plants
- emission reduction by best management practices (covering manure heap, etc)

Grasslands Carbon Sequestration

Higher carbon stocks compared to arable land

- favored OA feed for organic cattle
  - ⇝ productive use by organic ruminants maintains carbon stocks
- limited OA livestock density
  - ⇝ reduced risk of grassland degradation, more C sequestration

Preliminary estimate of OA grassland mitigation potential:

25% of global agricultural GHG (Niggli et al., 2009)

Organic Food Supply Chains and Lifestyle

Food Chains

Background:

- organic markets are driven by consumer demands
- organic philosophy involves preference for seasonal, local and natural food

Mitigation potential of OA:

- avoidance of unnecessary packaging (IFOAM standard)
- preference for local wholesalers and direct supply
- preference for regional food

⇝ energy saving!

Heating

Observation

- regional production is less energy efficient if heating glasshouses

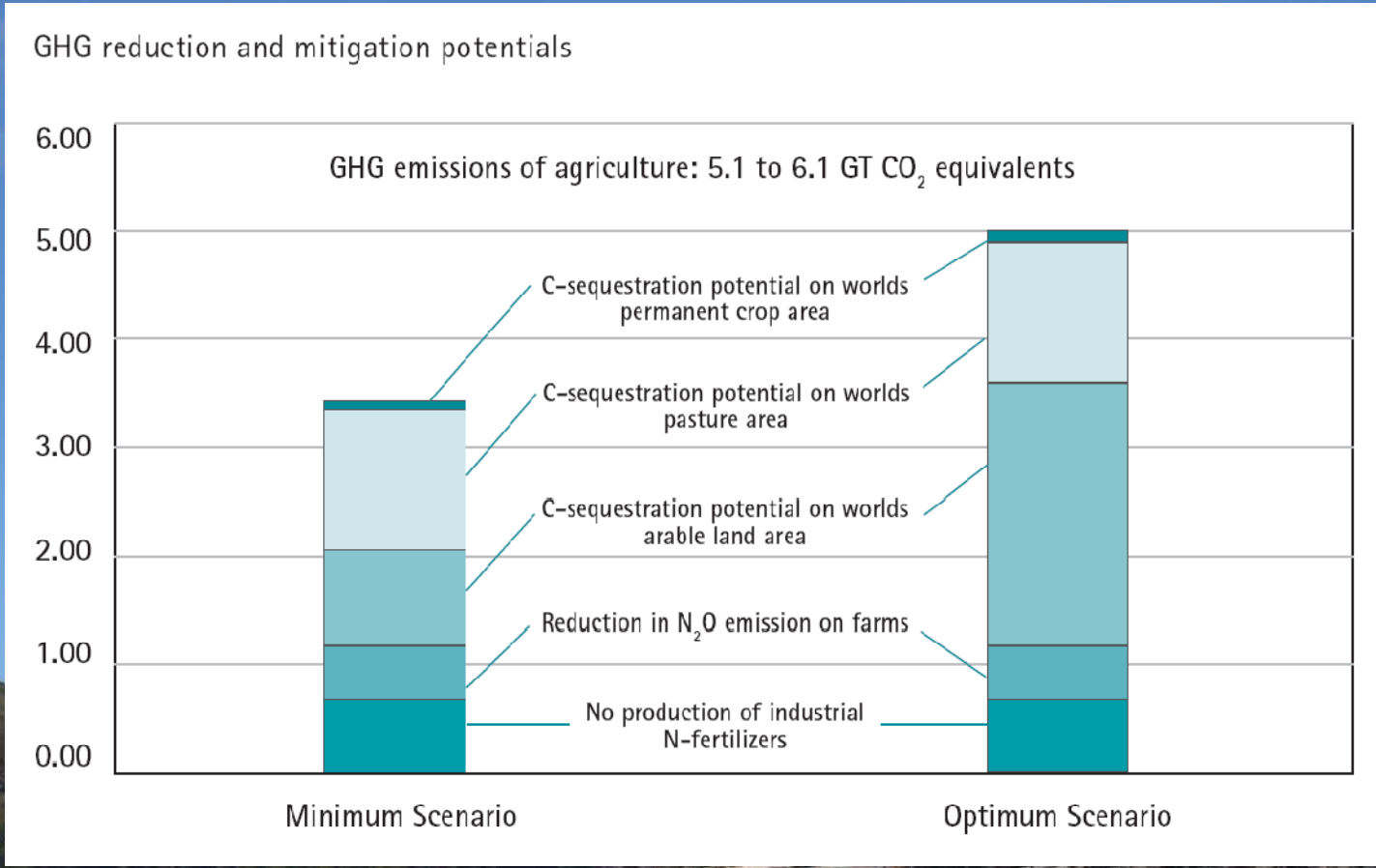
Organic Standards:

- Swiss OA standard: strict limitation for heating and air shipping

Standards should be developed on OA commodities carbon footprint

Conclusions

Mitigation Potential



Mitigation Potential

Outlook:

- further energy savings by organic lifestyle
- development of organic standards: integration of climate labeling

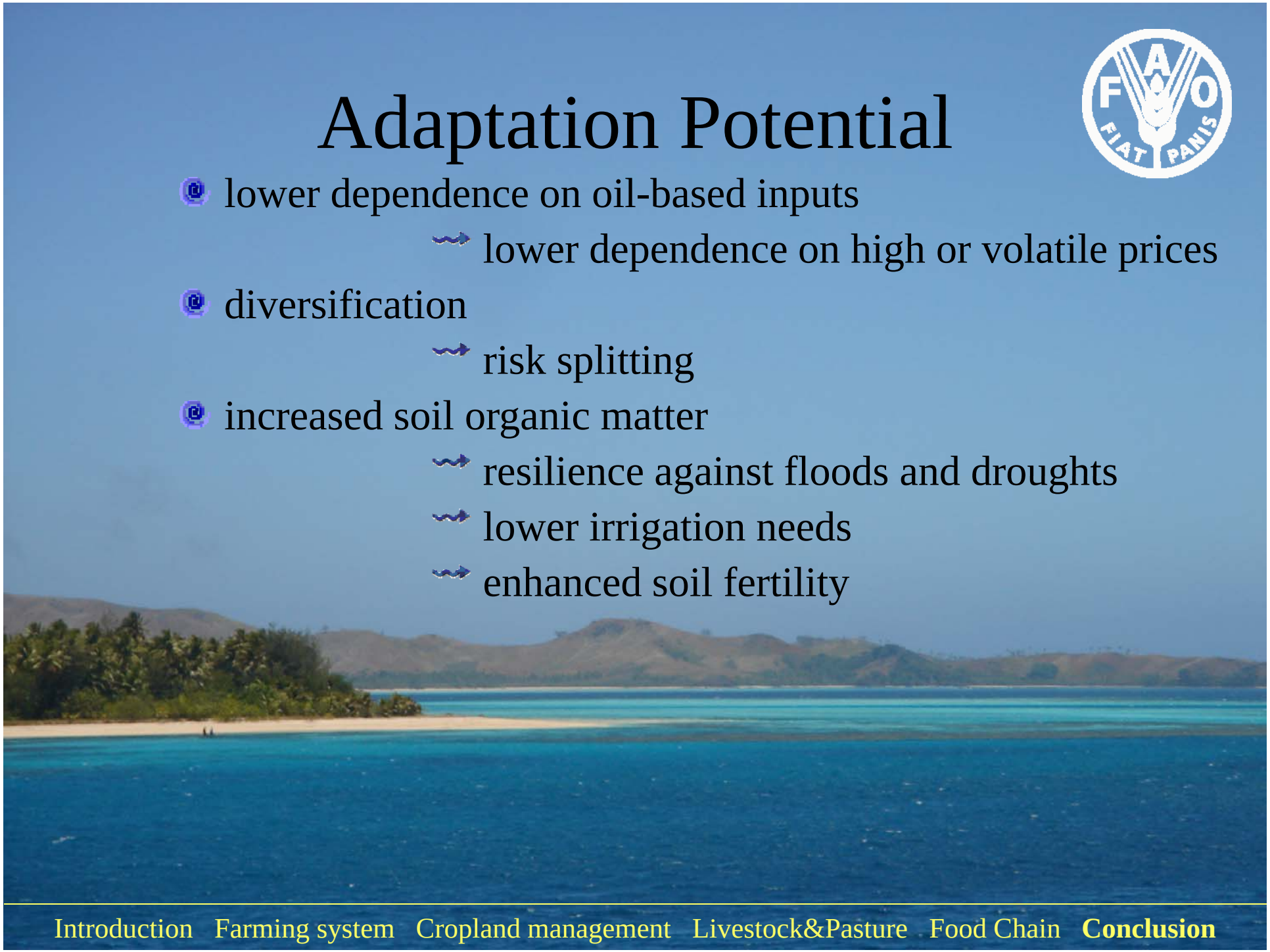
OA can compensate GHG emissions by carbon sequestration

Research needed:

- to confirm mitigation figures
- to quantify and recommend organic emission reduction strategies for livestock and paddy production

Adaptation Potential

- lower dependence on oil-based inputs
  - ⇝ lower dependence on high or volatile prices
- diversification
  - ⇝ risk splitting
- increased soil organic matter
  - ⇝ resilience against floods and droughts
  - ⇝ lower irrigation needs
  - ⇝ enhanced soil fertility

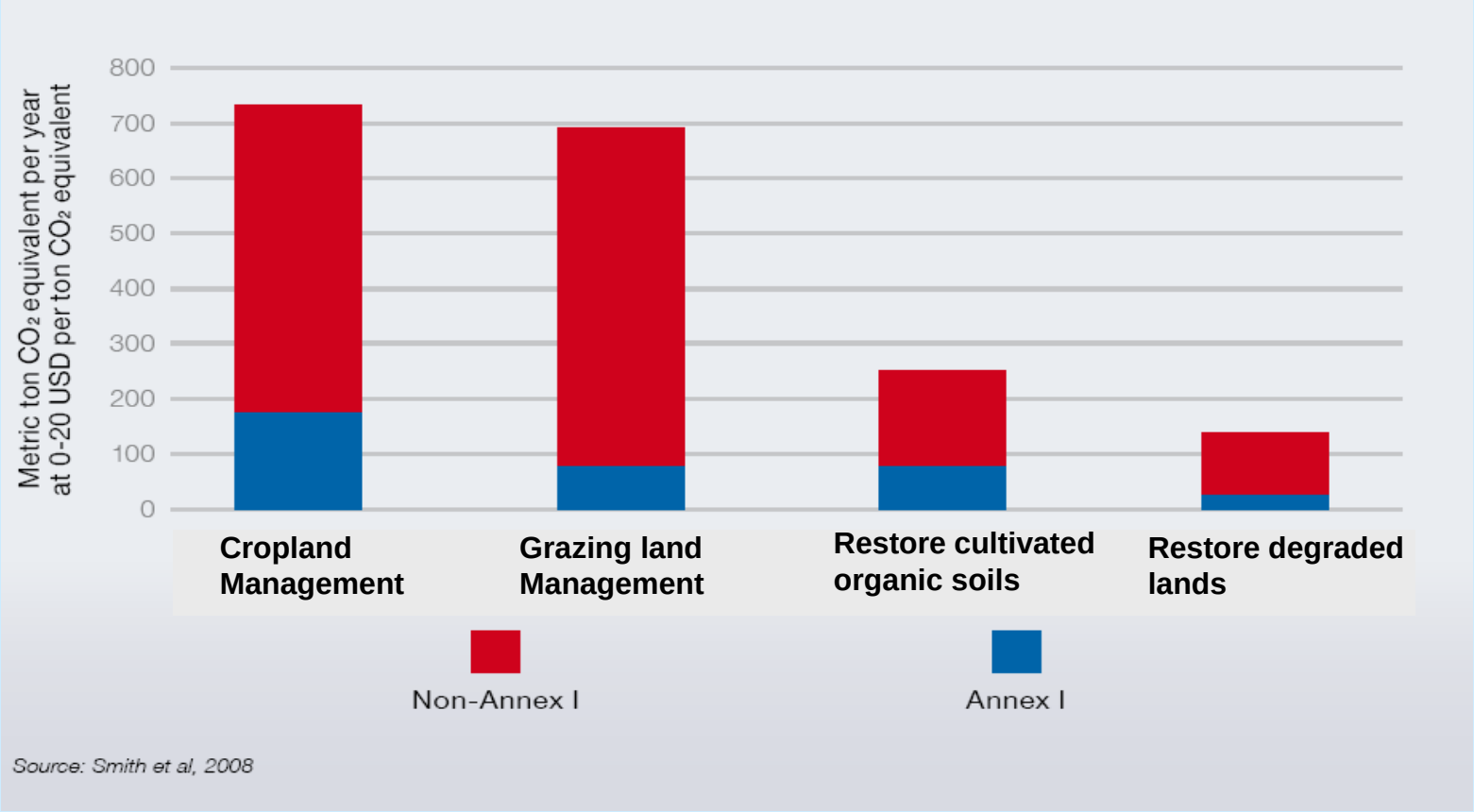


Summing up

- OA can be almost carbon neutral:
  - emission reduction potential: ~ 20% of global agriculture GHG
  - soil carbon sequestration: 40-72% of global agriculture GHG
- OA and climate adaptation: food system' resilience to uncertainties
- OA offers alternatives to fossil fuel price hikes and peak oil
- "Certified organic" caters for higher income options for producers

Potential Financial Flows from Agriculture Mitigation

Annex I (Developed) and Non-Annex I (Developing) countries



Developing countries: $30 billion @$20/Cton from top 4 mitigation actions

Agricultural mitigation activities submitted in response to the Copenhagen Accord

Country	Crop Land Management							
	Cons Ag	No till Ag.	Agro Forest	Soil C Sequest	N fixing species	Fertilizer Efficiency	Crop Improv	Irrigation
Brazil		■			■			
Rep Congo	■				■			■
Ethiopia			■	■				
Jordan						■		
Rep Macedonia								■
Madagascar						■	■	
Mongolia			■					
Morocco				■				
Sierra Leone	■		■					

Agricultural Mitigation Activities Submitted in Response to the Copenhagen Accord

	Pastureland	Livestock Mgmt		Waste Mgmt	Peatland Mgmt
	Restoration conservation	Improved Mgmt	Fodder Crops	Crop Residue Animal Waste	Improved Mgmt
Brazil					
Jordan					
Rep Macedonia					
Mongolia					
Madagascar					
Indonesia					


Thank’s for your attention!
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