



ORGANIC

CAN FEED THE PLANET

ACTION
NETWORK

Action Network "Il Biologico Nutrirà il Pianeta"



TITLE: Climate change and organic agriculture in the Mediterranean,
a focus on Italy

SPEAKER: Paola Migliorini,
Vice-president IFOAM AgriBioMediterraneo
Assistant Professor University of Gastronomic Science

THE ROLE OF ORGANIC AGRICULTURE IN FIGHTING CLIMATE CHANGE

AUGUST 24TH, 2015, 2:30 PM

EXPO Milan 2015, Biodiversity Park, Theater of the Earth



EFFECT OF CLIMATE CHANGE IN THE MED AND IN ITALY

Climate change affects all of us.

We now have solid evidence about anthropogenic climate change (IPCC, 2014):

a. more sudden heatwaves, droughts, storms and floods across the EU.

IPCC (2014) Climate Change 2014: Impact, adaptation and vulnerability.

Example 1

Florence, Saturday August 1st 2015, 45 minutes of torrential downpour:





EFFECT OF CLIMATE CHANGE IN THE MED AND IN ITALY

Example 1

Florence, Saturday August 1st 2015, 45 minutes of torrential downpour:





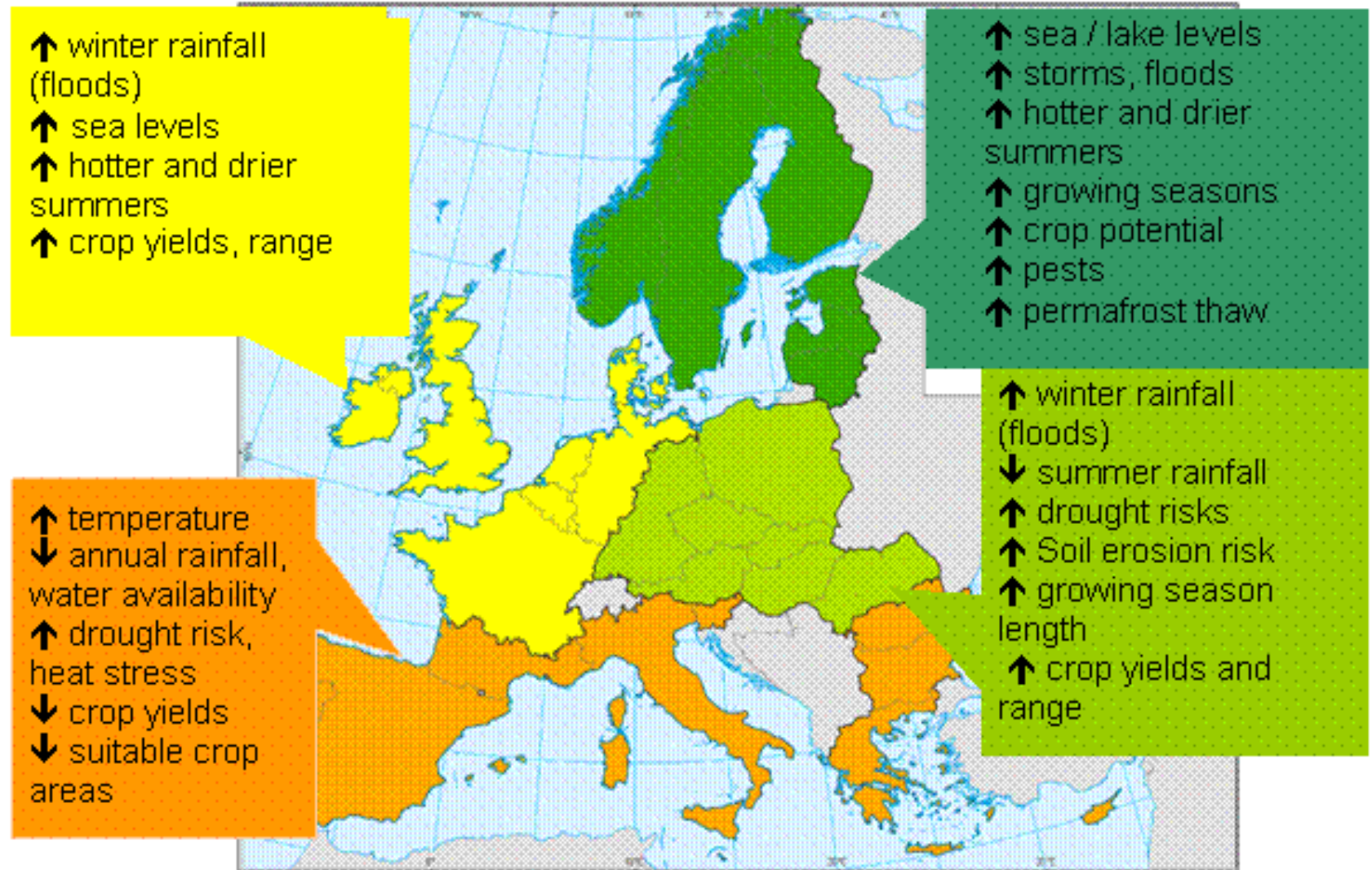
EFFECT OF CLIMATE CHANGE IN THE MED AND IN ITALY

b. decreasing average annual and seasonal rainfall, availability of water will be a serious problem in many regions.





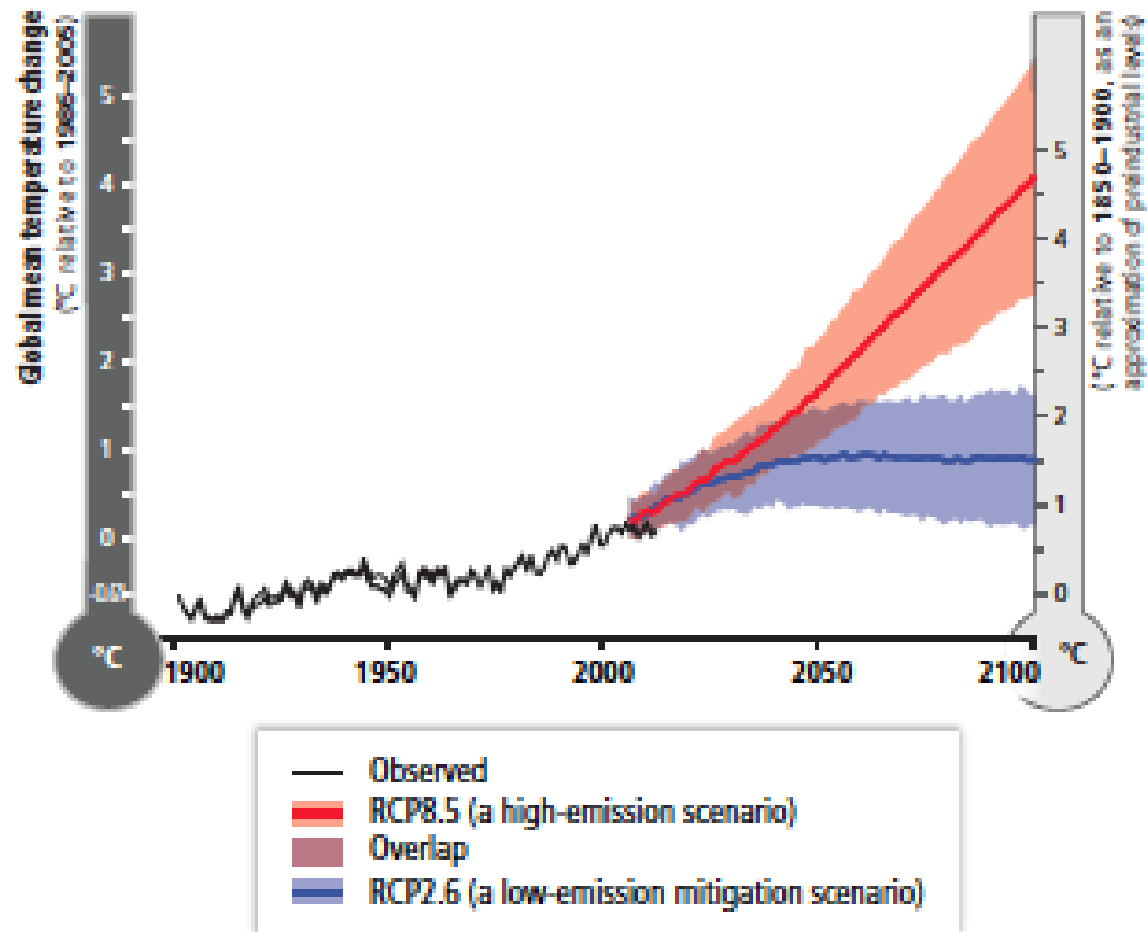
EFFECT OF CLIMATE CHANGE IN THE MED AND IN ITALY



http://ec.europa.eu/agriculture/climate-change/index_en.htm



EFFECT OF CLIMATE CHANGE IN THE MED AND IN ITALY



IPCC (2014). Climate Change 2014. Synthesis Report.



EFFECT OF CLIMATE CHANGE IN THE MED AND IN ITALY

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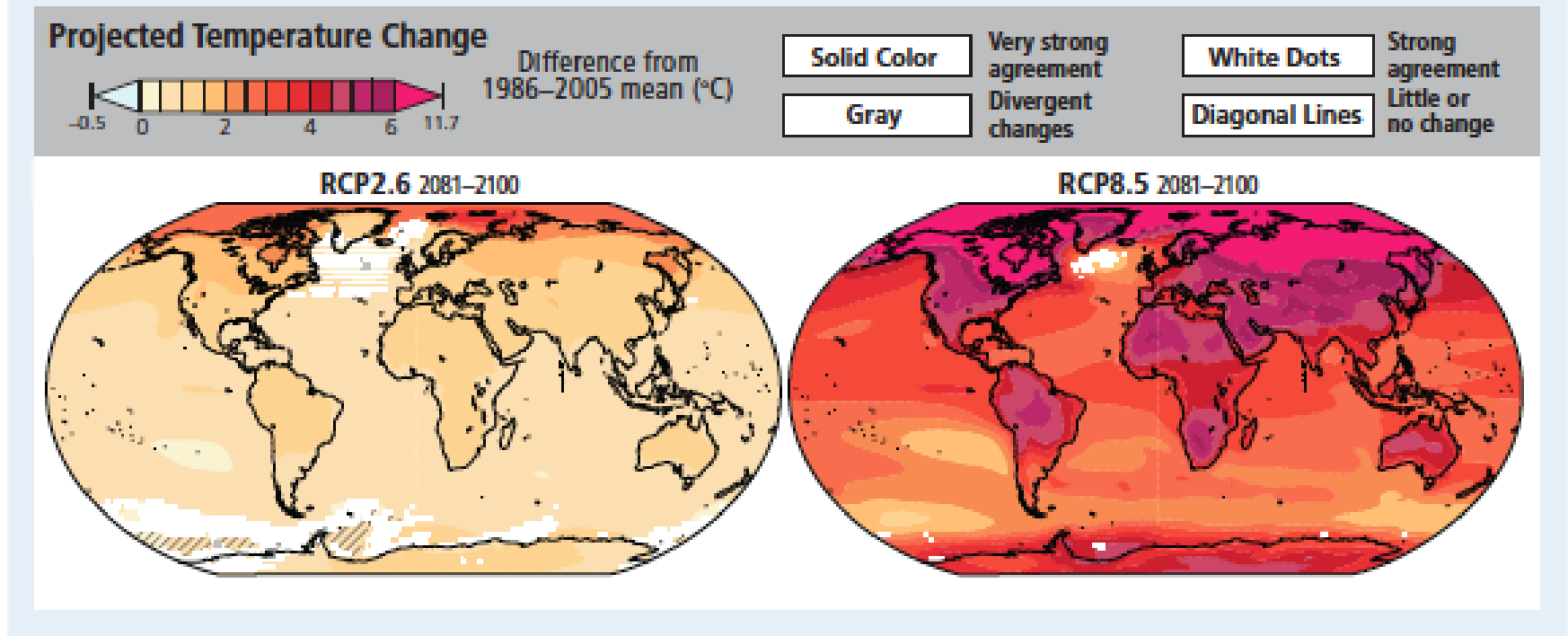


Figure SPM.4 | Observed and projected changes in annual average surface temperature. This figure informs understanding of climate-related risks in the WGII AR5. It illustrates temperature change observed to date and projected warming under continued high emissions and under ambitious mitigation.

IPCC (2014). Climate Change 2014. Synthesis Report.



EFFECT OF CLIMATE CHANGE IN THE MED AND IN ITALY

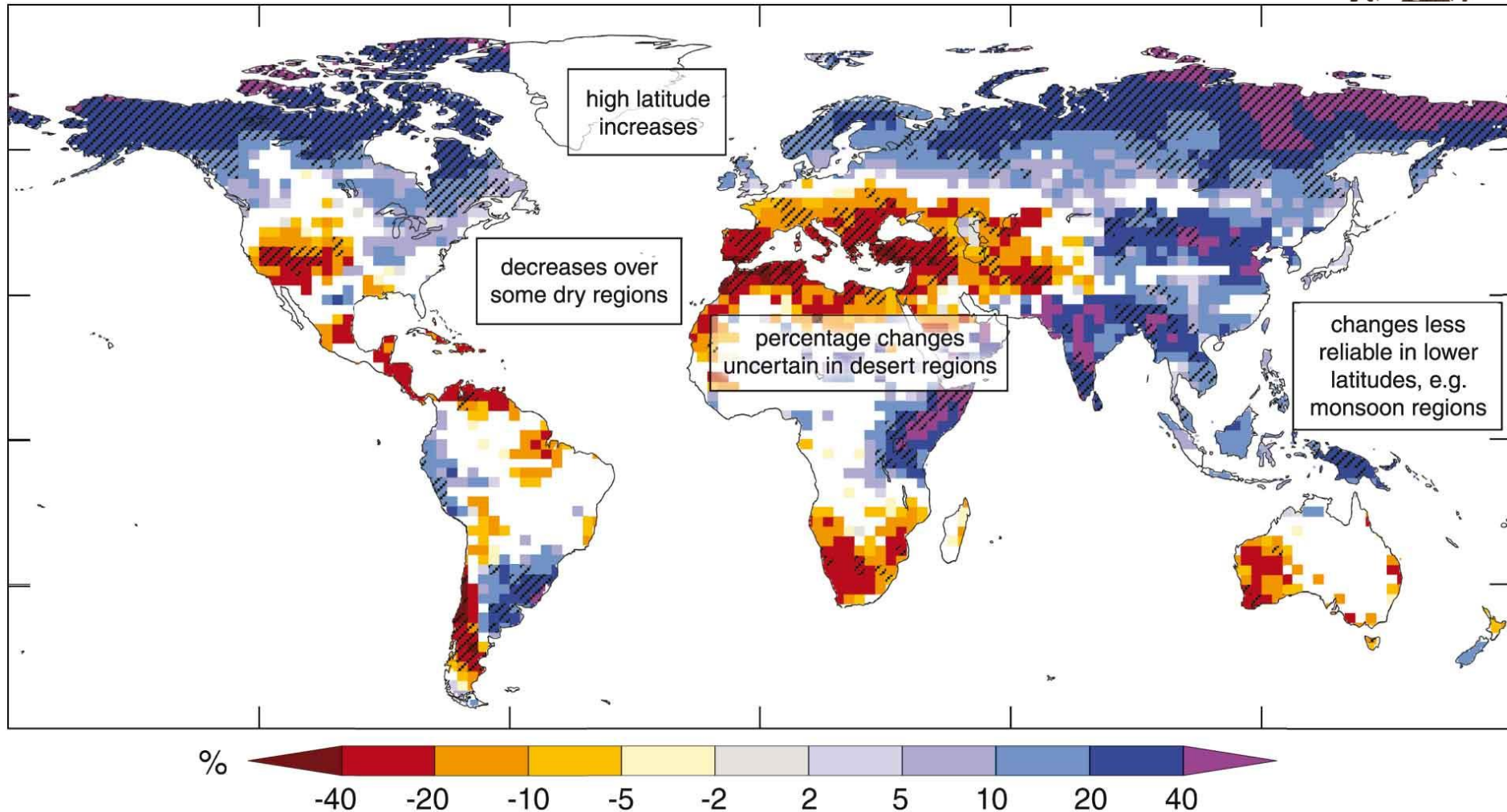


Figure 1. Percentage changes in average annual runoff projected by four climate models for the period 2090-2099, relative to 1980-1999 Source: IPCC. 2007. Climate Change 2007: Synthesis Report. Intergovernmental Panel on Climate Change. Figure 3.5, p. 49.



**CLIMATE CHANGE IS NOT A PROBLEM
FOR ANOTHER GENERATION.**



NOT ANYMORE.

President Obama
Climate Change Action Plan

<https://www.whitehouse.gov/climate-change>

EFFECT OF CLIMATE CHANGE IN THE MED AND IN ITALY



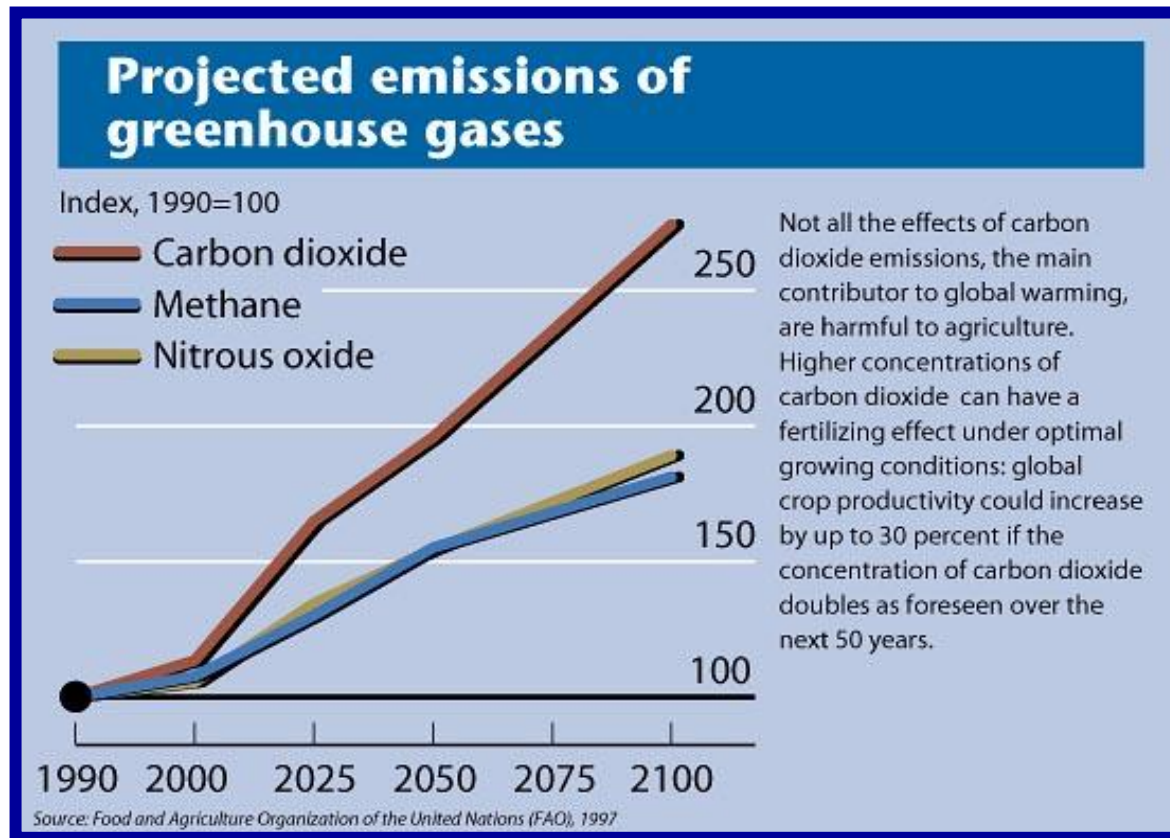
LETTERA ENCICLICA
LAUDATO SI'
DEL SANTO PADRE
FRANCESCO
SULLA CURA DELLA CASA COMUNE



ROLE OF AGRICULTURE IN GHG EMISSION

Agriculture is highly exposed to climate change, as farming activities directly depend on climatic conditions.

But, agriculture too contributes to the release of greenhouse gases to the atmosphere (GHG): Carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O).

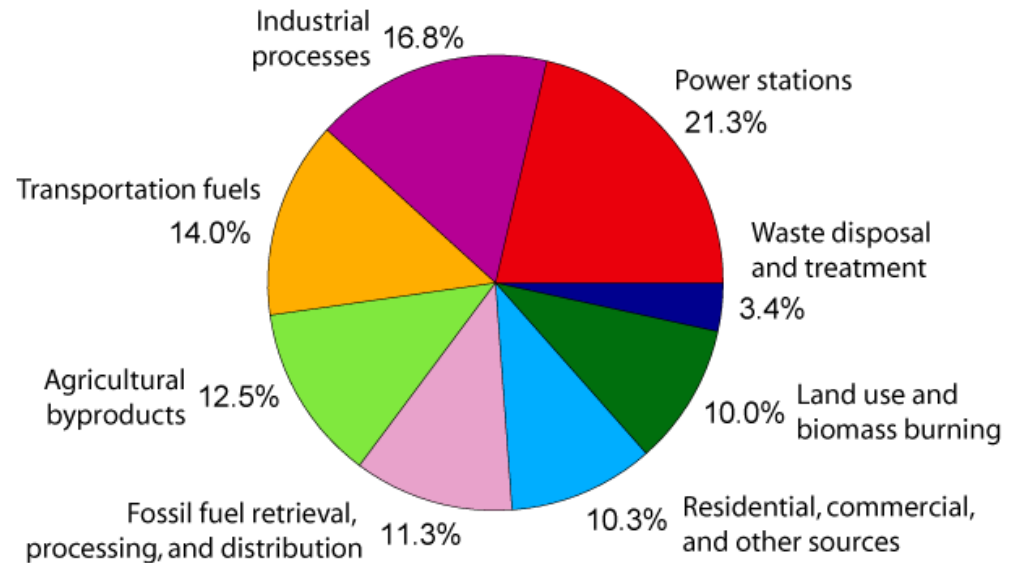
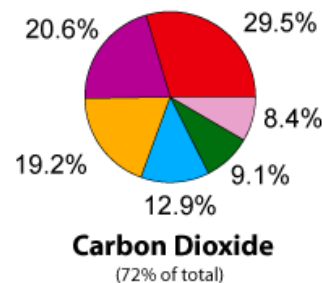
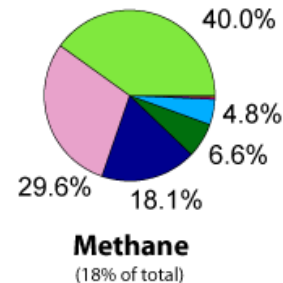
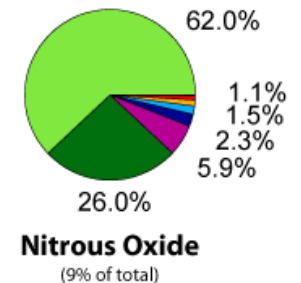




ROLE OF AGRICULTURE IN GHG EMISSION

In 2009, the GHG emissions from agriculture were 34.5 Mt CO₂eq and the agricultural sector was responsible for 7% of total GHG emissions (ISPRA, 2012), being therefore the second source after the energy sector (83%). Nitrous oxide emissions correspond to about 45% of the total global anthropogenic emissions from the agricultural sector (ISPRA, 2012).

Annual Greenhouse Gas Emissions by Sector



ROLE OF AGRICULTURE IN CLIMATE CHANGE MITIGATION



While, on the one hand, the agricultural sector contributes to greenhouse gas emissions, on the other it can also play a fundamental role in climate change mitigation through **soil carbon sequestration practices**:

- long crop rotations, with leguminous crop
- use of green manure and organic fertilisers.

In particular, this is true for cropping systems which are based on specific **conservation practices**:

- reduction of carbon loss as a result of conservative tillage systems.

(Robertson et al., 2000; Six et al., 2002; VandenBygaart et al., 2003; Drinkwater et al., 1998; West and Post, 2002; FAO, 2009).

Most of N_2O emissions are produced in soils during nitrification and denitrification processes (Hutchinson and Davidson, 1993).

The increase of N_2O in cultivated soils is mainly due to the use of N inputs in mineral fertilisers, animal wastes and biological N fixation (IPCC, 1996).

ROLE OF ORGANIC AGRICULTURE IN CLIMATE CHANGE MITIGATION



In the literature there are a number of studies that investigate greenhouse gas emissions from agriculture.

Audsley (1997), Ceuterick (1998), Kramer et al. (1999), Williams et al. (2006) and Warner et al. (2010) evaluated the emissions from different crops.

Other authors estimated emissions from different farming system, such as Flessa et al., 2002; de Boer, 2003; Cederberg and Mattsson, 2000; Haas et al., 2001 who compared organic and conventional farming systems.

In organic farming, a low nitrogen input in soils can potentially reduces nitrous oxide emissions (El-Hage-Scialabba and Müller-Lindenlauf, 2010).

ROLE OF ORGANIC AGRICULTURE IN CLIMATE CHANGE MITIGATION



Carbon sequestration in agriculture correlates with the farming system adopted.

Several studies have demonstrated that organically managed plots have a higher soil carbon content than conventionally managed ones (Mariott and Wander, 2006; Müller-Lindenlauf, 2009; Stalenga and Kawalec, 2008; Küstermann et al., 2008; Niggli et al., 2009; Mondelaers et al., 2009; El-Hage-Scialabba and Müller-Lindenlauf, 2010; Gattinger et al., 2012; Migliorini et al. 2014).



ORGANIC AGRICULTURE IN MEDITERRANEA BASIN

currently:

- 5.000.000 has over organic in the Mediterranean
- more than 200.000 companies

	Agri. Land ha	wild ha	tot ha	share %
Europa				
Spagna	1.593.197		1.593.197	6,5
Francia	1.032.941	3.380	1.036.321	3,7
Italia	1.167.362	17.988	1.185.350	9,0
Slovenia	35.101		35.101	7,6
Croazia	31.903	0	31.973	2,4
Bosnia Erzegovina	343	78.550	78.893	0,0
Serbia	6.340		6.340	0,1
Montenegro	3.068	139.809	142.877	0,6
Albania	515	467.783	468.298	0,0
Grecia	462.618		462.618	5,5
Malta	26		26	0,3
Cipro	3.923		3.923	2,7
Portogallo	200.151		200151	6,0
Asia				
Turchia	523.627	535.317	1.058.944	2,2
Siria	19.987	8.000	27.987	0,1
Libano	3.303	1.686	4.989	0,5
Israele	6.187		6.187	1,2
Giordania	2.895		2.895	0,3
Palestina Terr. Occ.	6.354		6.354	1,7
Africa				
Egitto	82.167		82.167	2,2
Libia	-	-		
Tunisia	137.188	41.716	178.904	1,4
Algeria	700		700	0,0
Marocco	16.600	418.000	434.600	0,1
	5.336.496	1.712.229	7.048.795	2,4

FIBL & IFOAM (2014). The world of organic Agriculture 2014. frick and Bonn

AN EXAMPLE OF COMPENSATION OF CO₂



BESTÄTIGUNG DER CO₂-KOMPENSATION CONFIRMATION OF CO₂ COMPENSATION

Migliorini Paola

Dieses Zertifikat bestätigt die Kompensation von
This certificate confirms the compensation of

0,18 Tonnen CO₂-Emissionen / tons of CO₂ emissions

die durch Ihren Flug entstanden sind
generated through your flight from

MXP Milan Malpensa Apt - VIE Vienna retour / return

Ihr Beitrag beträgt / Your contribution is € 7

Sie haben damit das Portfolio an österreichischen
Klimaschutzprojekten unterstützt. Vielen Dank!

*Your contribution serves to support the portfolio of Austrian
climate protection projects. Thank you!*

12.08.2015

DI Alexandra Amerstorfer

Kommunalkredit Public Consulting
Geschäftsführung
Managing Board

DI Christopher Giay

Kommunalkredit Public Consulting
Geschäftsführung
Managing Board



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Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft.
CLIMATE AUSTRIA - managed by Kommunalkredit Public Consulting in cooperation with the Federal
Ministry of Agriculture, Forestry, Environment and Water Management
www.climateaustria.at



I compensated 0,18 tons CO₂ emissions
generated by my flight with a contribution of
7 euro.

The revenue supports 190 projects and
compensate 116,00 tons of CO₂.
The largest share of revenue go to hydro
power, wind power and to improve energy
efficiencies.

None of these projects supports organic
agriculture!

CARBON BALANCE



Most of the above-mentioned research works were conducted using:

- i) complex methodologies, such as the life cycle analysis (LCA) Assessment to examine the contribution from different emission factors (Audsley, 1997; Ceuterick, 1998; Kramer et al., 1999; Williams et al., 2006; De Backer et al., 2009; Warner et al., 2010; Venkat, 2012);
- ii) complex mathematical models to assess the carbon balance (Grace et al., 2006; Küstermann et al., 2008; Stockmann et al., 2013).

However, it is also possible to calculate GHG emissions using simplified methods (Flessa et al., 2002; Lal, 2004).

A simplified method for the assessment of carbon balance in agriculture: an application in organic and conventional micro-agroecosystems in a long-term experiment in Tuscany, Italy

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¹*Dipartimento di Scienze delle Produzioni Agroalimentari e dell'Ambiente, Università di Firenze;*

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In our study we evaluated the carbon balance of two agroecosystems (organic vs conventional) through a simplified set of indicators, which includes both **carbon emissions** (expressed as CO₂eq) and **carbon sequestration** of crop rotations.

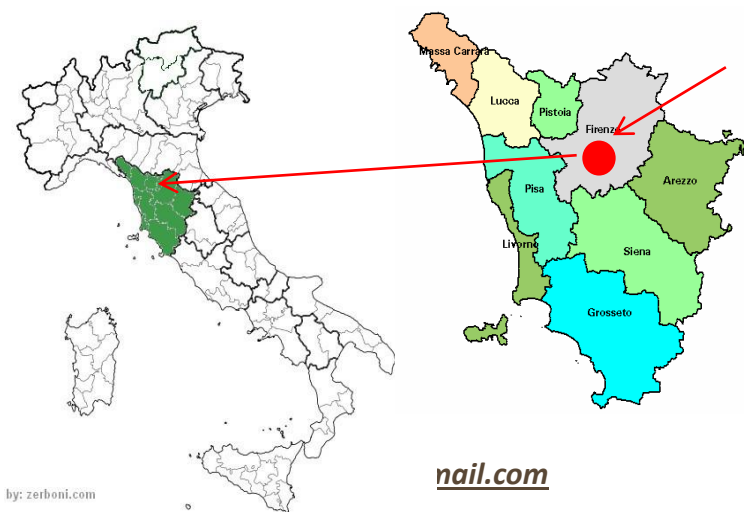
In our study, the set of SATREGAS indicators was tested on the organic and conventional micro-agroecosystems of the Montepaldi Long Term Experiment (MOLTE) at the experimental farm of the University of Florence (Italy), using data from the 2003-2007 period.

MATERIALS: STUDY SITE



The Montepaldi Long Term Experiment (MOLTE) has been ongoing since 1991 (Migliorini et al., 2014; Migliorini and Vazzana, 2007; Vazzana et al., 1997) at the experimental farm of the University of Florence.

In the MOLTE experiment, three micro-agroecosystems were set up to investigate differences between Old organic, Young organic and conventional management systems.



**Azienda
Sperimentale di
Montepaldi**



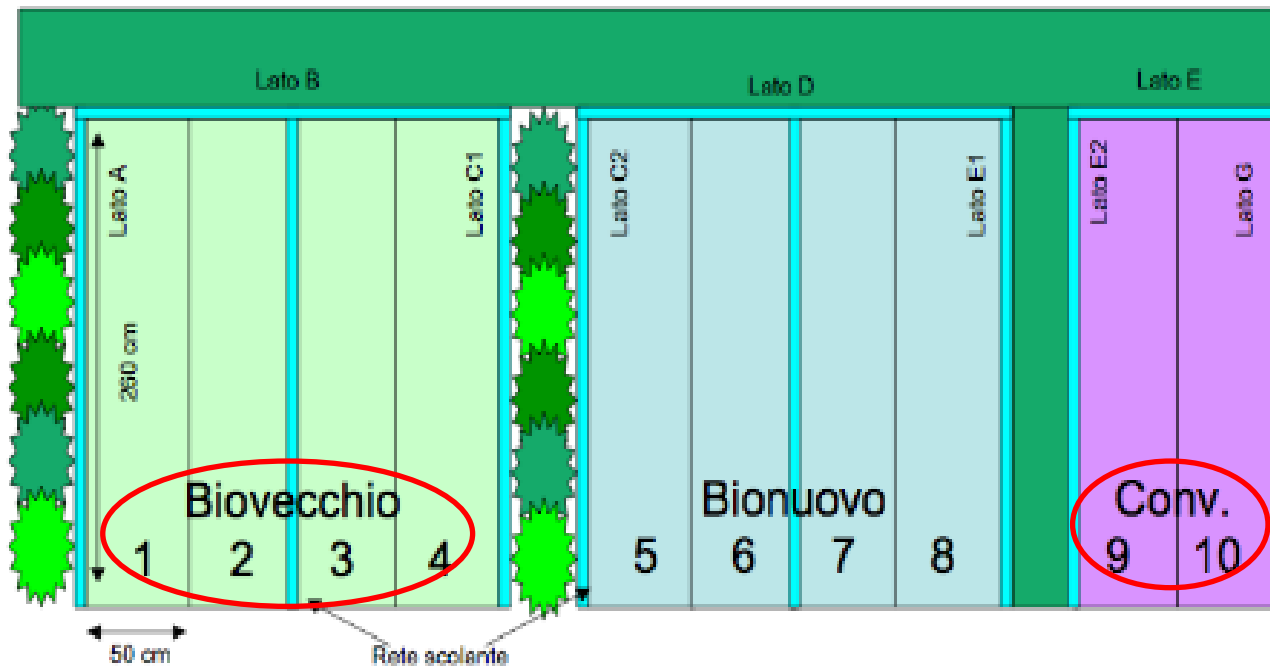
MATERIALS: STUDY SITE



In our study, we considered data from the following two micro agroecosystems:

- i) the Old Organic (OldO) system of 5.2 ha, consisting of 4 fields under organic management since 1992 (EC reg. 2092/91 and following regulations; European Commission, 1991);

- ii) the Conventional system of 2.6 ha, consisting of 2 conventional fields managed with the farming techniques generally adopted by the local conventional farms.



MATERIALS: STUDY SITE



Table 1. Characteristics of the two agroecosystems analysed at Montepaldi Long Term Experiment (Florence, Tuscany).

Input	OldO	Conv
Soil texture	Silty clay loam and clay loam	Silty clay loam and clay loam
Crop rotation	I: Green manure + Corn II: Common/Durum Wheat or Barley + overseeding Clover III: Clover IV: Common/Durum Wheat	I: Corn II: Common/Durum Wheat or Barley
Tillage	2003-2007: plow/ripper (25 cm)/ disc arrow (2 times 20 cm)	2003-2007: plow/ripper (25 cm)/ disc arrow (2 times 20 cm)
Input	OldO	Conv
Fertiliser: nitrogen (kg ha ⁻¹)	9.9	81.0
Fertiliser: phosphorus (kg ha ⁻¹)	8.5	56.9
Fertiliser: potassium (kg ha ⁻¹)	1.7	0.0
Crop residues nitrogen (kg ha ⁻¹)	34.6	25.2
Herbicides (l ha ⁻¹)	0.0	4.1
Fuel (l ha ⁻¹)	146.5	144.1
Harvest (Mg ha ⁻¹) ^o	Barley: 4.0 Common wheat: 2.5 Durum Wheat: 3.2 Corn: 2.3 Clover: 3.9	Barley: 4.7 Common wheat: 6.2 Durum wheat: 3.5 Corn: 1.7

OldO, Old Organic; Conv, Conventional. ^oAnnual average of the crop rotation.

METHODS: INPUT & OUTPUT



1. Emission

The three gasses, CO₂, CH₄ and N₂O are converted into a CO₂ equivalent value (CO₂eq) using the coefficients of 1, 25 and 298, respectively over a time span of 100 years (IPCC, 2006).

Table 2. Emission factors used for the calculation of CO₂eq.

Emission factors	CO ₂ eq (kg kg ⁻¹)	Reference
N ₂ O direct application of nitrogen fertiliser	2.98	IPCC, 2006
N ₂ O direct application of crop residues	2.98	IPCC, 2006
N ₂ O indirect volatilization fertiliser	0.5	IPCC, 2006
N ₂ O indirect leached fertiliser	3.5	IPCC, 2006
N fertiliser production	2.86	Küstermann <i>et al.</i> , 2008
P fertiliser production	2.57	Küstermann <i>et al.</i> , 2008
K fertiliser production	0.73	Küstermann <i>et al.</i> 2008
Herbicide production	26.63	Audsley <i>et al.</i> , 2009
Diesel	3.17	IPCC, 1996
Manufacture machine	1.17	Doering, 1980

N, nitrogen; P, phosphorus; K, potassium.

METHODS: INPUT & OUTPUT



2. Carbon sequestration

The calculation of carbon sequestration was performed using 2 indicators: the stock of SOC (Mg C ha⁻¹) and the carbon sequestration rate (Mg C ha⁻¹ year⁻¹), which were calculated as follows:

$$\text{SOCstock} = \text{BD} \times \text{SOCconc} \times D$$

where BD is soil bulk density (Mg m⁻³), SOCconc is the concentration of soil organic carbon (mg kg⁻¹), and D is the thickness of the soil layer (m).

The C sequestration rate (Mg C ha⁻¹ year⁻¹) was calculated with the following equation:

$$\text{C sequestration rate} = (\text{C}_{tt} - \text{C}_{to})/t$$

where C_{tt} and C_{to} represent SOC stocks (Mg C ha⁻¹) at the end and at the beginning of the experiment, respectively, and t refers to the duration of the experiment (years).

RESULTS



Table 3. Analysis of variance: average and significance of greenhouse gas emissions per unit of area (Mg ha^{-1}) and per unit of product (Mg kg^{-1}), soil carbon stock (Mg ha^{-1}) and carbon sequestration rate ($\text{Mg ha}^{-1} \text{ year}^{-1}$) for each farming system depending on the source of variation in the 2003-2007 period.

Source of variation	Degrees of freedom	CO ₂ eq emission (Mg ha^{-1})	CO ₂ eq emission (Mg ha^{-1})	Soil carbon stock (Mg ha^{-1})	Carbon sequestration rate (Mg ha^{-1})
System (S)	1	**	**	**	n.s.
OldO	-	0.74+0.11	0.30+0.07	27.93+0.53	0.48+0.70
Conv	-	1.76+0.11	0.78+0.07	24.51+0.75	-0.54+0.99

**Significant with $P \leq 0.01$; *significant with $P \leq 0.05$. n.s. not significant; OldO, Old Organic; Conv, Conventional.

Greenhouse gas emissions

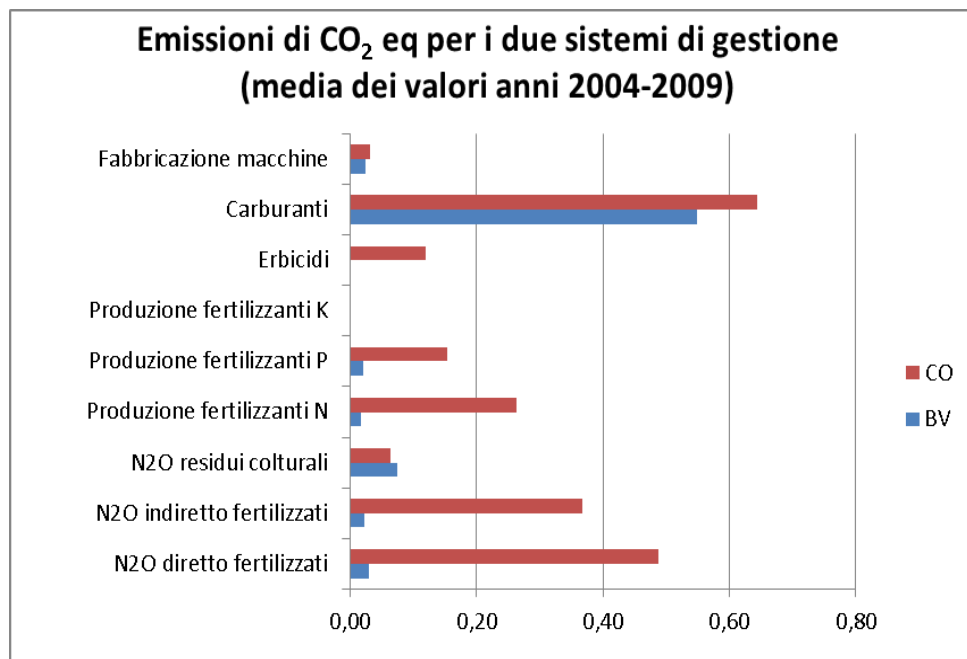
With regard to the crop rotation applied during the reference period (2003-2007), the emission level of CO₂eq per unit of area and per unit of product from the organic system was 58% and 61% lower compared to the conventional one.

Carbon sequestration

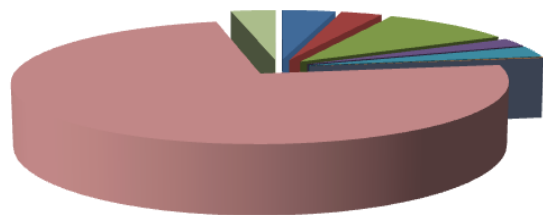
The carbon stock in the two farming systems was found to be statistically different: the carbon stock was 14% higher in the OldO system compared to the Conv system.
+ 3.4 Mg C ha^{-1} (in five years)

The rate of carbon sequestration instead was not significantly different.

EMISSIONS

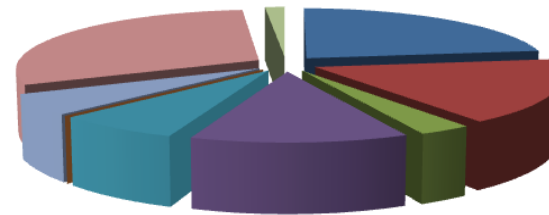


Emissioni di CO₂eq "Biovecchio"



- N2O diretto fertilizzanti
- N2O residui colturali
- Produzione fertilizzanti P
- Erbicidi
- Fabbricazione macchine
- N2O indiretto suolo fertilizzanti
- Produzione fertilizzanti N
- Produzione fertilizzanti K
- Carburanti

Emissioni di CO₂eq "Convenzionale"



- N2O diretto fertilizzanti
- N2O residui colturali
- Produzione fertilizzanti P
- Erbicidi
- Fabbricazione macchine
- N2O indiretto suolo fertilizzanti
- Produzione fertilizzanti N
- Produzione fertilizzanti K
- Carburanti

k "Org

CONCLUSIONS



Anthropogenic climate change is a serious problem

Mitigation and adaptation are fundamental.

Organic systems compared to conventional farming systems:

1. can more than halve GHG emissions
2. and increase soil carbon sequestration.

If 2,4% of organic will become 100% we will accomplish the mitigation goal in agriculture.

THANK YOU!



“Organic can feed the planet” [#OrganicCanFeedthePlanet](#)