Comparative greenhouse gas emission rates from organic farming *vs* conventional plots: *Organiko* findings

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Wednesday, 23 May 2018
European Parliament, Brussels

Presentation Outline

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  - The importance of organic farming
  - *Organiko* Aims
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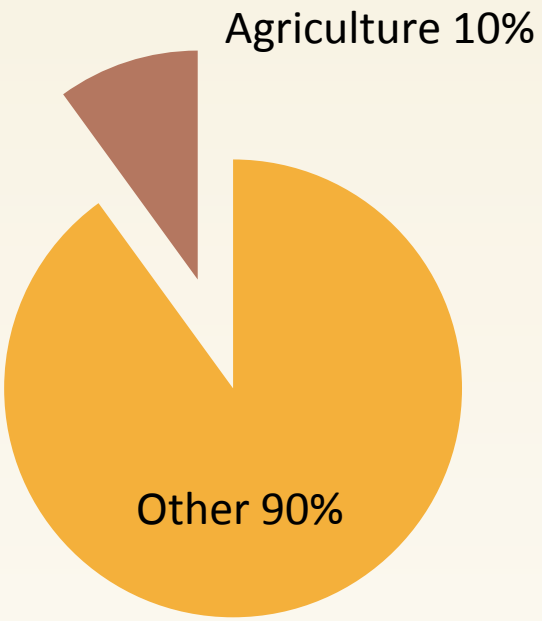
- Future Steps

Introduction

Understanding GHGe from Agriculture

- Agriculture is one of the main contributors to GHG emissions
  - The EU's agricultural sector accounted for 10 % of the EU's total GHG emissions
- GHG emissions reduced by 20% since 1990
  - The decrease in GHGe was due principally to a 17 % decline in nitrous oxide emissions from agricultural soils driven by the reduced use of nitrogenous fertilizers



Nitrous oxide in agriculture - FACTS

EU Agriculture is estimated to be responsible for 78% of the N_2O emitted to the atmosphere

Direct N_2O emissions from soils are estimated to be responsible for the 88% of the total N_2O emissions in agricultural sector

At EU level this accounts to 133 million tons of CO_2 equivalents

Agricultural practices are the most important factor controlling N_2O emissions from soils (nutrient management, tillage)

The importance of organic farming in GHGe

- No synthetic chemical fertilizers
- Organic crops have deeper and denser rooting system (scavenge soil nitrogen)
- N inputs are lower thereby the direct N_2O emissions are expected to be lower

  But!!!

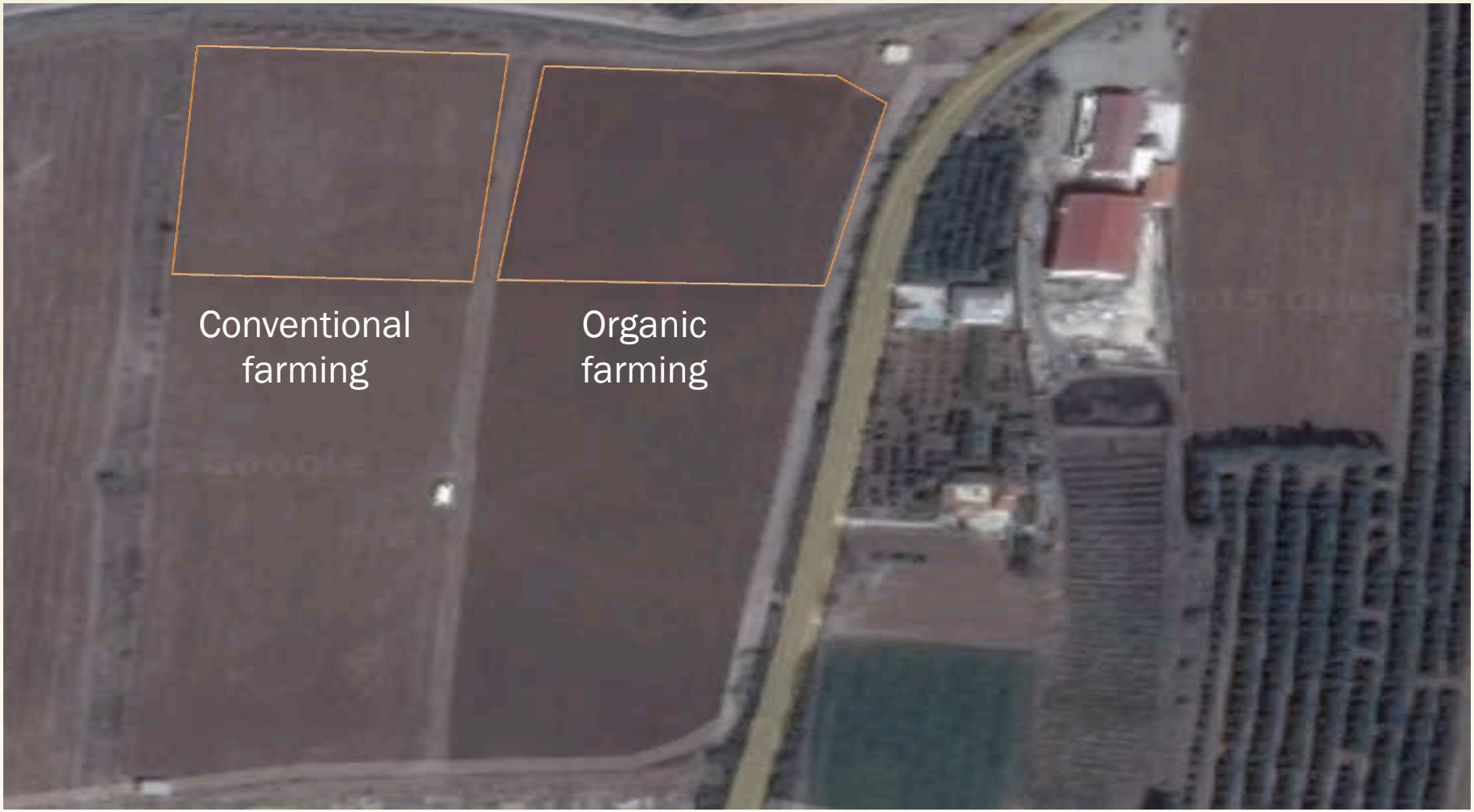
- N organic amendments (manure or compost) could lead to more N_2O emission due to mineralization

LIFE+*Organiko* Aims

Calculate N_2O emissions from the production of barley, vetch and pea in conventional and organic farming management schemes in semi arid conditions (such as Cyprus) by

- *In situ* measurement of direct soil N_2O emissions
- Comparison of the different nutrient strategic schemes (organic *vs* conventional)
- Estimate crop specific emission factors

Materials and Methods



- Preliminary studies to set and calibrate the static chamber system for soil N_2O direct emissions (11/15-10/16)
- The trials started at 11/2016 at the experimental station of ARI at Acheleia Paphos where a conventional and an organic farming system have been established since 2008

Static Chamber deployment

- Gas samples for N_2O analysis were taken from the static chambers using gas tight syringes
- N_2O was determined using GC-MS and the emission flux was calculated

In situ measurements

Treatments (4)	Crops (3)
Manure	Barley
	Vetch
	Pea
Compost	Barley
	Vetch
	Pea
Ammonium Nitrate	Barley
	Vetch
	Pea
No N input	Barley
	Vetch
	Pea

Experimental design

- Split plot design
- With six replicates

In each replicate 2 static chambers were used

Manure, compost and ammonium nitrate applied once at 11/2016

Measurements every week

Results

In situ measurements: Barley, Vetch, Pea

- A significant amount of nitrous oxide (N_2O) emissions in all treatments compared to the plots received no inputs
- ANOVA analysis showed that nutrient treatment had a significant effect on N_2O emissions
- N_2O emissions showed a seasonal pattern
  - During the drying season the emissions were substantially lower and no differences were noticed between the different systems

In situ measurements: Barley, Vetch, Pea

- The findings show that irrespective of the crop, plots receiving **ammonium nitrate** exhibited a peak of N_2O flux early December
  - Barley 9,5g (± 0,52) N-N_2O/ha/day
  - Vetch 7,1g (± 0,39) N-N_2O/ha/day
  - Pea 9,7g (± 1,18) N-N_2O/ha/day

- **Manure** treated plots showed also a peak of fluxes within January
  - Barley 6,2g (± 0,28) N-N_2O/ha/day
  - Vetch 3,6g (± 0,18) N-N_2O/ha/day
  - Pea 8,5g (± 0,32) N-N_2O/ha/day

- **Compost** treated plots showed a peak in early March
  - Barley 2,5g (± 0,14) N-N_2O/ha/day
  - Vetch 7,2g (± 0,55) N-N_2O/ha/day
  - Pea 4,6g (± 0,72) N-N_2O/ha/day

Estimated emission factors so far as calculated in LIFE+*Organiko* project

Cyprus is under the default International Panel of Climate Change (IPCC) emission factor 1% (every 100 kg of N input, 1 kg is emitted as N_2O) for N_2O direct soil emissions due to the lack of experimental data

LIFE+*Organiko* revealed that the emission factor (EF) for each crop under the different schemes is by far below the default IPCC values for N additions from mineral fertilizers, organic amendments and crop residues due to the low water availability in soil (low rainfall)

The lowest EF was calculated in compost treated plots and it was crop depended

Manure and fertilizer treated plots had similar EF except Vetch which EF in manure treatment was even lower compared to the conventional system

No different EF between organic and conventional nutrient management strategies was noticed in pea

Estimated emission factors so far as calculated in LIFE+*Organiko* project

	Barley-Organic	Vetch-Organic	Pea-Organic
Manure	0.24 %	0.11 %	0.19 %
Compost	0.13 %	0.07 %	0.15 %

	Barley-Conventional	Vetch-Conventional	Pea-Conventional
Ammonium Nitrate	0.23 %	0.15 %	0.13 %

Conclusions I

- N_2O emissions reveal a seasonal pattern that is related to environmental conditions
- Both nutrient treatment and crop had a significant effect on N_2O direct emissions
- The highest emissions were noticed
  - during winter months as expected in a short period after the implementation of chemical fertilizer

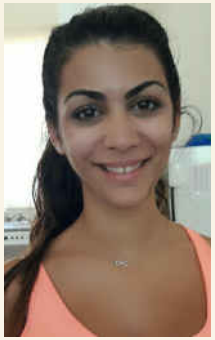
Conclusions II

- Findings suggest that organic farming exhibits lower emission factors when compost is used
- Compost addition resulted in a substantially lower Emission Factor compared to manure and fertilized soils that is likely related to lower Nitrogen availability
- Overall, the emission factors are by far lower than the default values (1%) used for the estimation of direct N_2O emissions in Cyprus

Future steps

- Continue for another growing period sampling and analysis within LIFE+*Organiko*
- Evaluate and reveal the microbial contribution on the emission profile in the specific system
- Evaluate the bacterial diversity on these ecosystems
- Map N_2O emissions and calculate emission factors in more locations and crops in Cyprus

Thank you for your attention









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