Lysimeter site Wagna:

Comparative assessment between conventional and organic farming regarding water balance, nitrate leaching, crop yield and economic profit

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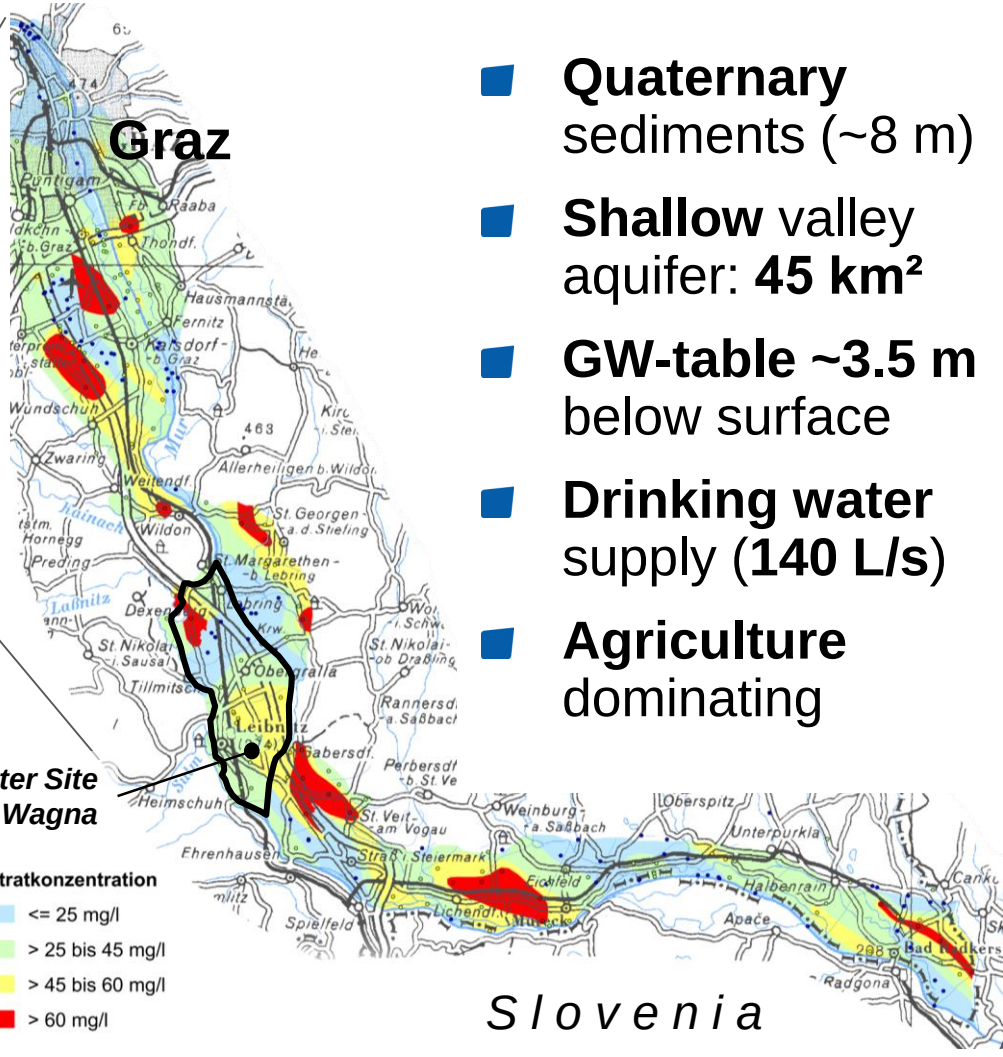
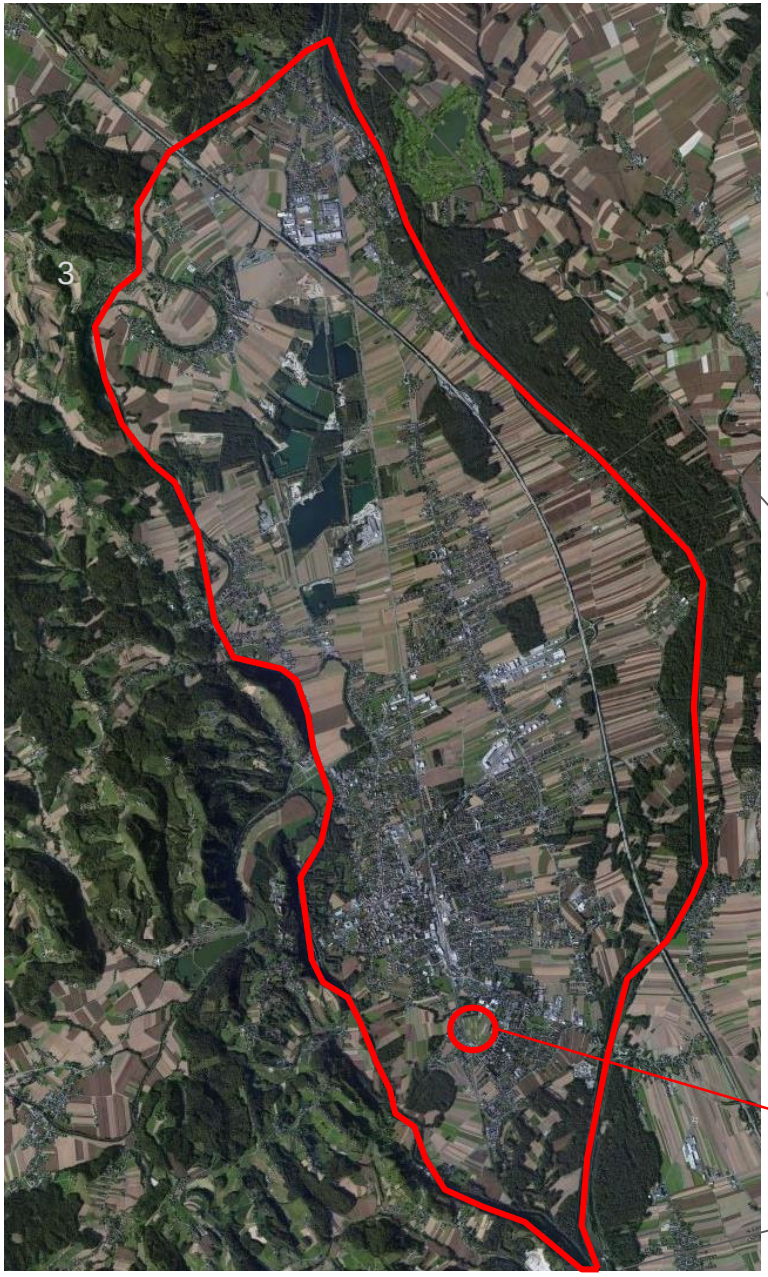
Background & Location

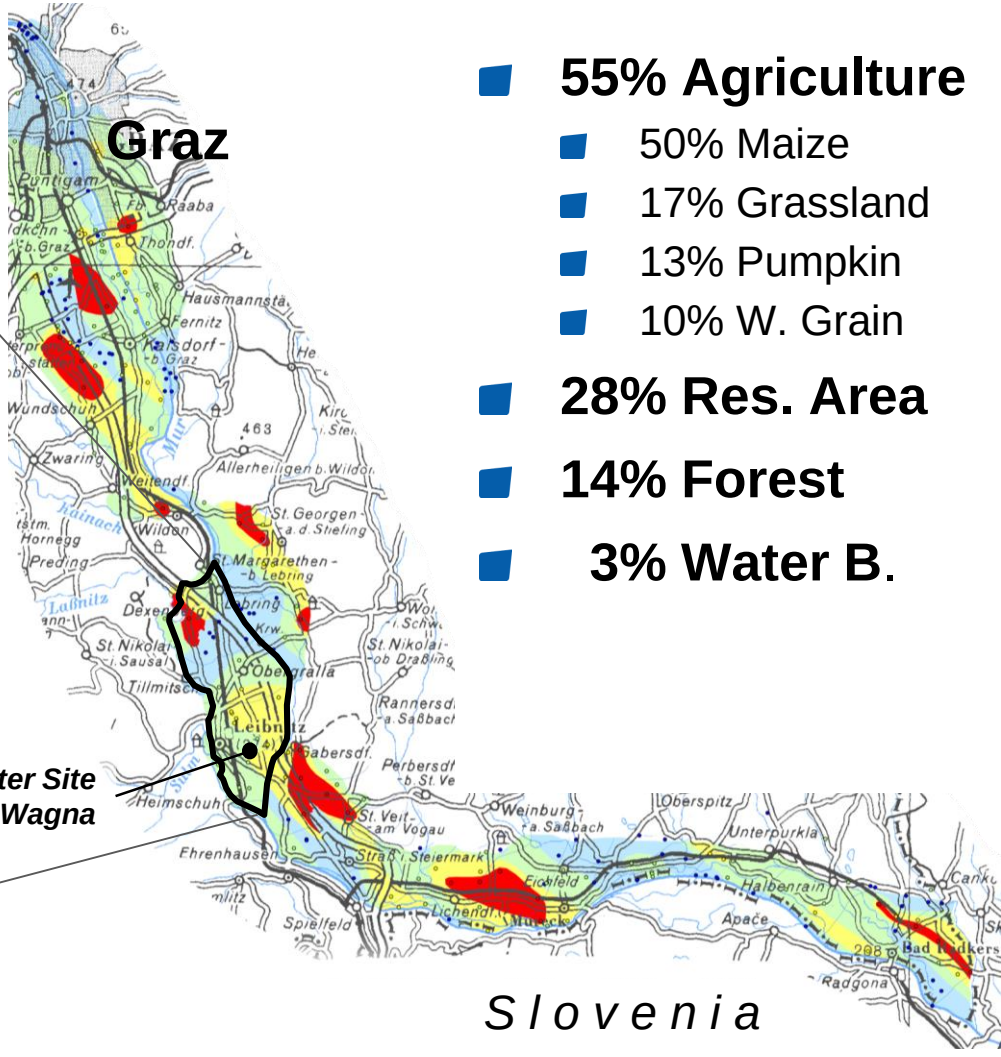
- **Nitrate**
- Threshold value 50 mg/L



- **Quaternary** sediments (~8 m)
- **Shallow** valley aquifer: **45 km²**
- **GW-table ~3.5 m** below surface
- **Drinking water** supply (**140 L/s**)
- **Agriculture** dominating

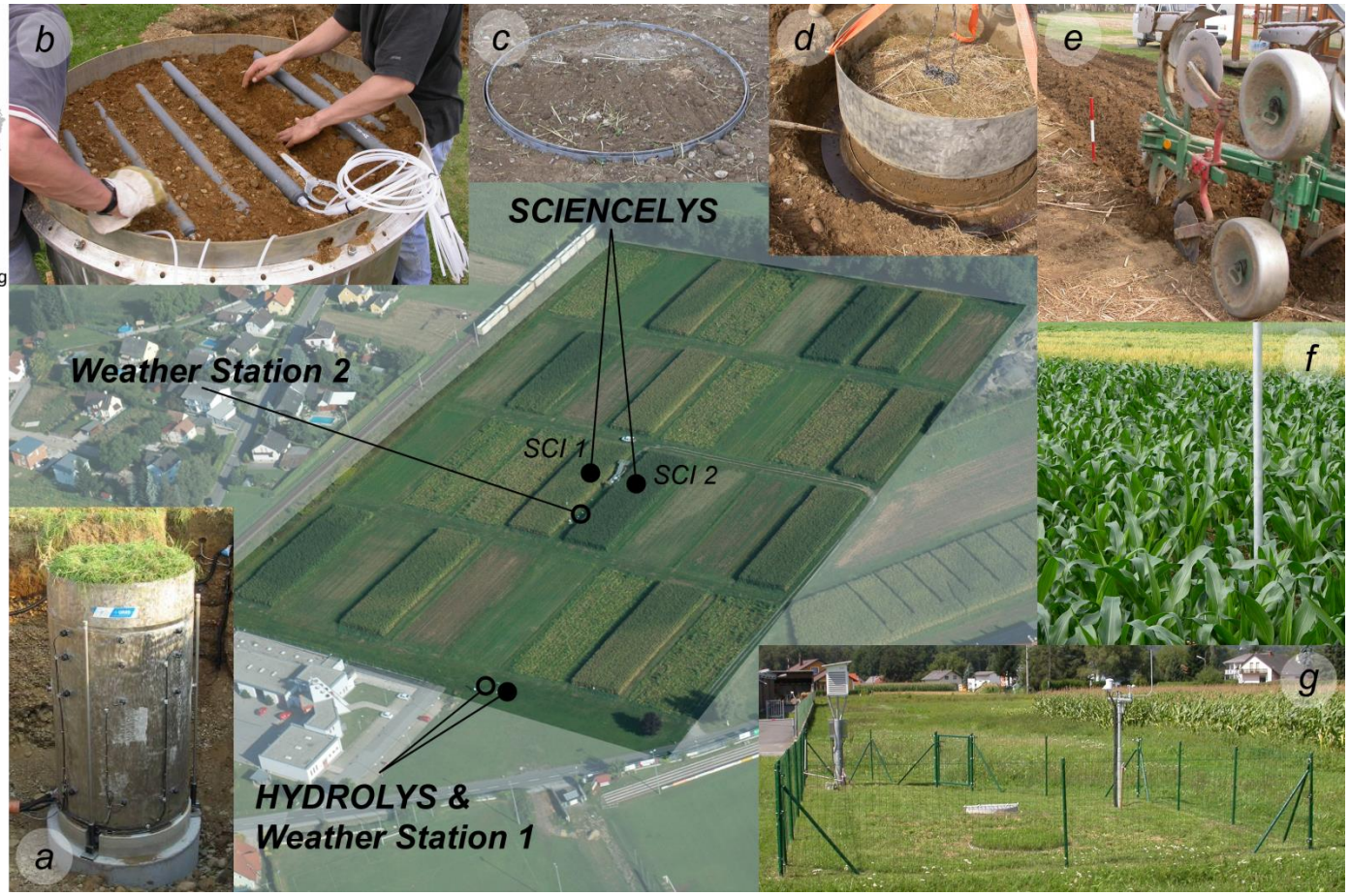
Location & Landuse





- **55% Agriculture**
  - 50% Maize
  - 17% Grassland
  - 13% Pumpkin
  - 10% W. Grain
- **28% Res. Area**
- **14% Forest**
- **3% Water B.**

Lysimeter Site Wagna Overview



a) SCIENCELYS situated on load cells
b) Lower boundary condition of lysimeter realized as suction cups rake
c) Gap between lysimeter and outer cone about 0.5 cm
d, e) Removable upper lysimeter ring allows tillage with standard machinery
f) Lysimeter implemented into test plot to avoid oasis effects
g) HYDROLYS with an accompanied weather station built in the grassland area outside the agricultural test plots

Lysimeter Site Wagna Soil Conditions

- **Sandy Loam** and **Loamy Sand**
- **Gravel** layer starts in depths between 30 and 200 cm

Water and Nitrogen Balance Conventional Farming

- N-Fertilization rate based on guideline for **appropriate fertilization** (Richtlinie für die Sachgerechte Düngung)

CONV. F.		P [mm/a]	ETr [mm/a]	GWRC [mm/a]	N-Fert.[1] [kg/ha/a]	N Crop Yield[2] [kg/ha/a]	N-Leaching [kg/ha/a]	cNO_3 [mg/l]
2005	Pumpkin	943	627	319	*2005 and 2006 not considered due to possible influence of previous cultivation*			
2006	Maize	907	607	320				
2007	Maize	925	586	296	121	93 (9 Pfl./m²)	18	27
2008	W. Barley	974	775	192	120	132 (330)	20	45
2009	Pumpkin	1314	697	609	52	57 (2)	25	18
2010	Maize	1039	597	429	116	142 (9)	8	8
2011	W.Triticale	767	761	63	150	156 (400)	4	29
2012	Maize	1111	745	324	150	151 (12)	31	42
2013	Pumpkin	966	544	476	57	49 (2)	33	31
2014	Maize	1139	595	561	174	115 (8)	28	22
Mean:		**1009**	**653**	**359**	**118**	**112**	**21**	**26**

[1]) N amount in liquid manure is presented assuming a volatilization-loss of 13% due to application
[2]) N in crop yield corresponds to number of plants cultivated on the lysimeter (given in brackets)

Water and Nitrogen Balance Organic Farming

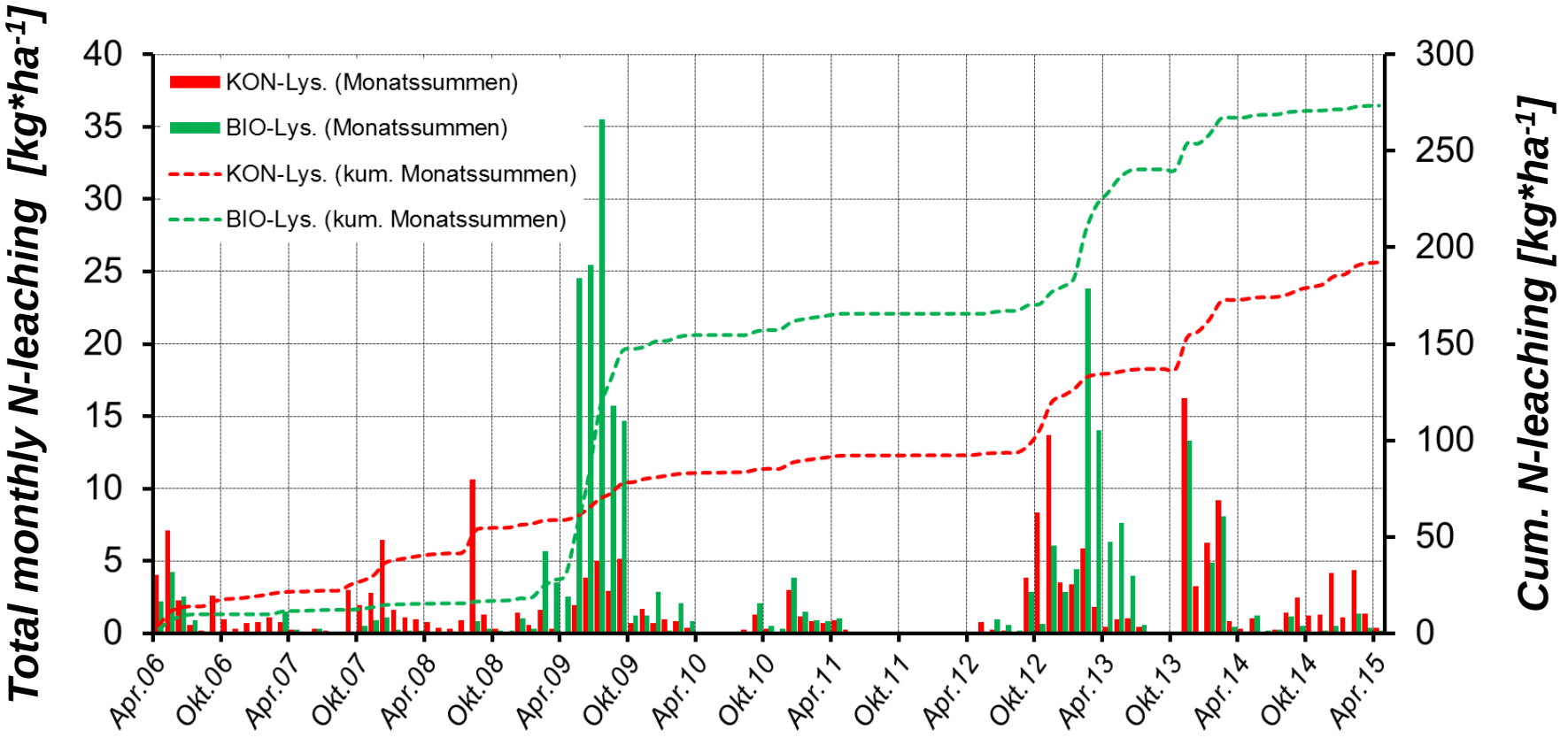
- N-Fertilization generally by cultivation of **legumes;** **no pesticide** application

ORG. F.		P [mm/a]	ETr [mm/a]	GWRC [mm/a]	N-Fert.[1] [kg/ha/a]	N Crop Yield[2] [kg/ha/a]	N-Leaching. [kg/ha/a]	cNO_3 [mg/l]
2005	Pumpkin	959	585	374	*2005 and 2006 not considered due to possible influence of previous cultivation*			
2006	Clover	866	687	276				
2007	Maize	973	651	217	-	143 (10 Pfl./m²)	5	10
2008	Triticale	928	775	151	-	125 (400)	3	10
2009	Pumpkin	1276	608	662	-	93 (3)	133	89
2010	Maize	1024	580	436	-	99 (9)	10	10
2011	Triticale	772	791	60	-	62 (400)	4	30
2012	Maize	1051	697	286	-	146 (9)	14	22
2013	Pumpkin	972	534	506	50	27 (2)	74	65
2014	Maize	1192	607	647	-	112 (8)	18	12
Mean:		**1001**	**652**	**362**	**6**	**101**	**33**	**40**

[1]) N-Input by legumes not considered

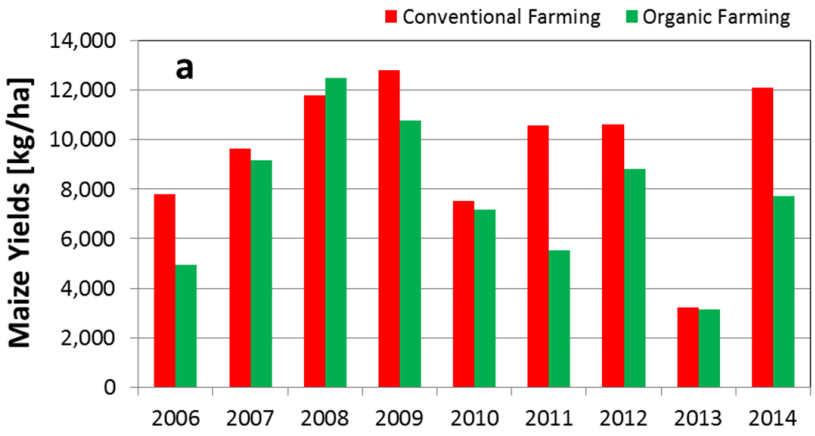
[2]) N in crop yield corresponds to number of plants cultivated on the lysimeter (given in brackets)

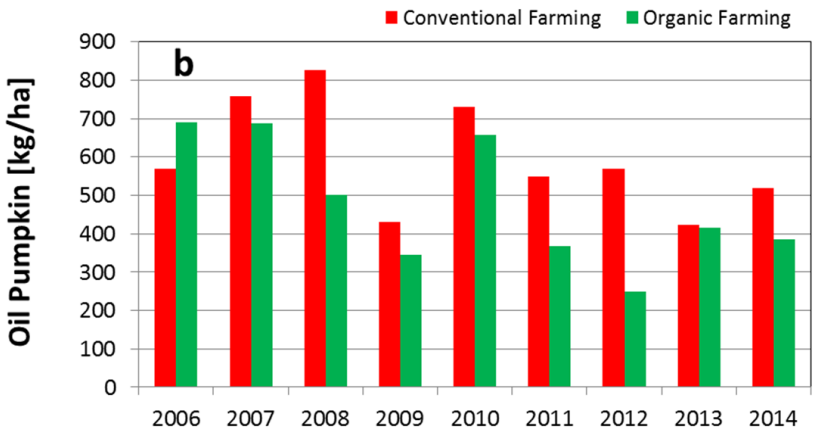
Nitrogen Leaching

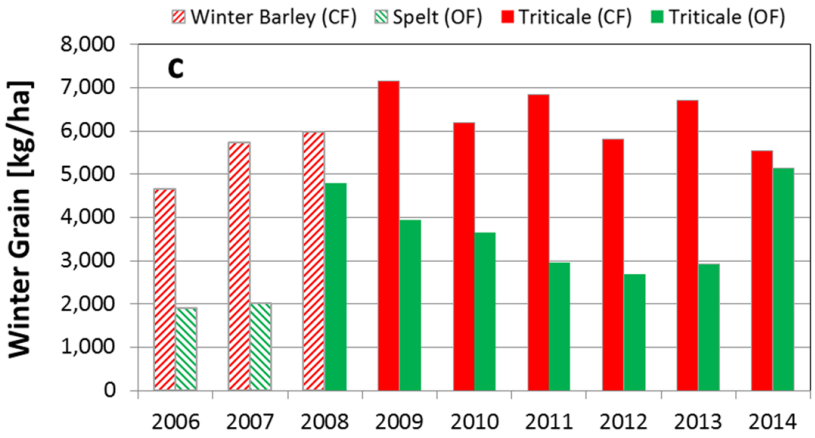


Crop Yields

	CONV [kg/ha/a]	ORG [kg/ha/a]	Difference [%]
Maize	9.600	7.800	19
Triticale	6.400	3.600	44
Pumpkin	600	480	20







Economic Profit
Conventional vs. Organic Farming

[€/ha/a]	CONV. F.	ORG. F.
Revenues from cash crops	1519	1548
+ Revenues from selling strow	13	0
- Costs for seeding cash crops	-244	-252
- Costs for seeding cover crops	-115 ←	-156
- Costs for fertilization	-216 →	-63
- Costs for plant protection and plant care	-119 ←	-192
- Costs for tillage	-263	-272
- Costs for harvesting and drying	-406 →	-314
= **Economic Profit***	**168 €/ha/a**	**298 €/ha/a**

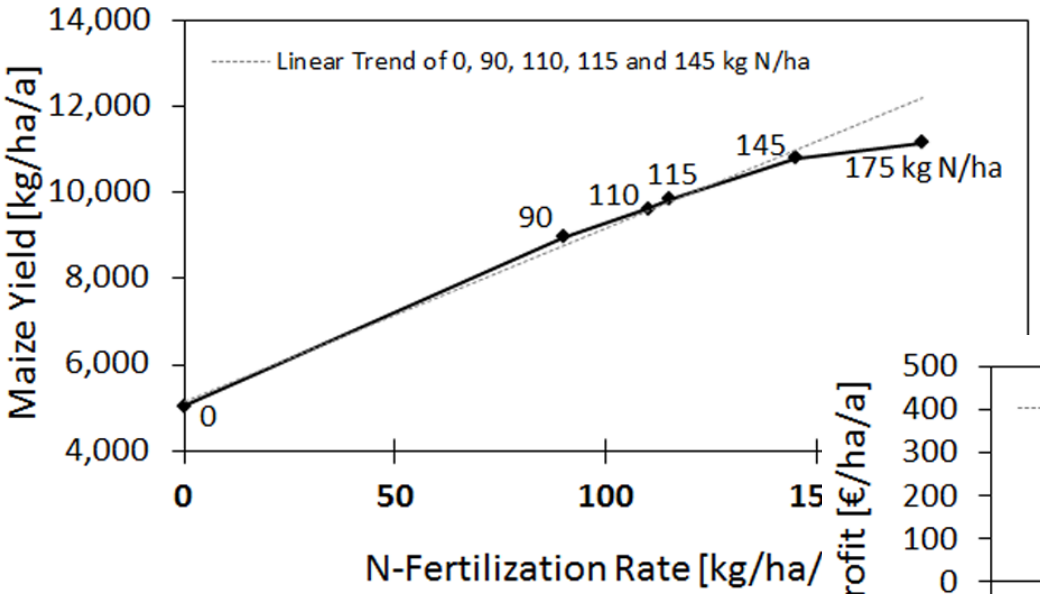
*) not including governmental subsidies

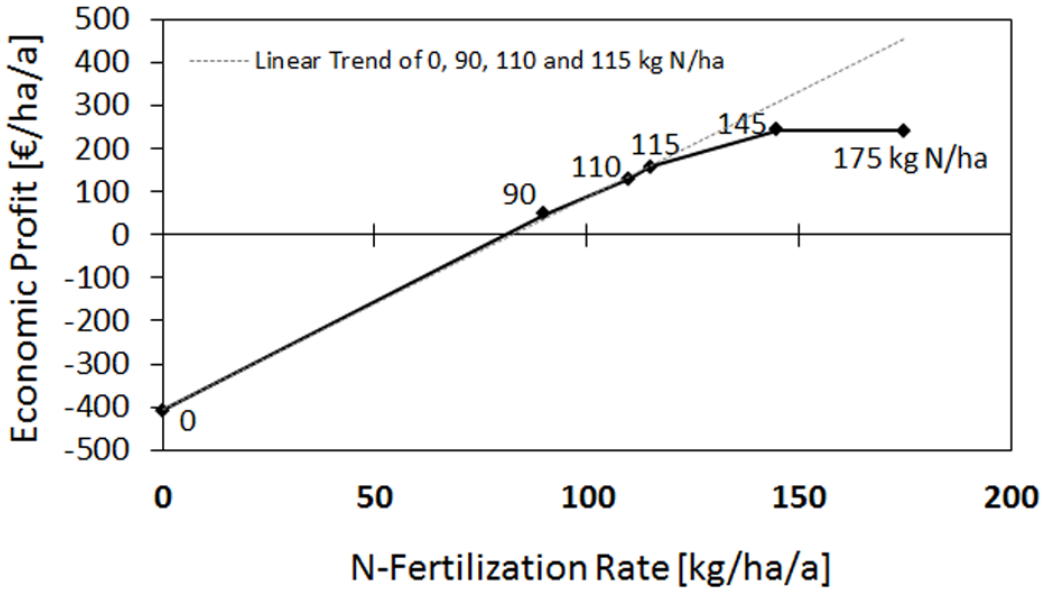
Economic Profit for cultivated Crops

[€/ha/a]	CONVENTIONAL F.				ORGANIC F.				
	Maize	Pumpkin	W. Barley	W. Triticale	Maize	Pumpkin	Grass/ Clover	W. Spelt	W. Triticale
2006	-141	-4	-199		-170	716	-455	15	
2007	863	293	321		2146	708	-519	144	
2008	306	577	119		1674	749	-455		838
2009	371	-160		-331	532	47	-626		245
2010	-252	673		46	521	1053			-127
2011	485	-82		282	108	-47			-119
2012	1209	10		223	1458	-1104			-60
2013	-707	-284		288	-122	-287			5
2014	-172	437		-74	660	118			455
Mean Crop	**218**	**162**	**80**	**72**	**756**	**217**	**-514**	**79**	**177**
	Mean CONV: 168 €/ha/a*				**Mean ORG: 298 €/ha/a***				

*) not including governmental subsidies

Economic Profit
Fertilization Experiment Maize





Conclusions & Outlook

- Both cultivation strategies **GWRC < 50 mg/l cNO_3**
- **Maize → N-Fert. 145 kg/ha/a** (ecol. + econ.)
- **Legumes → high N-fixation** rate (difficult to handle)
- **Hydrologic conditions** + **cultivated crops** relevant for N-leaching
- Crop Yields CONV. F. → Economic Profit ORG. F.
- Future: Further **Pesticide experiments**

Thank you for your attention!

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