



University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

Soil management through agro-environmental programmes and beyond

Walter W. Wenzel

Key-note

26th Conference of the Working Group Sustainability / Soil Protection

Innovations for Soil Health

April, 09-10, 2019

Tulln an der Donau, Austria



Content



University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

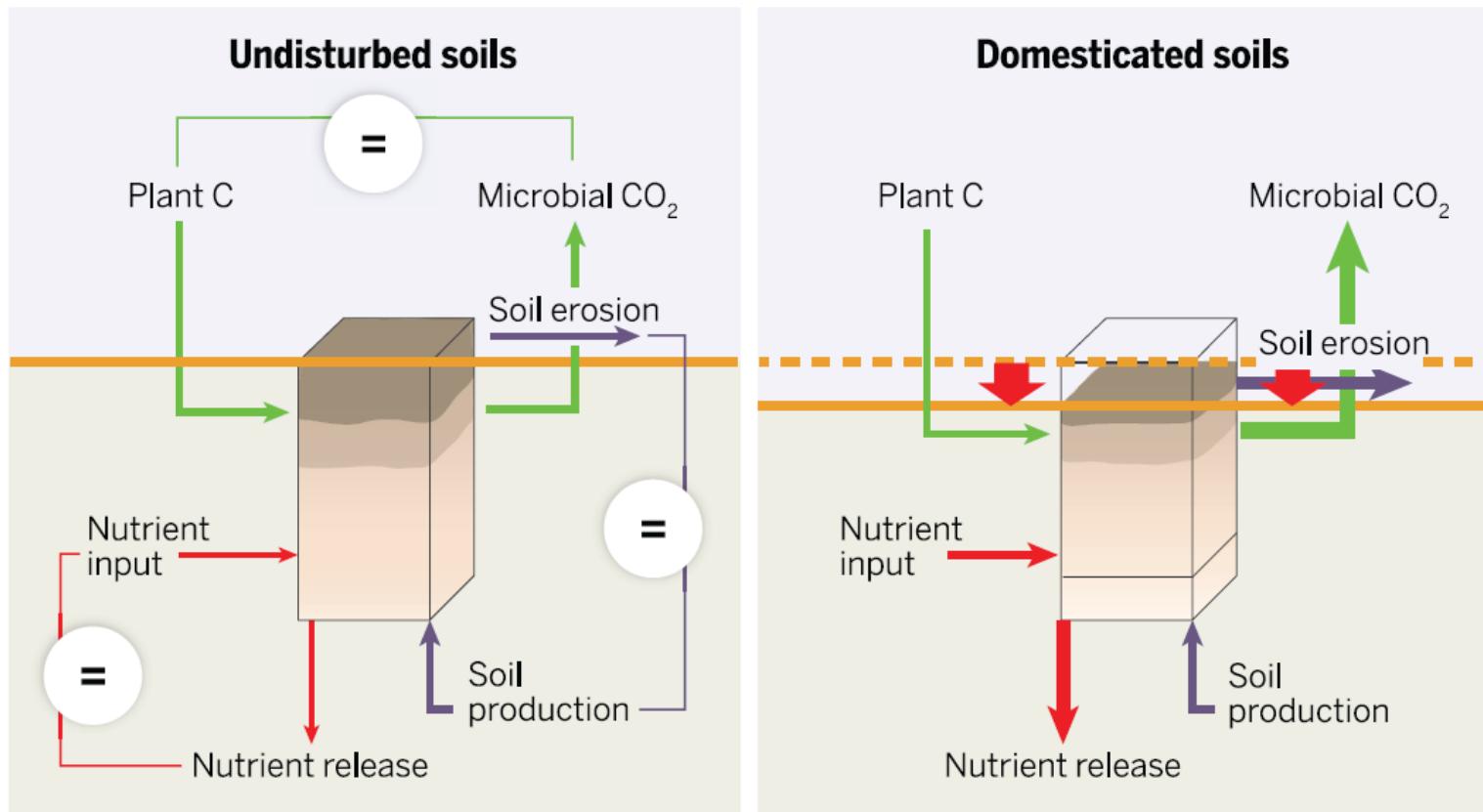
- Soil Threats & Agro-Environmental Programme
- Some Examples
- The 9th (Hidden) Soil Threat
- Effective Solutions

Soil threats



University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

Amundson et al (2015)
Science 348: 647-653



Soil threats



- **Soil Thematic Strategy of EU (adopted February 2012)**
 - Sealing
 - Erosion
 - Compaction
 - Decline of organic matter
 - Soil pollution
 - Salinization
 - Decline of biodiversity
 - Land slides



University of Natural Resources
and Life Sciences

Department of Forest and Soil Sciences

Soil threats



Robinson et al (2014), SSSAJ 78: 685-700



University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

European Union soil threats based on the Impact Assessment (SEC 2006)

Soil threat	Estimated annual cost
1) Erosion	€0.7–14.0 billion USD 1.05–21.03 billion, 2013
2) Organic matter decline	€3.4–5.6 billion USD 5.11–8.41 billion, 2013
3) Compaction	no estimate possible
4) Salinization	€0.158–0.321 billion USD 0.237–0.482 billion, 2013 (1.3)
5) Landslides	up to €1.2 billion per event USD 1.80 billion, 2013
6) Contamination	€2.4–17.3 billion USD 3.61–25.99 billion, 2013
7) Sealing	no estimate possible
8) Biodiversity decline	no estimate possible

† Conversions to 2013 USD use an exchange rate for the given year (1.3, 2006) and inflation using a CPI index calculator (Areppim, 2014).

Agro-Environmental Programme



University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

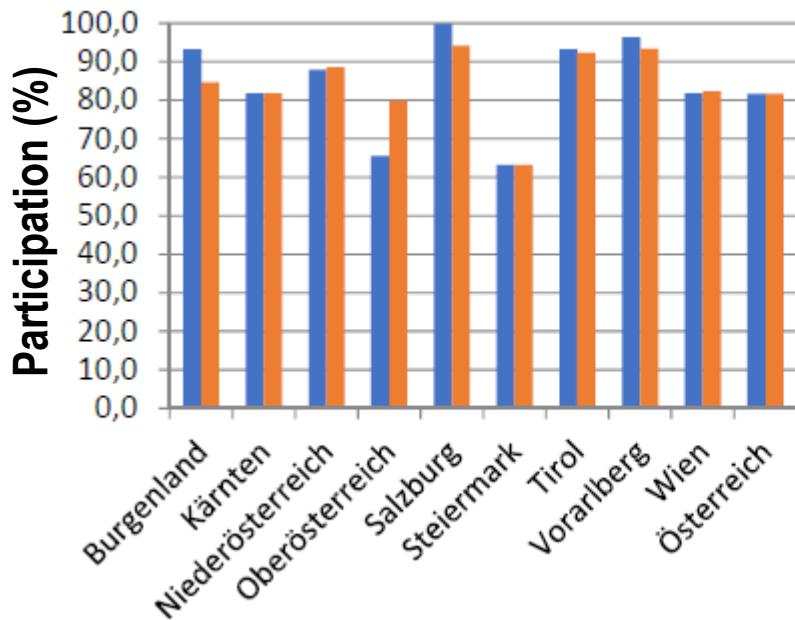
Agro-Environmental Programme in Austria

- Co-funded by EU
- Since 1995
- ÖPUL 2015 and soil protection
 - Intercropping - cover crops – greening
 - Mulch and direct seeding
 - Leaching risk
 - Organic farming
 - Erosion in viticulture and fruit-growing
 - Biodiversity

Agro-Environmental Programme



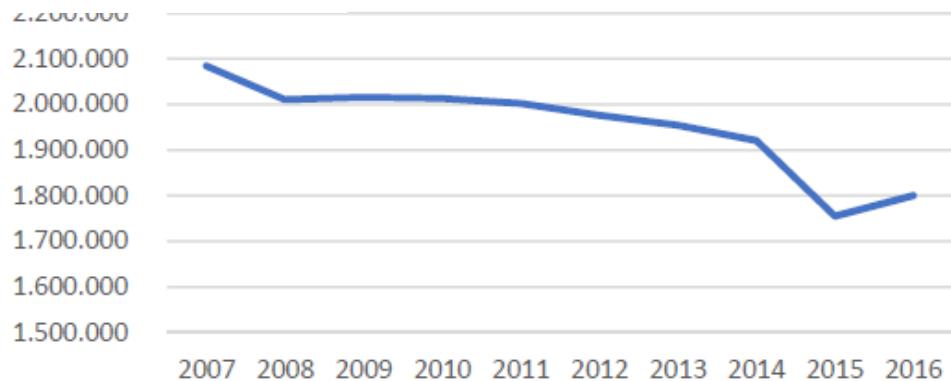
University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences



Austria: 82% (both
are and farm
number)

- ÖPUL area (%)
- ÖPUL farms (%)

ÖPUL area (ha)

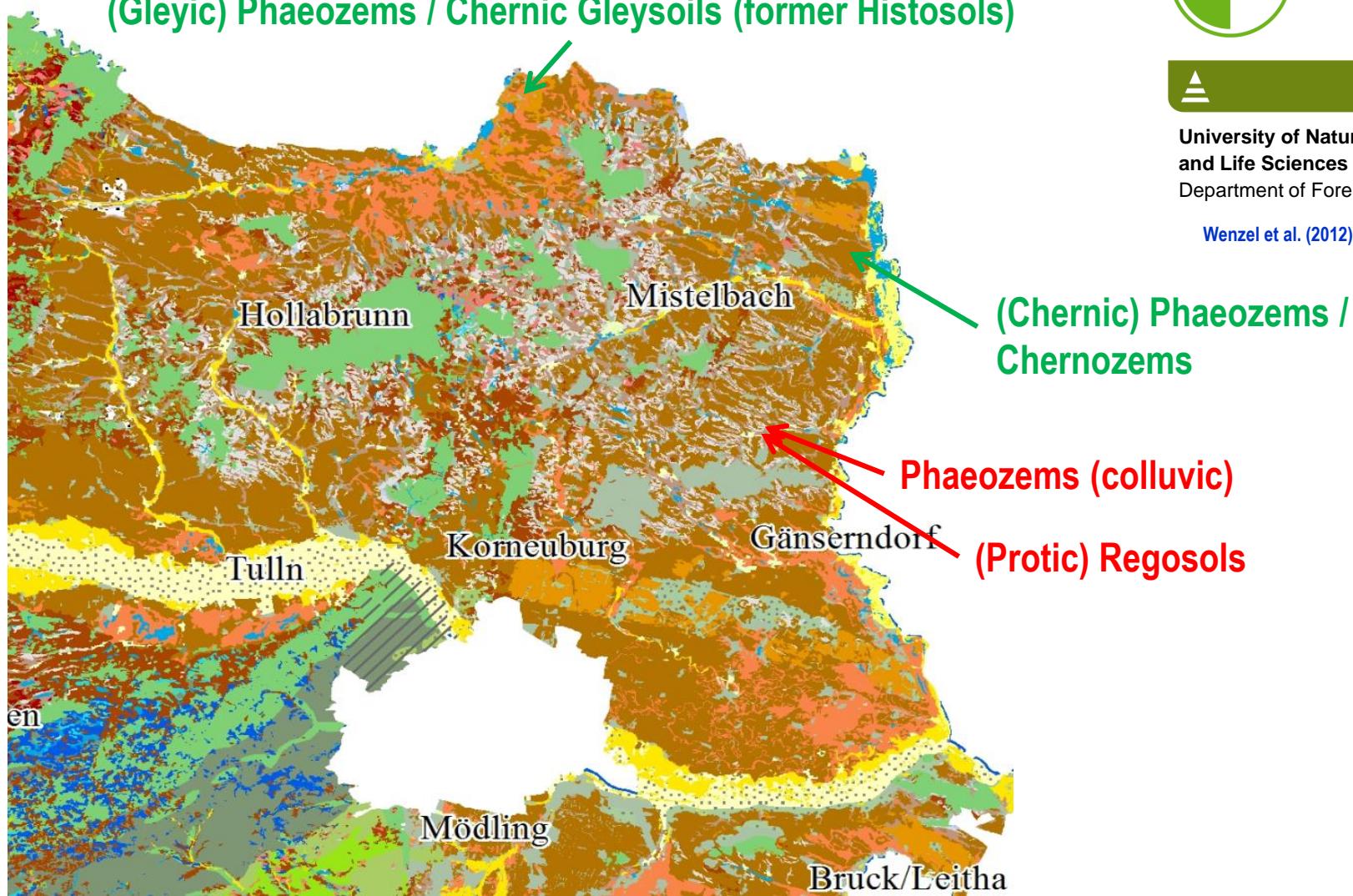


Some examples – soil erosion



University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

Wenzel et al. (2012): Soil map of Lower Austria



Some examples – soil erosion



University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

Soil formation in
after ~ 10000 years
(0.07 mm y^{-1})

Average soil erosion
in Lower Austria:
 $3.4 \text{ t ha}^{-1} \text{ y}^{-1} =$
 0.26 mm y^{-1}

Factor 3.7

Typical soil erosion
in the region:
 $5-10 \text{ t ha}^{-1} \text{ y}^{-1} =$
 $0.35-0.7 \text{ mm y}^{-1}$

Factor 5-10

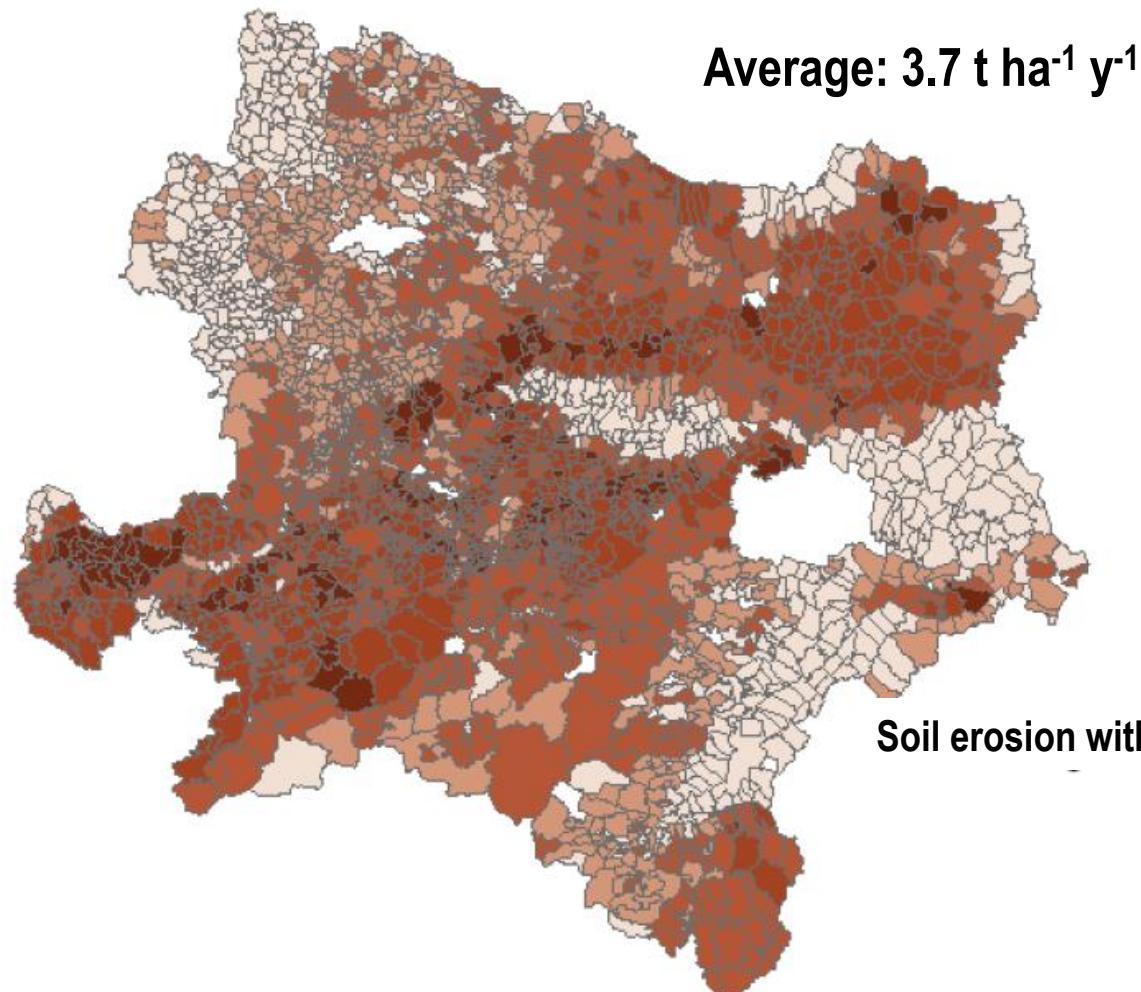
Phaeozem / Chernozem
Ziersdorf, Weinviertel, NÖ
Photo : W. Fitz 2011

Some examples – soil erosion



University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

BAW (2009)



Average soil erosion in
Lower Austria without
ÖPUL measures

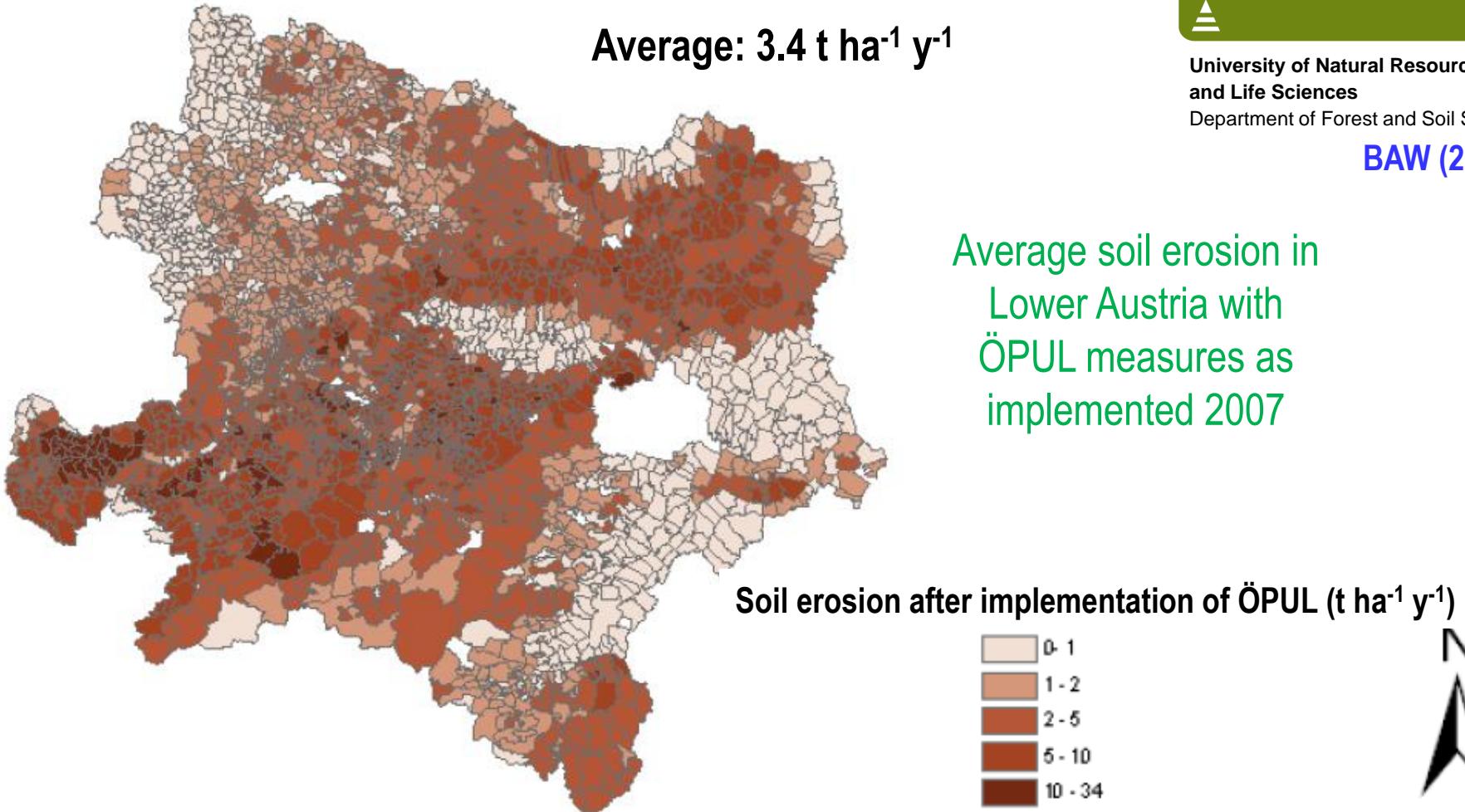


Some examples – soil erosion



University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

BAW (2009)



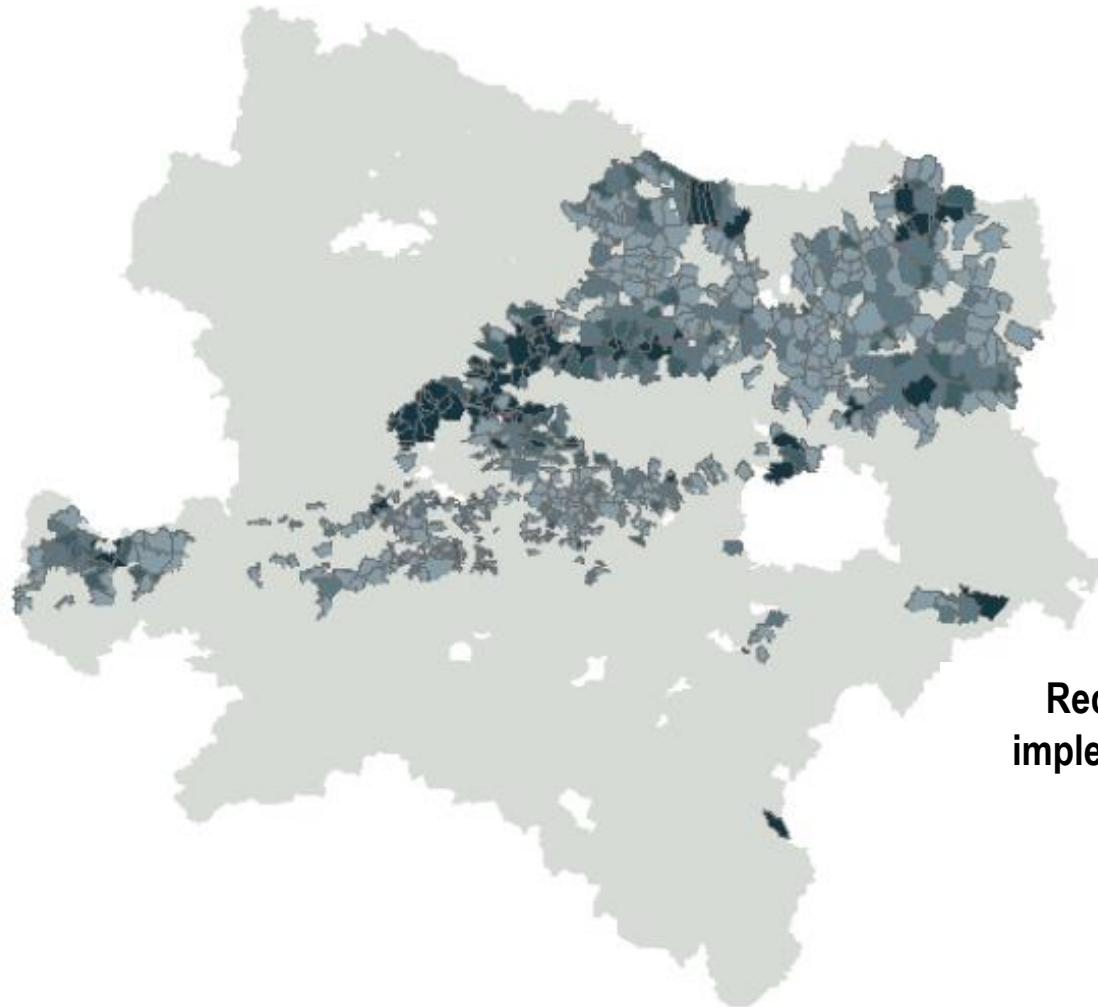
Some examples – soil erosion



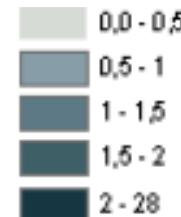
University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

BAW (2009)

Reduction of soil
erosion by ÖPUL
measures in Lower
Austria as implemented
2007



Reduction of soil erosion after
implementation of ÖPUL ($t \text{ ha}^{-1} \text{ y}^{-1}$)



Some examples – soil compaction



Photos: Wenzel (2006)



Some examples – soil compaction



University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

BAW & AGES (2010)

Aggregate quality in the plough pan in relation to ÖPUL measures

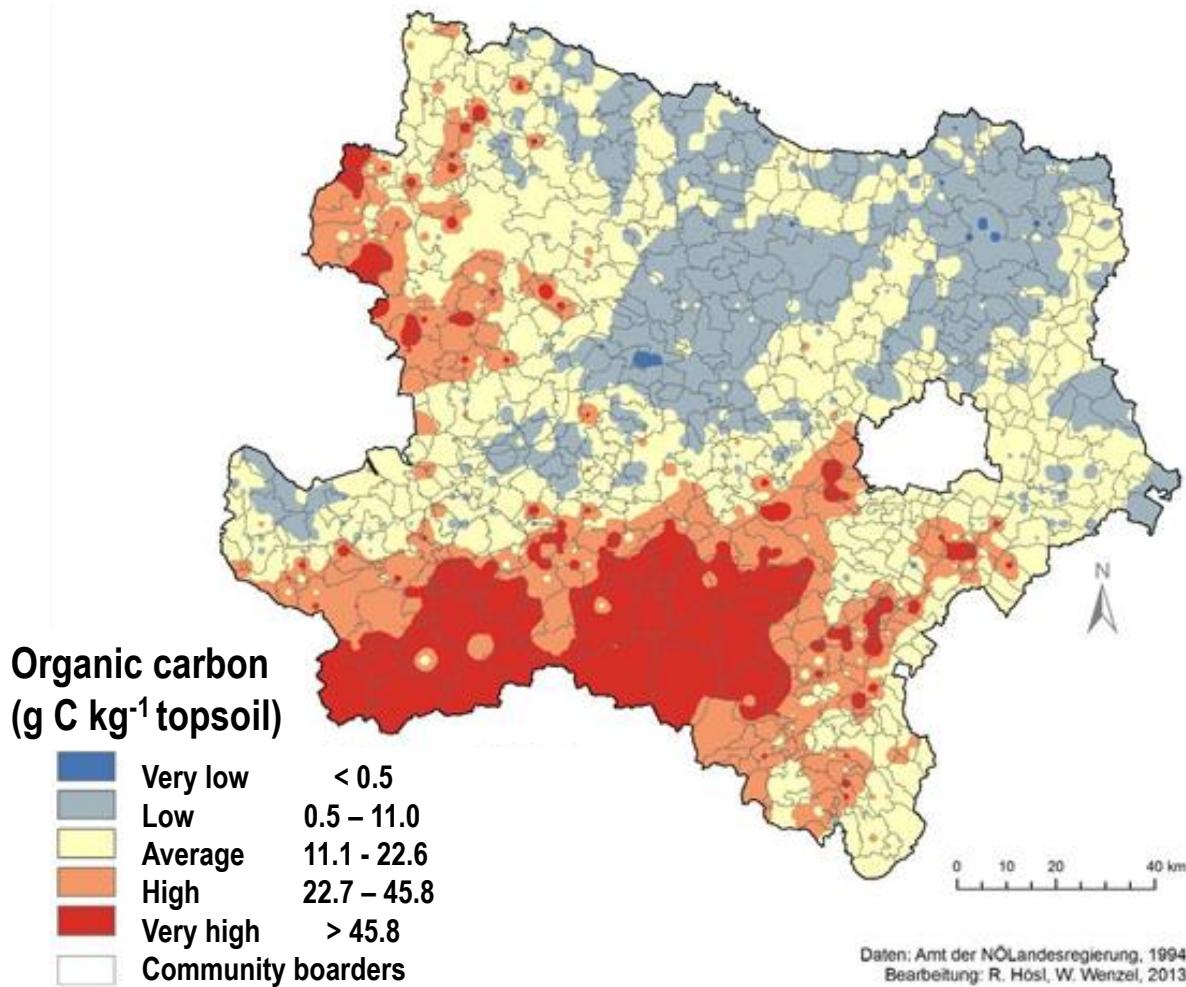
Aggregate quality	Investigated farms	Beet production	No till	Deep ploughing	Reduced till	Livestock farming	Corrected tire pressure
good	12	2	1	1	3	9	10
poor	7	5	1	1	4	6	4
critical	11	4	2	3	8	2	8

Some examples – organic matter



University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

Hösl & Wenzel (2013)
Lower Austrian Soil Report
(unpublished).

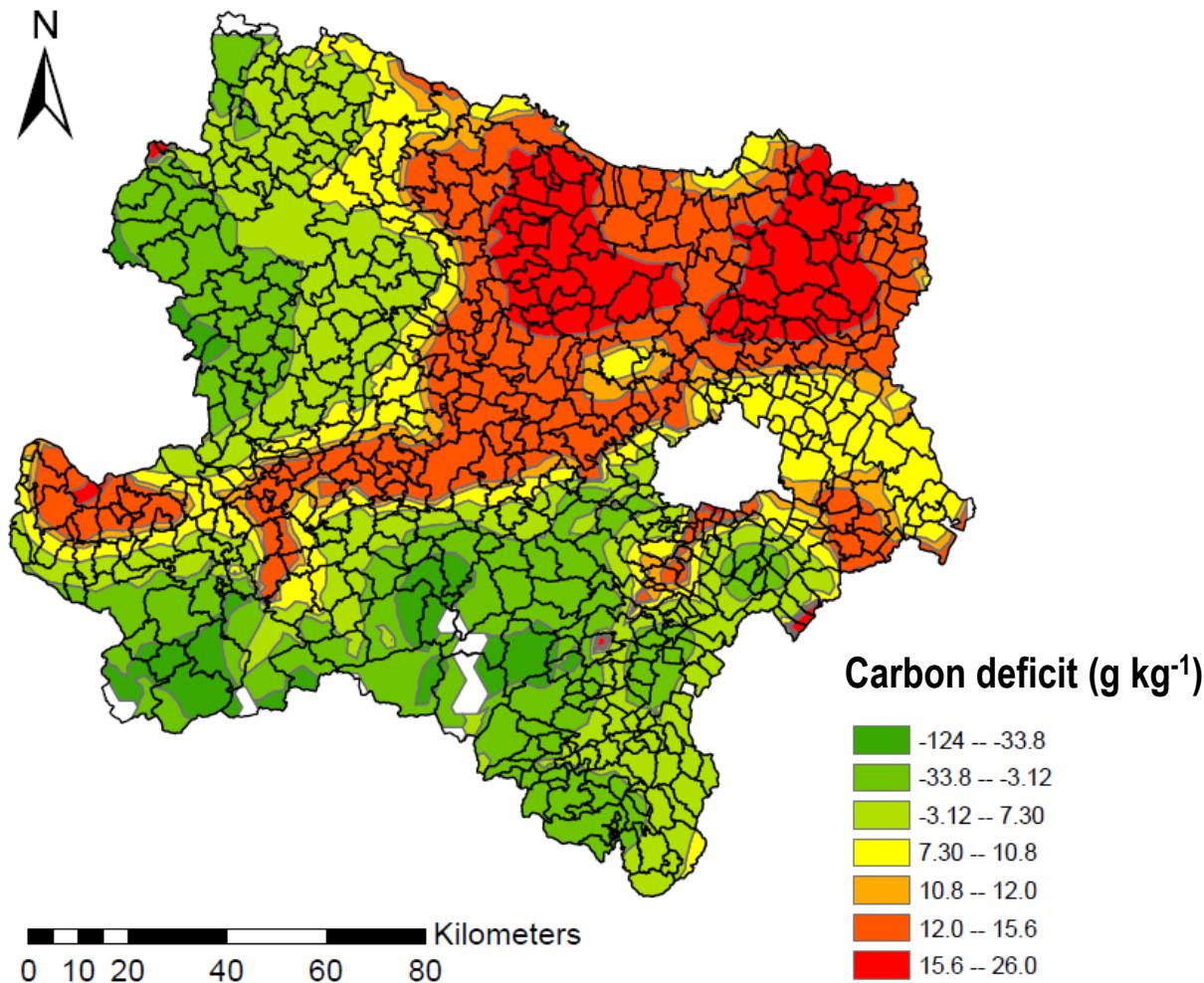


Some examples – organic matter



University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

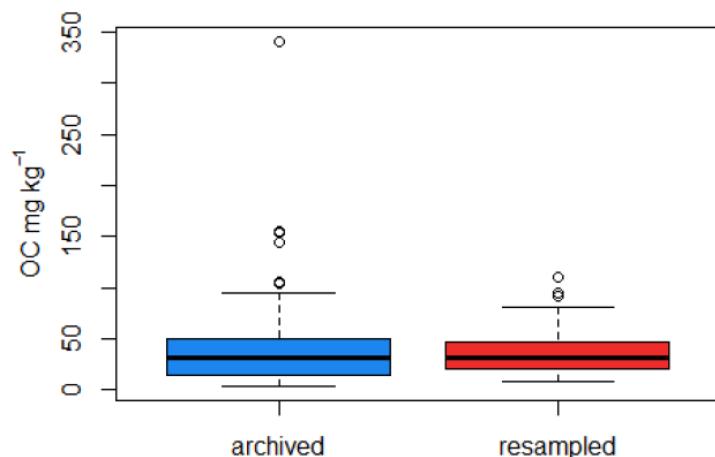
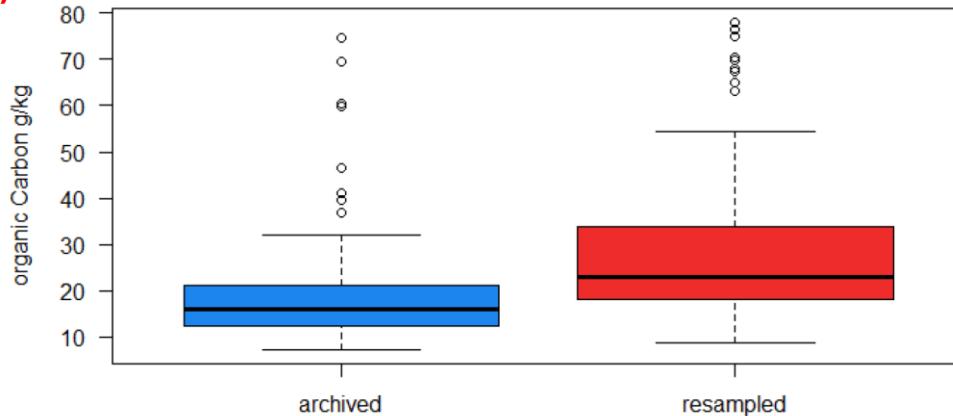
Gruber & Wenzel (2014)
(unpublished).



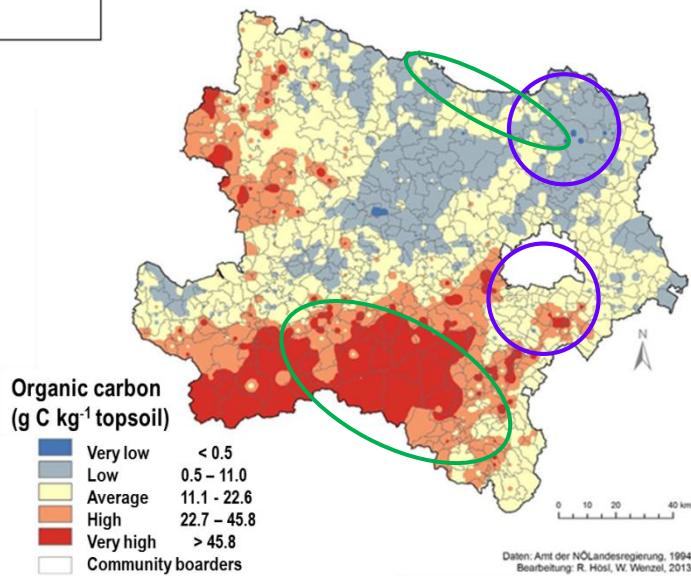
Some examples – organic matter



Organic carbon in intensively cultivated Phaeozems / Chernozems in Lower Austria increased considerably during the past 30-40 years
(CAP policy?)



	Mean	Median
Archived	19.5	16.1
Resampled	29.0	22.9
Change (%)	+48.9	+39.8



The 9th (and hidden) threat

Wasting calories



University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

<https://science.orf.at/stories/2959122/>

ORF SCIENCE NEWS 17.01.2019

Forscher fordern „Planetendiät“

In 30 Jahren werden nach Schätzungen bereits zehn Milliarden Menschen leben. Laut neuer Analyse könnten sie sich alle gesund ernähren und dabei Umwelt und Klima schonen. Voraussetzung: Die Ernährung stellt sich weltweit um, wie nun Forscher fordern.

The 9th (and most important) threat

Wasting calories



Healthy reference diet (2500 kcal/day)	Macro-nutrients (g/day)	Energy (kcal/Tag)
Cereals (rice, maize, wheat etc.)	232	811
Potatoes & manioc (= starchy vegetables)	50	39
Vegetables	300	78
Fruits	200	126
Dairy products	250	153
Proteins		
Meat	43	92
Eggs	13	19
Fish, sea food	28	40
Legumes & pea nuts	100	426
Nuts	25	149
Fat additives (excluding milk fat)	52	450
Sugar additives	31	120

Data source: Willet et al. (2019): Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. The Lancet Commissions. Published online January 16, 2019 [http://dx.doi.org/10.1016/S0140-6736\(18\)31788-4](http://dx.doi.org/10.1016/S0140-6736(18)31788-4)

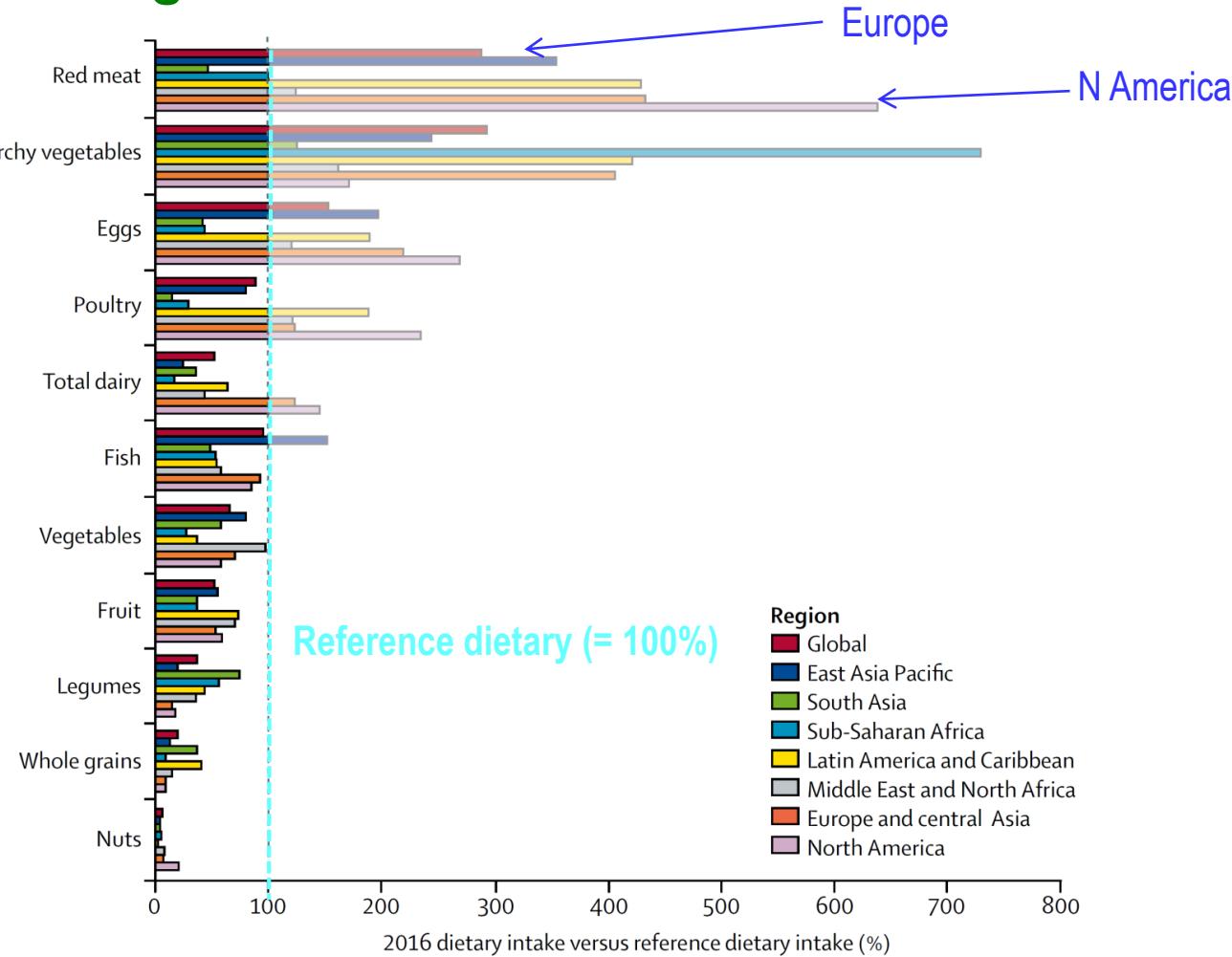
The 9th (and most important) threat

Wasting calories



University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

Willet et al. (2019): Food in the
Anthropocene: the EAT–Lancet
Commission on healthy diets from
sustainable food systems. The Lancet
Commissions. Published online January 16,
2019 [http://dx.doi.org/10.1016/S0140-
6736\(18\)31788-4](http://dx.doi.org/10.1016/S0140-
6736(18)31788-4)



The 9th (and most important) threat

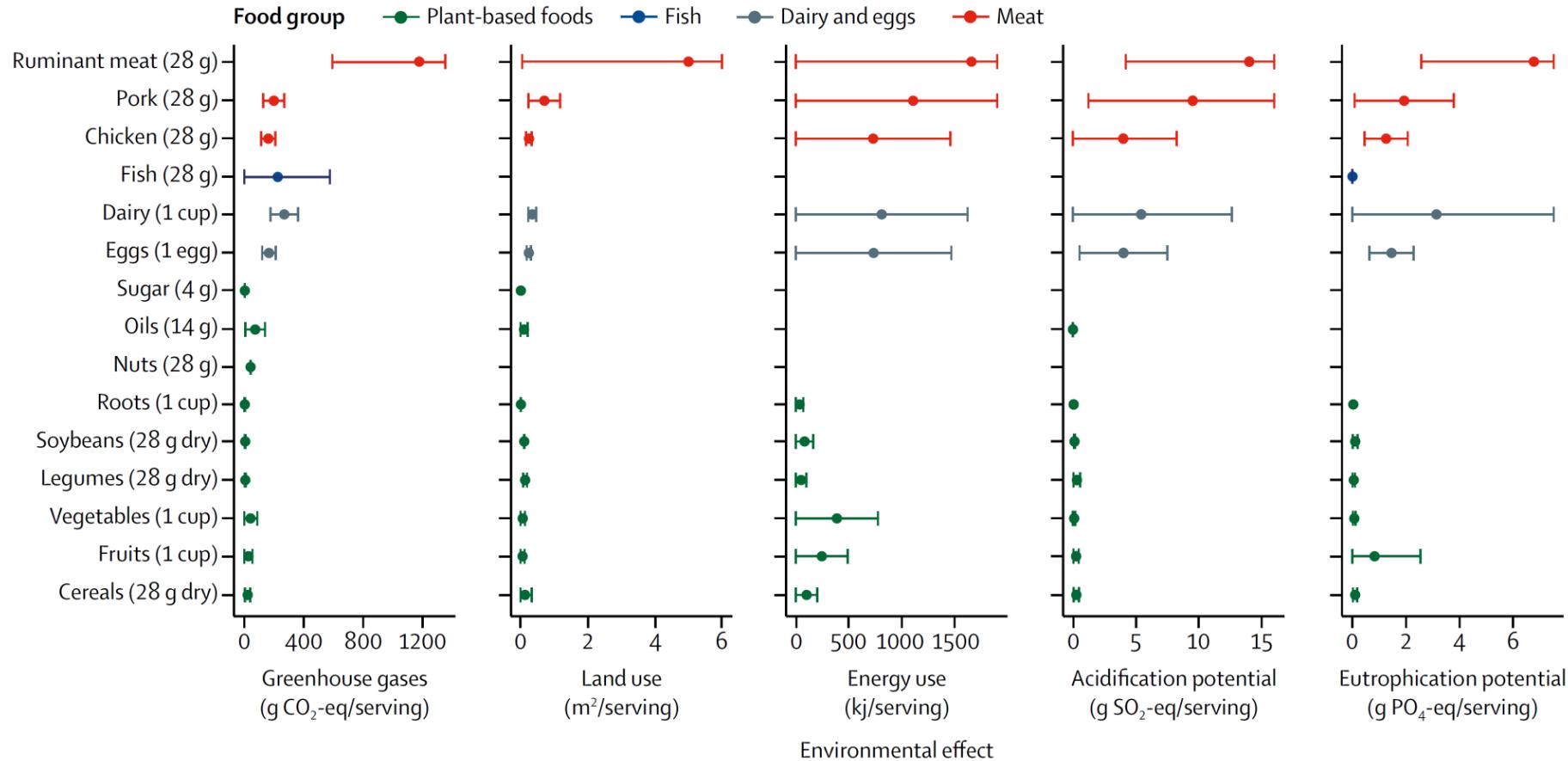
Wasting calories



Willet et al. (2019): Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. The Lancet Commissions. Published online January 16, 2019
[http://dx.doi.org/10.1016/S0140-6736\(18\)31788-4](http://dx.doi.org/10.1016/S0140-6736(18)31788-4)



University of Natural Resources



The 9th (and most important) threat

Wasting calories



University of Natural Resources
and Life Sciences

Department of Forest and Soil Sciences

Statistik Austria

• Agricultural land use in Austria

- Cultivated soils: 1.36 Mio. ha
- Intensively used permanent grassland: 0.56 Mio. ha
- Extensive permanent grassland: 0.73 Mio. ha
- Other crops: 0.067 ha

- Total agricultural area: 2.71 Mio. ha
- Forest: 4 Mio. ha
- Total land area of Austria: 8.39 Mio. ha

The 9th (and most important) threat

Wasting calories

Land use and food consumption (Austria)

- **Area grown per capita (2002-2006)**
 - Cultivated: 1520 m²
 - Grassland: 2190 m²
 - Fruit plantations: 20 m²
 - Vegetarian food 12%
 - Animal-based food 84%
 - Renewables 4%
- **„Import / export of soil per capita**
 - Cultivated: Import 405 m²
 - Grassland: Export 455 m²
 - e.g. soy cake: 505.000 t / year



University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

Zessner et al. . 2011. Ernährung
und Flächennutzung in Österreich.
ÖWAW 5-6/2011: 95-104.

Total consumption:

- Sum: 3700 m²
- Cultivated: 1970 m²
- Grassland: 1730 m²

The 9th (and most important) threat

Wasting calories

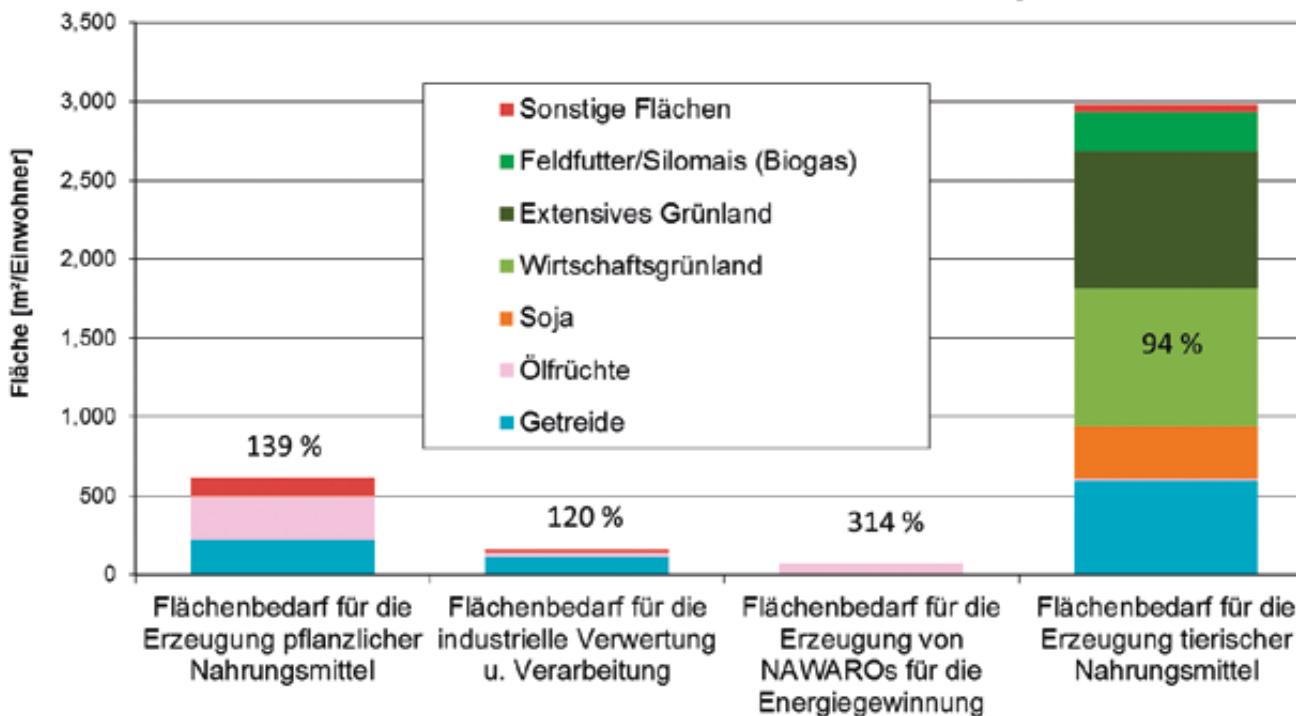
Area required for self-sufficiency in Austria

(based on current food consumption)

Eigenversorgung; konventionelle Bewirtschaftung; Nutzung freier Flächen zur Energiegewinnung (alle Flächen ausser extensives Grünland)

Flächennutzung in Relation zur Flächennutzung im Referenzzustand (2001-2006)

129 % der Acker- und 80 % der Grünlandflächen werden benötigt



University of Natural Resources
and Life Sciences

Department of Forest and Soil Sciences

Zessner et al. . 2011. Ernährung
und Flächennutzung in Österreich.

ÖWAW 5-6/2011: 95-104.

The 9th (and most important) threat

Wasting calories



Area required for self-sufficiency in Austria
(Current situation versus Szenario 1 – recommended nutrition)

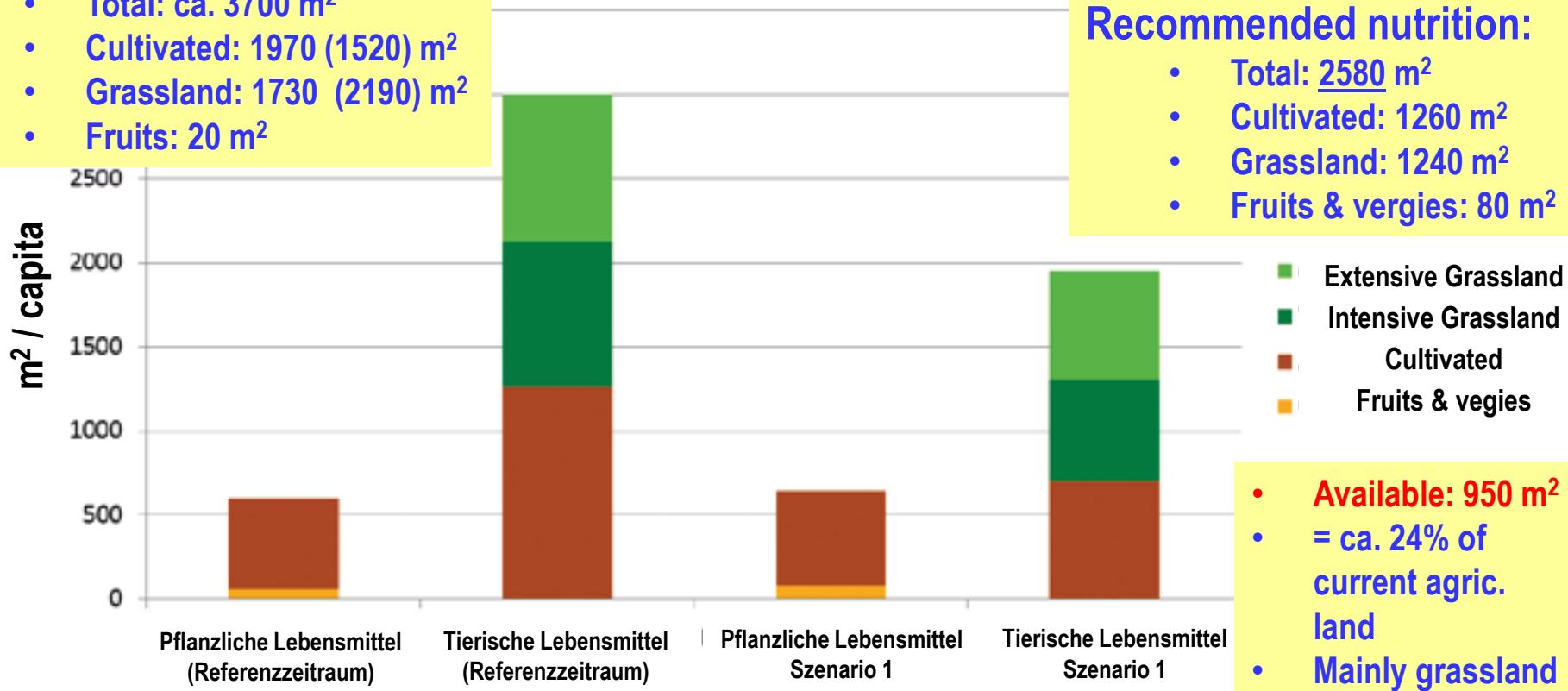
Zessner et al. . 2011. Ernährung und Flächennutzung in Österreich.
ÖWAW 5-6/2011: 95-104.



University of Natural Resources and Life Sciences
Department of Forest and Soil Sciences

Status quo:

- Total: ca. 3700 m²
- Cultivated: 1970 (1520) m²
- Grassland: 1730 (2190) m²
- Fruits: 20 m²



Effective solutions



Westhoek et al. (2014), Global
Environmental Change 26: 196-
205



University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

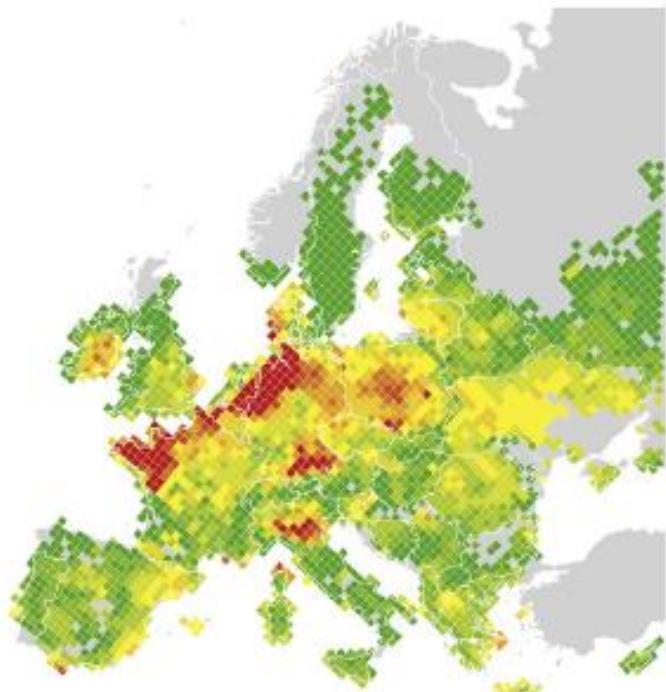
Halving the production of meat, eggs and dairy production in Europe.....

-40% reduction in nitrogen emissions
-25-40% reduction in greenhouse gas emissions
-23% per capita decrease in cropland use for food production
-enhance human health (40% reduction of intake of saturated fat)
-soymeal use reduced by 75%
-nitrogen use efficiency in food system would increase from 18% to 41-47%

Effective solutions



Reference, 2009



Alternative diet (minus 50% meat and dairy)



University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

Westhoek et al. (2014), Global
Environmental Change 26: 196-205

Equivalents nitrogen per hectare and year



Fig. 4. Annual exceedance of the critical load for N deposition in $N\text{ ha}^{-1}$ for natural ecosystems, under the reference scenario and the 50% less meat and dairy alternative diet under the *high prices* land-use scenario.

Effective solutions



University of Natural Resources
and Life Sciences



Effective solutions



- Reduce animal-based diet considerably
- Taking pressure from soil:
 - Extensify land use
 - Release soil / land for other purposes
- Expected effects:
 - Improved soil properties
 - Enhanced biodiversity
 - Restore multiple functions / services
- Enhanced resilience of food systems
 - Increased redundancy / transformability
 - Preparedness for crisis
 - Contribution to feed the world



University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences

Effective solutions



- Focus of Agro-Environmental Programme
 - Increase participation
 - Emphasis on most effective measures
 - Direct money to key issues
 - Limited feed production on cultivated land

University of Natural Resources
and Life Sciences
Department of Forest and Soil Sciences