Adressing old problems with new (bio)fuels

Taking on agronomic issues while solving Climate Change

BioMob#3

Hans Langeveld and Asher Lazarus
Biomass Research
11 January 2024

Contents

- Old and new targets
- Sustainability issues
- Adjusting cropping patterns
- Water pollution
- Soil erosion
- Conclusion

biomass research

Asher Lazarus

- Junior consultant at Biomass Research

- Background in International Agricultural Development (BSc, UC Davis) and Climate Studies (MSc, Wageningen University)

- Experienced in quantitative and qualitative research methods for topics in agriculture and the environment

biomass research

Hans Langeveld

- Wageningen University
  - Crop production, soil sciences, animal production, development economics
- Academia
  - Centre for World Food Studies; Plant Research International (WUR)
- Biomass Research
  - IEA Bioenergy; DG Agri; CBE JU; Ministry of Agriculture; Friends of the Earth; RVO ABC
- Policy:
  - Ministry of Agriculture; Province of Flevoland; IPO / BIJ12

Published: October 1995

Estimating nutrient surplus and nutrient use efficiency from farm characteristics

An application to private farms in two districts in Poland

Tabel 1b. Streefwaarden voor nutriënten binnen 'Telen met toekomst', kwantitatief

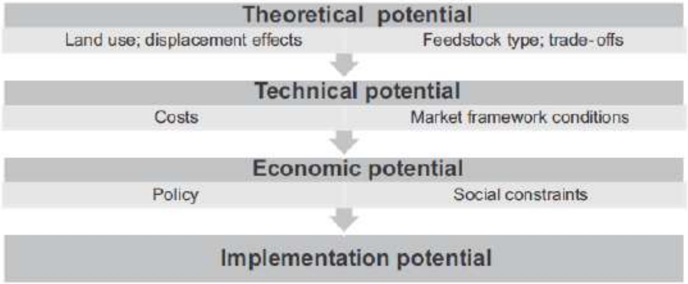
	Parameter	Eenheid	Voorloperbedrijven	Kernbedrijven
A	Totaal P in grondwater (zand)	mg P/l	-	0,4
	(veen en klei)	mg P/l	-	3,0
B	Totaal P in zoet opp.water	mg P/l	0,15	0,05
C	Nitraatconcentratie grondwater	mg N/l	11,3	5,6
D	Totaal N in oppervlaktewater	mg N/l	2,2	1
E	NH3-vervluchtiging	kg N/ha per jr	15	5

biomass research

New targets

- Chemical industry ..
- Materials ..
- Air France-KLM 2030 target: 10% SAF (sustainable aviation fuel)
- World’s largest SAF user in 2022, using 17% of global supply (0.6% incorporation)

Availability: S2Biom



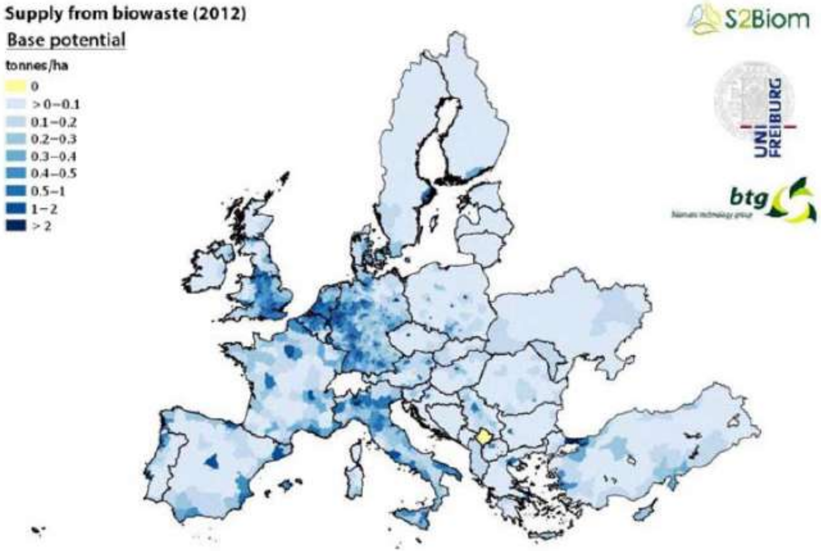


FIGURE 8.3 Regional distribution of the production of bio-waste production in 2012. *Dees, M., Datta, P., Höhl, M., Fitzgerald, J., Verkerk, H., Zudin, S., et al., 2017. Atlas with regional cost supply biomass potentials, Version 1.1. Deliverable D1.4 of the S2Biom project, grant agreement no. 608622.*

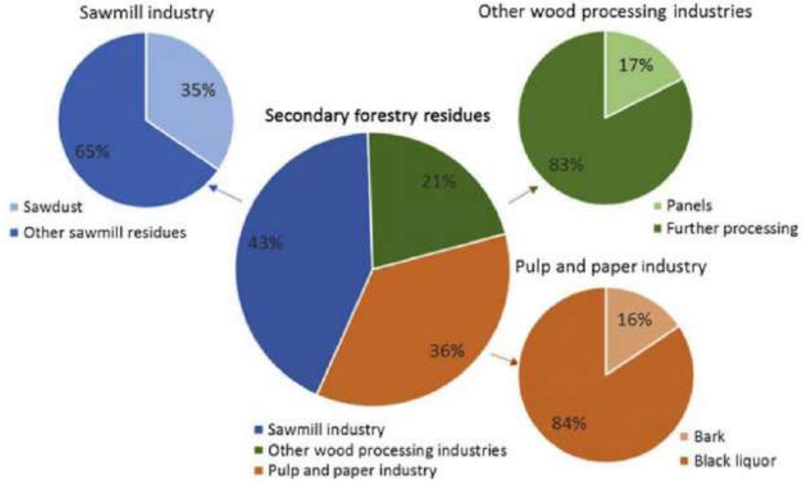


FIGURE 6.8 Supply from secondary forestry residues by major category—base potentials for all EU countries (2012).

Issues

- Availability: food vs fuel
- Indirect land use change
- Sustainability
- GHG emission reduction

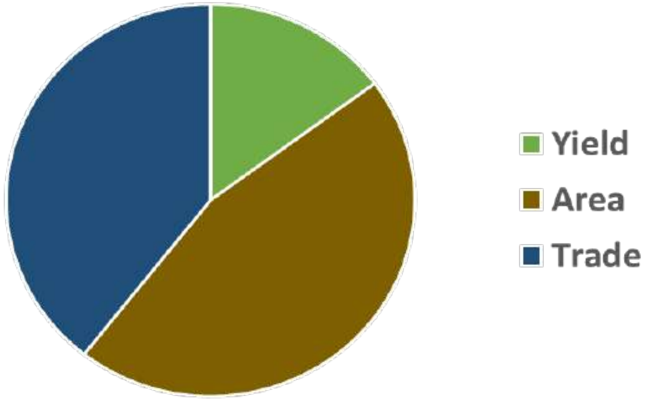
WORLD RESOURCES INSTITUTE | Insights
Most Recent Podcasts News All Insights
DONATE

Under New Guidance, "Sustainable" Aviation Fuel in the US Could Be Anything But

biomass research

Searchinger et al.(2008)

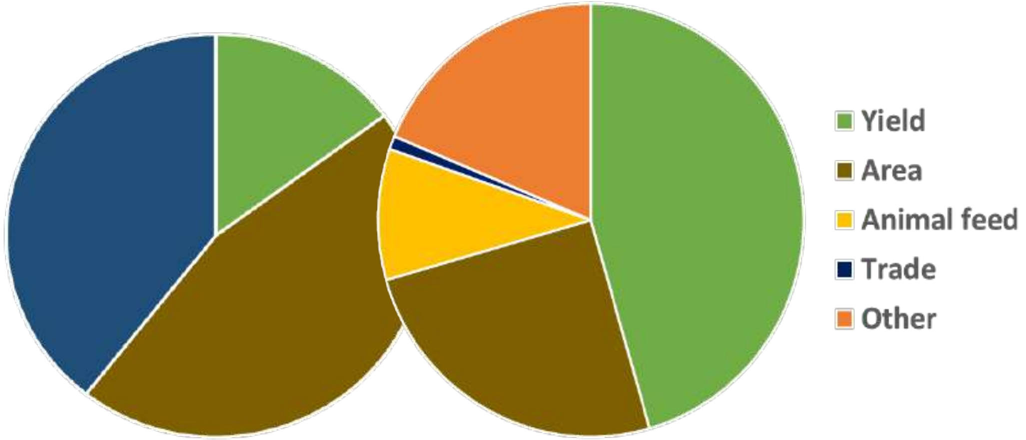
- Trade and market response narrative
- Driver: policy => increased demand
- Price effects => drop in exports
- Land effects in Brazil



Main results	Searchinger et al. (2008)
U.S. corn ethanol production	Additional corn demand is 138 million tonnes; only 20% of which is covered by yield improvement. Corn area increases with 8.5 million ha. Increased ethanol production requires additional 12.8 million ha U.S. cropland
Crop prices, livestock	Increase of domestic prices with 62% by 2015
U.S. trade	Decline in exports (corn: -62%, wheat: -31%, soybeans: -28%, pork: -18%, chicken: -12%)
Brazil	increasing crop cultivation; conversion of 10.8 million ha of land: China and India (2.3 million ha), Brazil (2.8 million ha) and Africa (0.8 million ha)

Statistics (2005-2015)

- Increased demand but also supply (DDGS)
- Price fluctuations, but no drop in exports
- Land effects in Brazil but no link



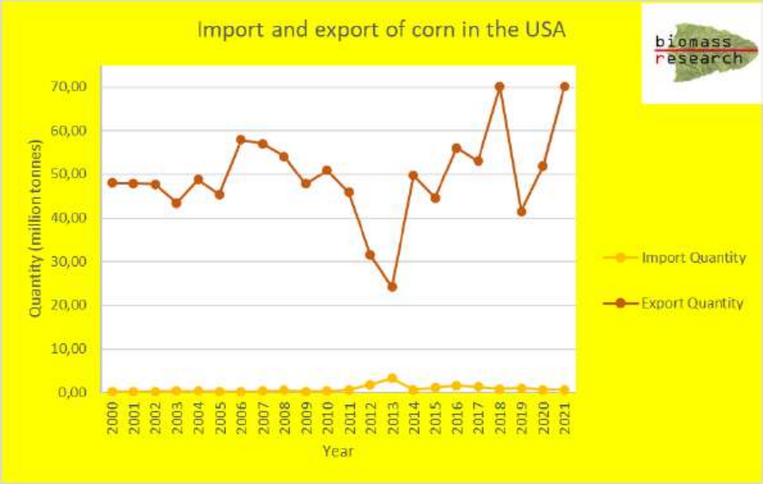
Main results	Statitstics
U.S. corn ethanol production	Increase in corn use by 92 million tonnes.
Crop prices, livestock	Corn price went up by 75% Corn feed use declined by 20 million tonnes but DDGS output increased by 29 million tonnes (feed availability increased by 9 mln tonnes)
U.S. trade	Corn export declined with 0.7 million tonne.
Brazil	Corn production has gone up by 50 million tonnes.

Langeveld et al. (2022) . IEA Bioenergy

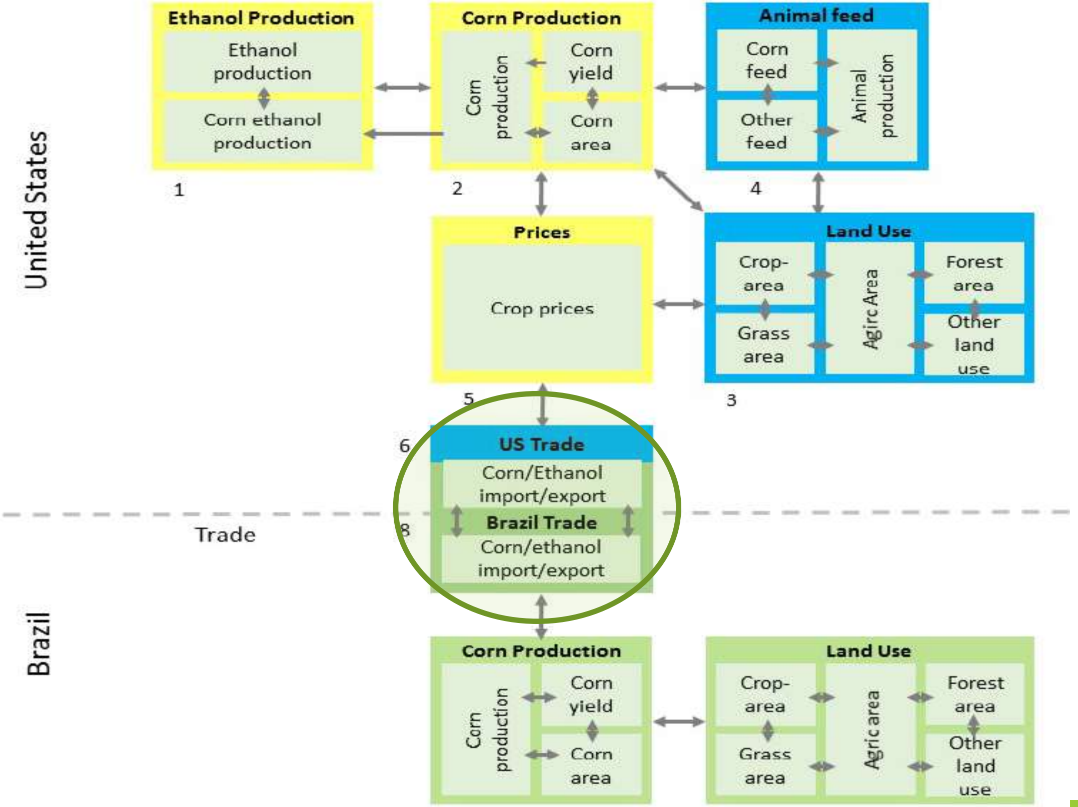
Analytical framework

- Global trade = transfer
- No change in trade

-> No transfer

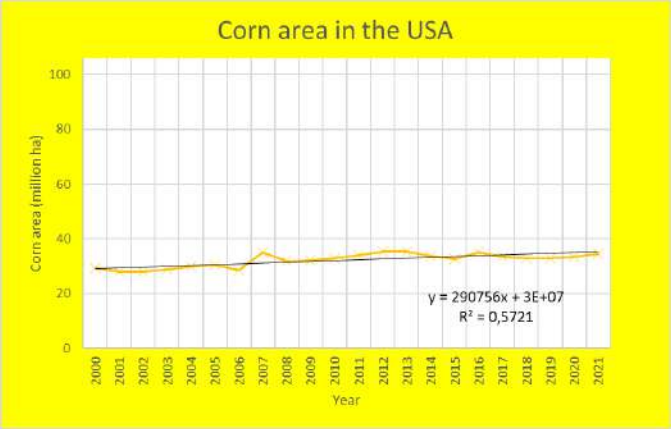


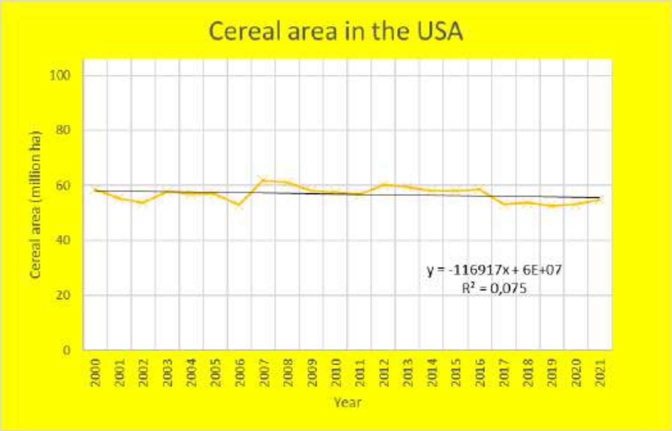
Source: FAOSTAT



Source: Langeveld etal. (2022) IEA Bioenergy

Data (2000-2021)

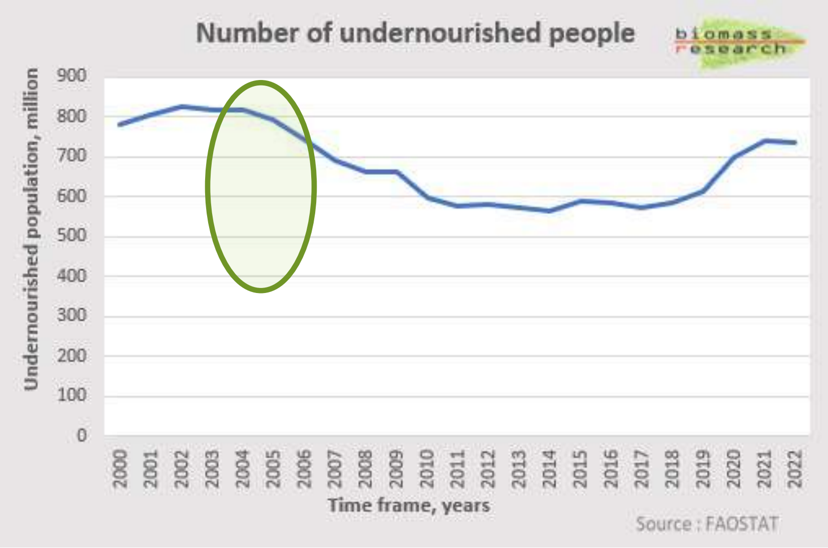




Corn area increases but cereal area is declining
No lasting effect on corn exports
Cereal output per ha is increasing

Langeveld et al. (2014) *Land use, crop management and impacts of biofuel production.* Routledge

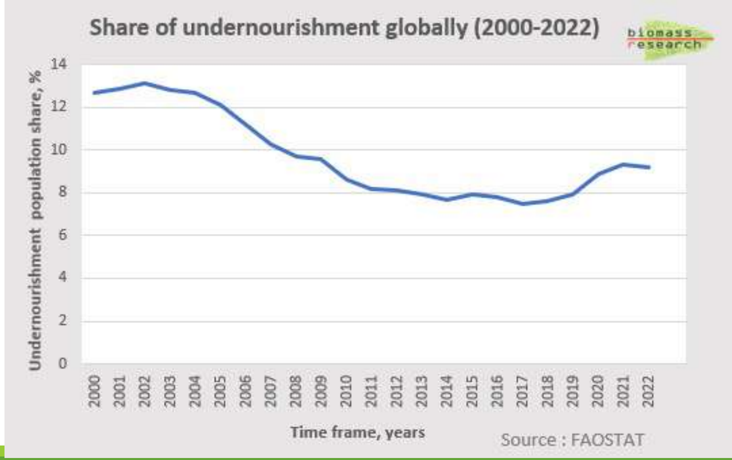
Food vs Fuels



Since introduction of major biofuel targets in 2005:

- Number of undernourished has declined
- Share of undernourished dropped from 12 to 9%

Food vs fuel??!



Streetlight effect

From Wikipedia, the free encyclopedia

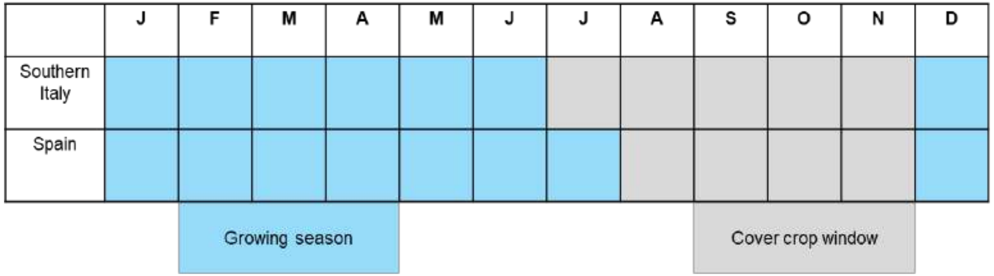
The **streetlight effect** is a type of observational bias where people only look for whatever they are searching by looking where it is easiest.[1][2][3]

Adressing real problems

Major problems in crop production and agriculture

- Water pollution
- Soil erosion

Can we address them with new fuels??!



Cropping calendars for wheat in Southern Italy and Spain, where fallow periods offer the opportunity for (biofuel) cover crops

Water pollution

(Oilseed) cover crops reduce water pollution as compared to bare soil

- Plant stores available nutrients (released the following season)
- Less nutrients are available for loss via leaching and runoff
- Cover delays the onset and intensity of runoff (10-98% reduction in runoff volume)

Blanco-Canquí (2018) https://westerncovercrops.org/

Soil erosion

Erosion in Italy is estimated to cost **€619 million per year** in productivity losses

Cover crops proven to reduce erosion

- Cover reduces impact of water and wind
- Roots hold soil in place
- Increased soil organic matter has long-term effects on erodibility

Effect of a winter cover crop on a Nebraska field

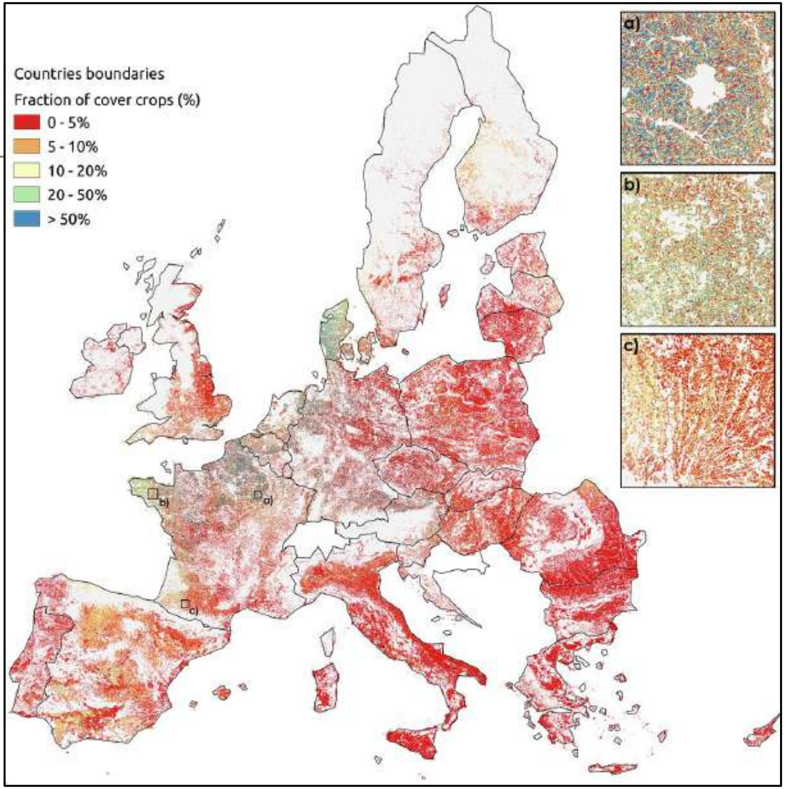
Panagos et al. (2016)

Soil erosion

Still, cover crops are scarce in some of the regions hardest hit by erosion

The prevalence of cover crops, as indicated by the likelihood of their presence in arable land pixels, is:

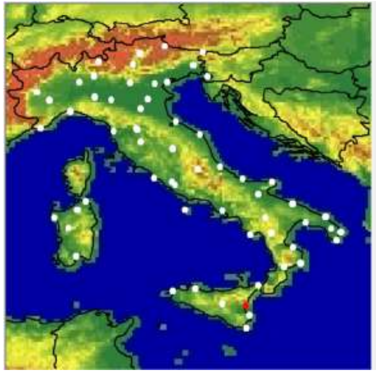
- Castilla la Mancha, Spain: <1%
- Sicily: 0%
- Netherlands: 31%

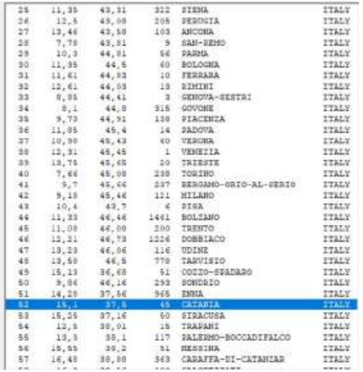


Satellite-based modelling reflects a low prevalence of cover crops in Southern Europe

Satellite data and groundwork

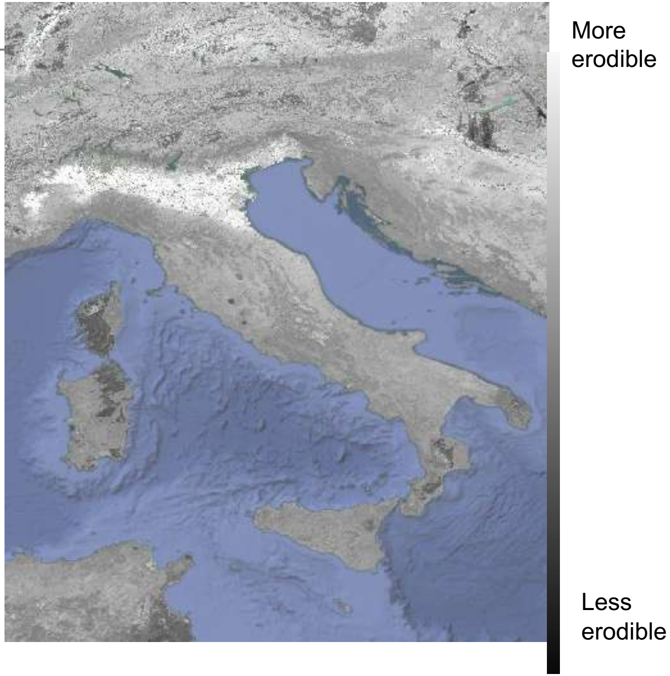
Link local soil, weather and crop production





25	11,35	43,31	322	SIENA	ITALY
26	12,5	43,08	205	PERUGIA	ITALY
27	13,46	43,58	103	ANCONA	ITALY
28	7,78	43,81	9	SAN-REMO	ITALY
29	10,3	44,81	56	PARMA	ITALY
30	11,35	44,5	60	BOLOGNA	ITALY
31	11,61	44,83	10	FERRARA	ITALY
32	12,61	44,03	13	RIMINI	ITALY
33	8,85	44,41	3	GENOVA-SESTRI	ITALY
34	8,1	44,8	315	GOVONE	ITALY
35	9,73	44,91	138	PIACENZA	ITALY
36	11,85	45,4	14	PADOVA	ITALY
37	10,90	45,43	60	VERONA	ITALY
38	12,31	45,45	1	VENEZIA	ITALY
39	13,75	45,65	20	TRIESTE	ITALY
40	7,66	45,08	238	TORINO	ITALY
41	9,7	45,66	237	BERGAMO-ORIO-AL-SERIO	ITALY
42	9,18	45,46	121	MILANO	ITALY
43	10,4	43,7	6	PISA	ITALY
44	11,33	46,46	1461	BOLZANO	ITALY
45	11,08	46,08	200	TRENTO	ITALY
46	12,21	46,73	1226	DOBBIACO	ITALY
47	13,23	46,06	116	UDINE	ITALY
48	13,58	46,5	778	TARVISIO	ITALY
49	15,13	36,68	51	COZZO-SPADARO	ITALY
50	9,86	46,16	253	SONDRIO	ITALY
51	14,28	37,56	965	ENNA	ITALY
52	15,1	37,5	45	CATANIA	ITALY
53	15,25	37,16	60	SIRACUSA	ITALY
54	12,5	38,01	15	TRAPANI	ITALY
55	13,3	38,1	117	PALERMO-BOCCADIFALCO	ITALY
56	15,55	38,2	51	MESSINA	ITALY
57	16,48	38,88	363	CARAFFA-DI-CATANZAR	ITALY

A list of weather stations in Italy (CLIMWAT)



Soil erodibility based on texture and organic matter content

RUSLE

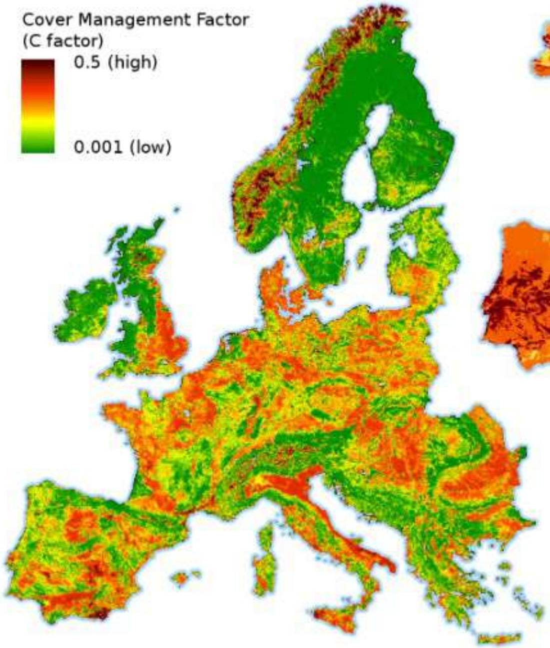
Bosco & de Rigo (2013) mapped individual RUSLE factors across Europe

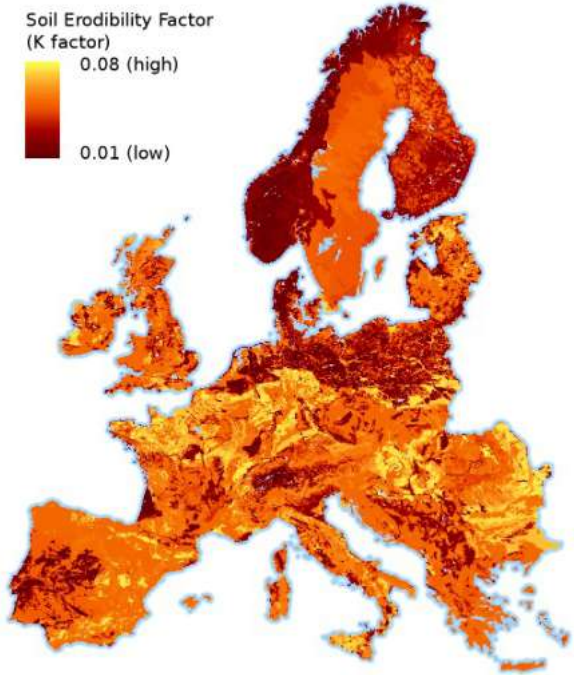
C factor based on

- Percent soil coverage
- Fraction of year of each covera stage

K factor based on

- Soil texture
- Soil organic matter





K (erodibility) factor in RUSLE

Using rUSLE, we see organic fertilizers could **increase soil organic matter** content from 2.3% to 2.4%, we see a **decrease in erosion** via the K factor.

Assuming constants for other values of the RUSLE, this small increase in soil organic matter (SOM) can reduce annual erosion by 1.77%, meaning a **19% reduction over 10 years**.

The introduction of a cover crop is also proven to increase soil organic matter

Increasing SOM, from introduction of a cover crop, has **environmental and monetary value**.

Discusion

- New targets, old issues
- No food vs fuel
- Indirect land use change cannot be demonstrated
- More agronomic work is needed
  - Cropping systems analysis: windows of opportunity
  - Soil and water issues
  - TRL 8 or 9

Conclusion

- Old issues : a huge trap
- More groundwork is needed
- Quantified data are called for
- Let’s get going

Let’s work together!

Hans Langeveld

hans@biomassresearch.eu

Linkedin.com/in/hans-langeveld-68432011

Asher Lazarus

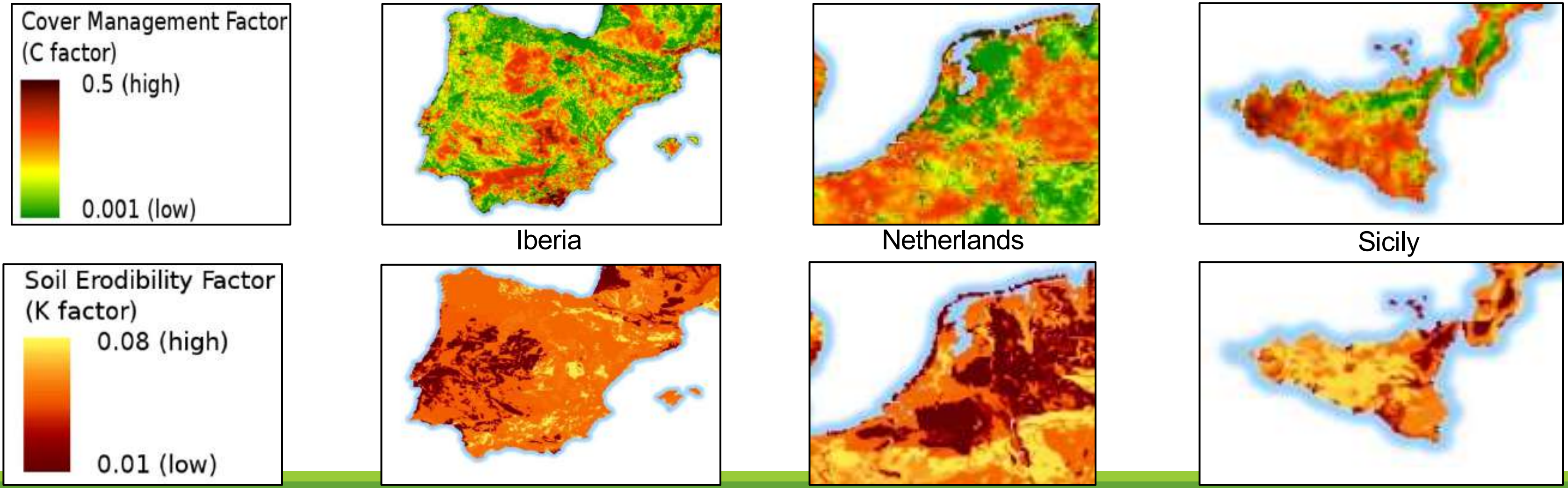
asher@biomassresearch.eu

Linkedin.com/in/asherlazarus

Soil erosion

Erosion largely determined by cover and organic matter (organic matter reduces erodibility, K)

Higher C, K = more erosion



Safe residue removal

- Removal is net result of
  - Nutrient removal
  - Soil OM replenishment
- Safe removal rate depends on
  - **Current SOM concentration** -> 2% mineralisation
  - Residue yield (ton/ha)
  - Share of EOM in residues
  - **Soil texture** -> clay

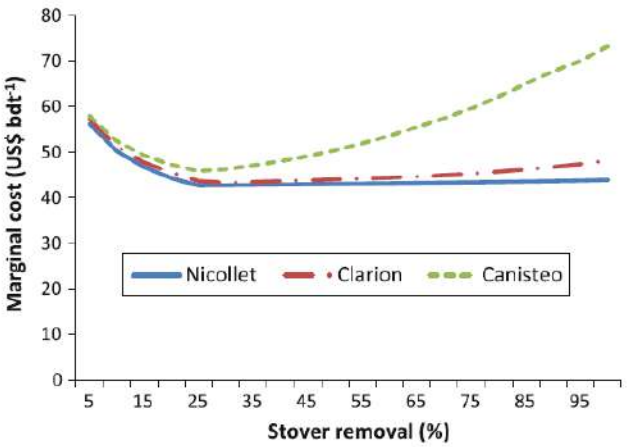


Fig. 3 Total marginal cost of corn stover removal by soil type in Palo Alto County, Iowa (including the costs of soil erosion, nutrient loss, and stover harvesting)

biomass research

Gan et al. (2014) *An Agent-Based Modeling Approach for Determining Corn Stover Removal Rate and Transboundary Effects Environmental Management (2014) 53:333–342.*

SOM replenishment

- SOM concentrations vary
  - Depend on moisture, temperature and supply
- Depletion is estimated at 2% loss per year
- Safe removal rate depends on
  - Current SOM concentration
  - Residue yield (ton/ha)
  - Share of EOM in residues
  - Soil texture

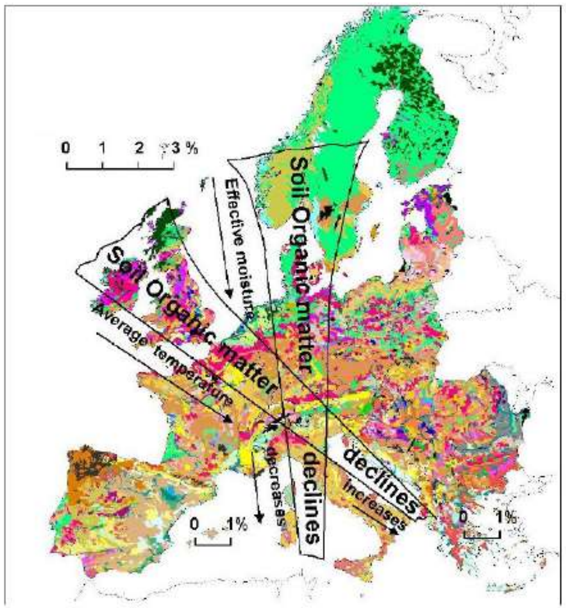


Figure 1 *Influence of temperature and moisture on soil organic matter content in Europe*

Rusco et al. (2021) *Organic matter in the soils of Europe: present status and future trends.* European Soil Bureay; JRC ISPRA