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Does the approach on weighting in the Swiss ecological scarcity method allow a consistent assessment? Normalization and grouping as influencing factors

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Normalization and weighting: The forgotten theme in LCA
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Who are we?

Dr Niels Jungbluth

Over 20 years of experience in life cycle assessment

Founded 1998 as an ETHZ spin-off

Christoph Meili

Clients from industry, NGOs, administration, universities

Own LCA database with more than 6‘000 datasets

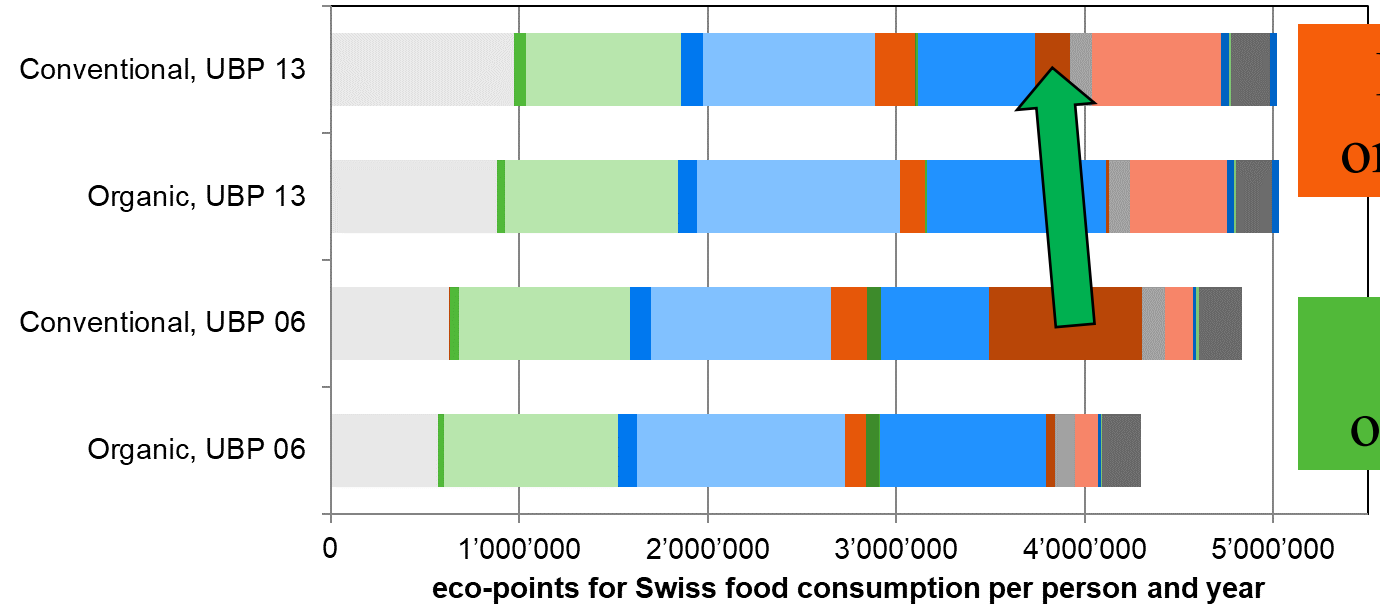
Background

- Update of the ecological scarcity method from version 2006 to 2013 (ES 2013)
- Presentation of applications on LCA DF54 without consideration of the agricultural sector
- Since then: observation of massive changes in the results for comparing conventional and organic food products

➢ What shall we recommend our customers regarding this important question?

➢ Which shortcomings of the ES 2013 can be identified by a thorough analysis?

Comparing average food consumption



Disadvantage organic by 0.2%

Advantage organic by 11%

climate change | ozone depletion | air, NMVOC
acidification | other air pollutants | air, heavy metals
water pollutants | water, heavy metals | water, radioactive
water, toxic hydrocarbons | soil, heavy metals | soil, plant protection products
resources, energy | resources, land | resources, mineral
resources, water use | waste | noise

- An overall advantage for organic diet turns to a disadvantage between 06 and 13
- Relevant changes in assessment of land use, pesticides and heavy metals in soils

Reason 1: Increased normalization factor

E.g. Plant protecting products (PPP) / pesticides

		UBP 2006		UBP 2013	Relative change
Normalization	t PPP-eq.	1'507	t glyphosate-eq.	8'241	547%
Actual flow	t PPP-eq.	1'577	t PPP-eq.	2'208	140%
Critical flow	t PPP-eq.	1'500	t PPP-eq.	1'995	133%
Weighting	-	1.11	-	1.22	110%
UBP factor	UBP/g PPP-eq.	737	UBP/g glyphosate-eq.	149	20%

Normalization: Sum of characterised amounts of PPP sold in Switzerland

- Higher normalization factor for plant protecting products (PPP) leads to a lower ecological scarcity-factor and therefore to lower relevance of pesticides!

Formula

$$Eco-factor = \underbrace{K}_{\substack{Characterization \\ (optional)}} \cdot \underbrace{\frac{1 \cdot UBP}{F_n}}_{Normalization} \cdot \underbrace{\left(\frac{F}{F_k}\right)^2}_{Weighting} \cdot \underbrace{c}_{constant}$$

K = *Characterization factor of an emission or resource*

F_n = *Normalization quantity (technical term: normalization flow): current annual quantity (emission or consumption), with Switzerland as the system boundary*

F = *Current quantity (technical term: current flow): current annual quantity (emission or consumption) in the reference area*

F_k = *Tolerance level (technical term: critical flow): statutory limit value in the reference region*

c = *Constant (10^{12}/a): serves to obtain readily representable numerical quantities*

UBP = *Eco-point: the unit of environmental impact assessed*

- Fundamental problem in the formula: A high current load (normalization) leads to lower eco-factors if tolerance levels are not adjusted simultaneously

Conclusions normalization

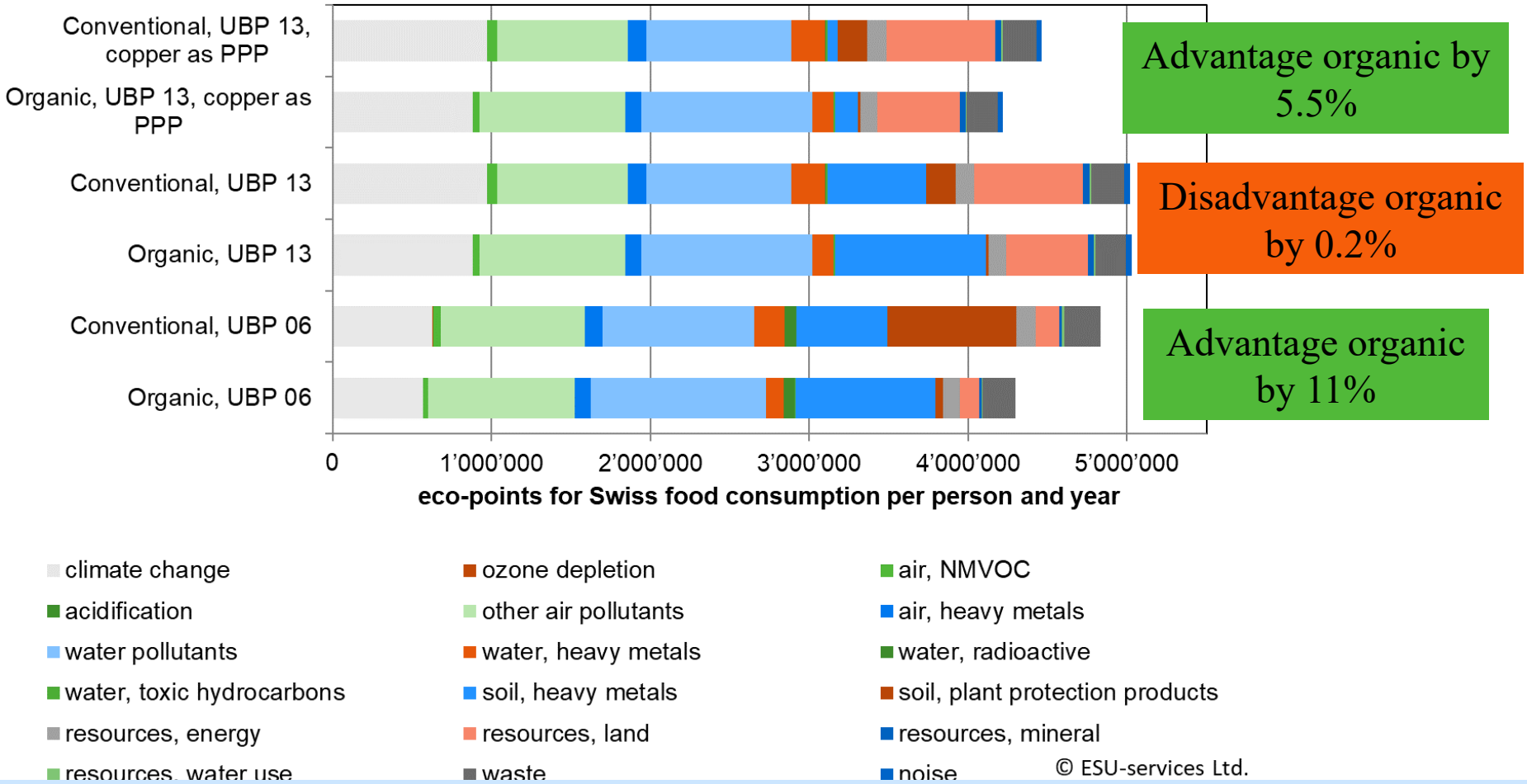
- More recent statistical evidence for normalization leads to plant protecting products being considered less severe
- Improvements lead to higher impacts while worsening situation is rewarded with lower impacts per emission
- Normalization and weighting should be adjusted together in each update (Would require fast policy changes!)

Reason 2: Grouping

		Copper as a pesticide		Copper as a single group (heavy metal)	Relative change
Normalization	t glyphosate-eq./a	8'241	t Cu/a	118	1%
Actual flow	t PPP-eq.	2'208	g Cu/(ha*a)	73	3%
Critical flow	t PPP-eq.	1'995	g Cu/(ha*a)	58	3%
Reduction target		-11%		-27%	249%
Weighting	-	1.22	-	1.60	131%
Characterisation	g glyphosate-eq./g	2.80			
UBP factor	UBP/g PPP-eq.	416	UBP/g Cu	13'572	3261%

- Reduction targets for copper twice as high as for plant protecting products
- Since the normalization amount for the single target is much smaller, the ecological scarcity factor increases 33-fold instead of 2.5-fold
- If substances are evaluated individually, the relevance increases massively compared to substance groups that must be reduced in total

Comparing average food consumption



- Including factor for copper in group of PPP leads to lower results for „soil, heavy metals“ and an overal advantage for organic diet

Conclusions grouping

- If assessed in a separate group, niche problems with small normalization factor, like copper as a heavy metal are getting a higher importance
- Copper therefore seems massively overrated compared to other pesticides
- With grouping there is an important influence on the final results
- Prohibited pesticides (critical flow =0) are not included in a separate category.

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Thank you very much for your attention!

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