Dioxins and dioxin-like PCBs entering the food chain and the need for lower “low POP content” and unintentional trace limits for fertilizers and biosolids

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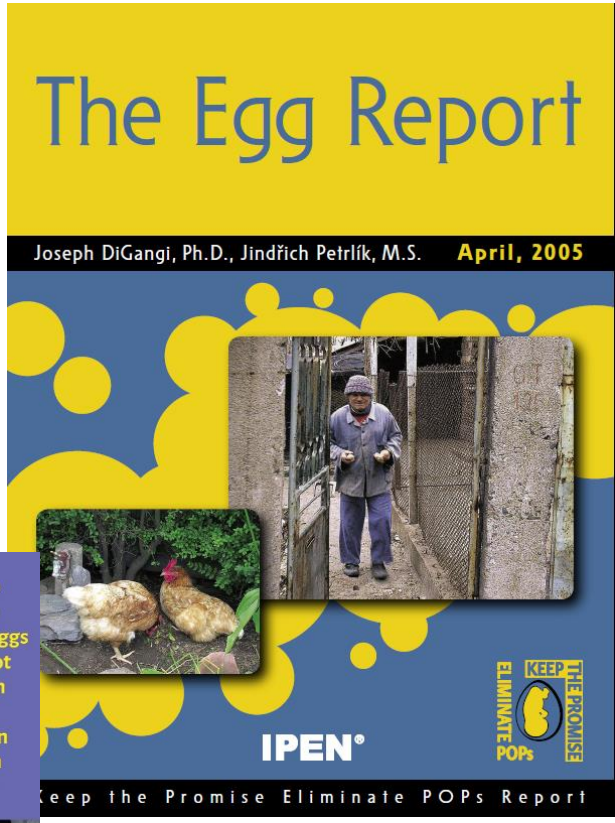
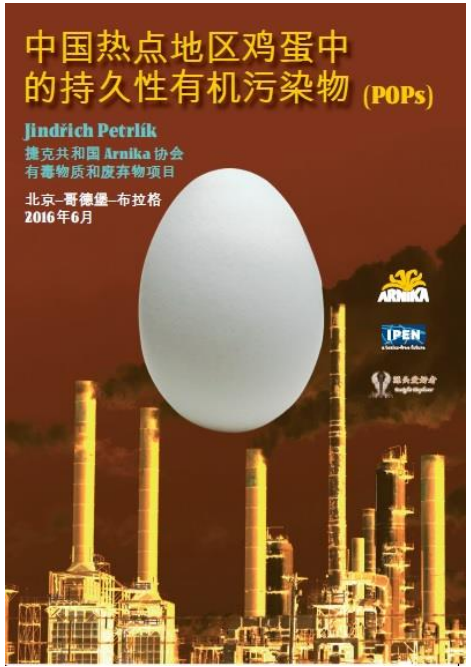
Eggs as exposure pathway of PCDD/F & PCB from contaminated soil

- Free-range eggs are sensitive indicators for PCDD/F and PCB contamination in soils and eggs are an important exposure pathway from polluted soils to humans.
- Chickens and eggs are therefore ideal “active samplers” and indicator species for Dioxin & PCB contaminated soils.
- Since the beginning of the Stockholm Convention the International Pollutants (POPs) Elimination Network (IPEN) monitored eggs around priority UPOP sources listed in the Stockholm Convention (e.g. waste incinerators, metal industries, chemical industry, cement plants, e-waste recycling sites, dumpsites and other open burning sites).





Global egg study – Outcome of IPEN & Science for PCDD/Fs & PCBs

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Monitoring dioxins and PCBs in eggs as sensitive indicators for environmental pollution and global contaminated sites and recommendations for reducing and controlling releases and exposure

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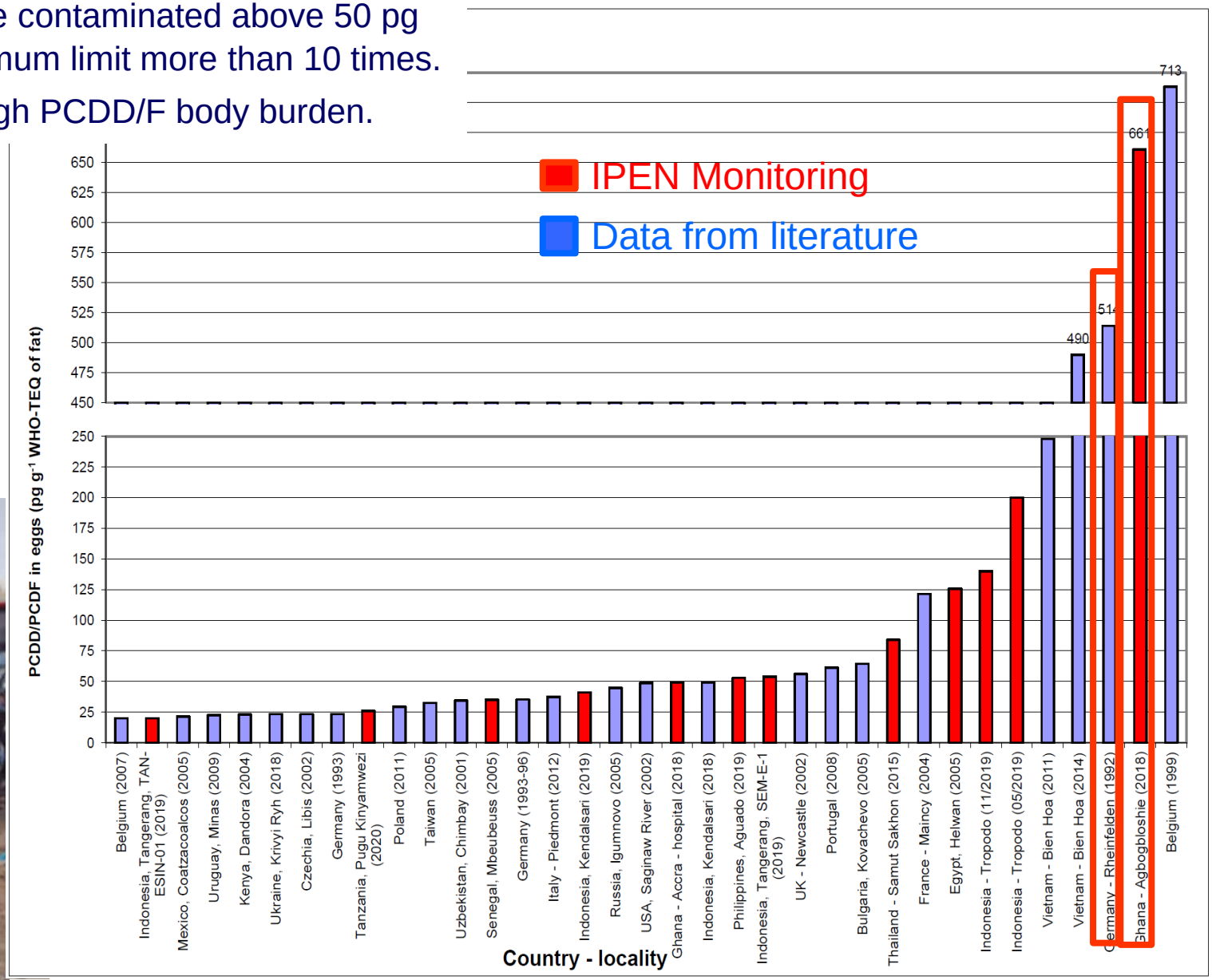
- IPEN monitored 113 chicken flocks at potential PCDD/F- and PCB-contaminated sites and **88% of the pooled egg samples were above the EU maximum limits** for PCDD/Fs (2.5 pg PCDD/F-TEQ/g fat) or the sum of PCDD/Fs and dioxin-like PCBs (5 pg PCDD/F-PCB-TEQ/g fat).
- **Children consuming just one egg exceed the FAO/WHO TDI (based on 70 pg TEQ/kg month) and the EU tolerable weekly intake (TWI). This indicates that close to 90% of areas around these industrial emitters and open burning sources in developing countries were unsafe for the consumption of free-range eggs.**

IPEN Global Egg Study – High contaminated eggs and exposure

- Sixteen out of the 113 IPEN egg samples (14%) were contaminated above 50 pg PCDD/F-PCB TEQ/g fat and exceeded the EU maximum limit more than 10 times.
- People regularly consuming such eggs will have a high PCDD/F body burden.
- The blood level of people living in a German city contaminated by a chloralkali plant consuming eggs had up to 93 pg TEQ/g fat of PCDD/F in blood.
- For the highest contaminated eggs from Ghana containing a total of 1156 pg TEQ/g fat, a child (15 kg) ingests with one egg (7 g fat) more dioxins than the FAO/WHO consider tolerable intake for 230 days and the EU consider a tolerable intake for 5 years.



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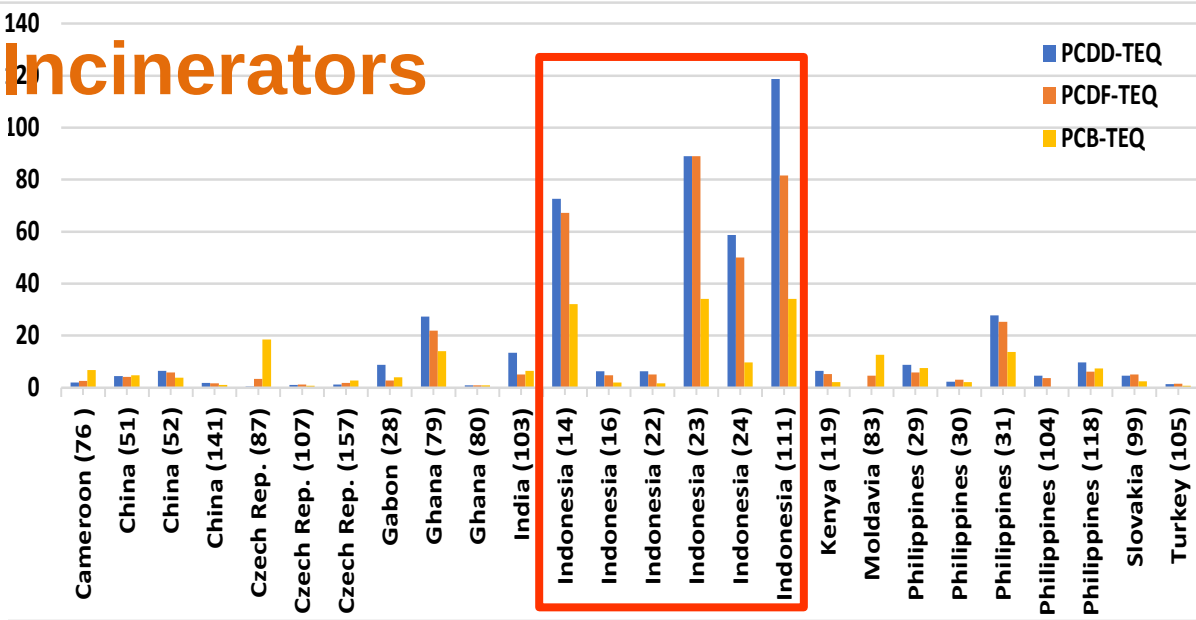
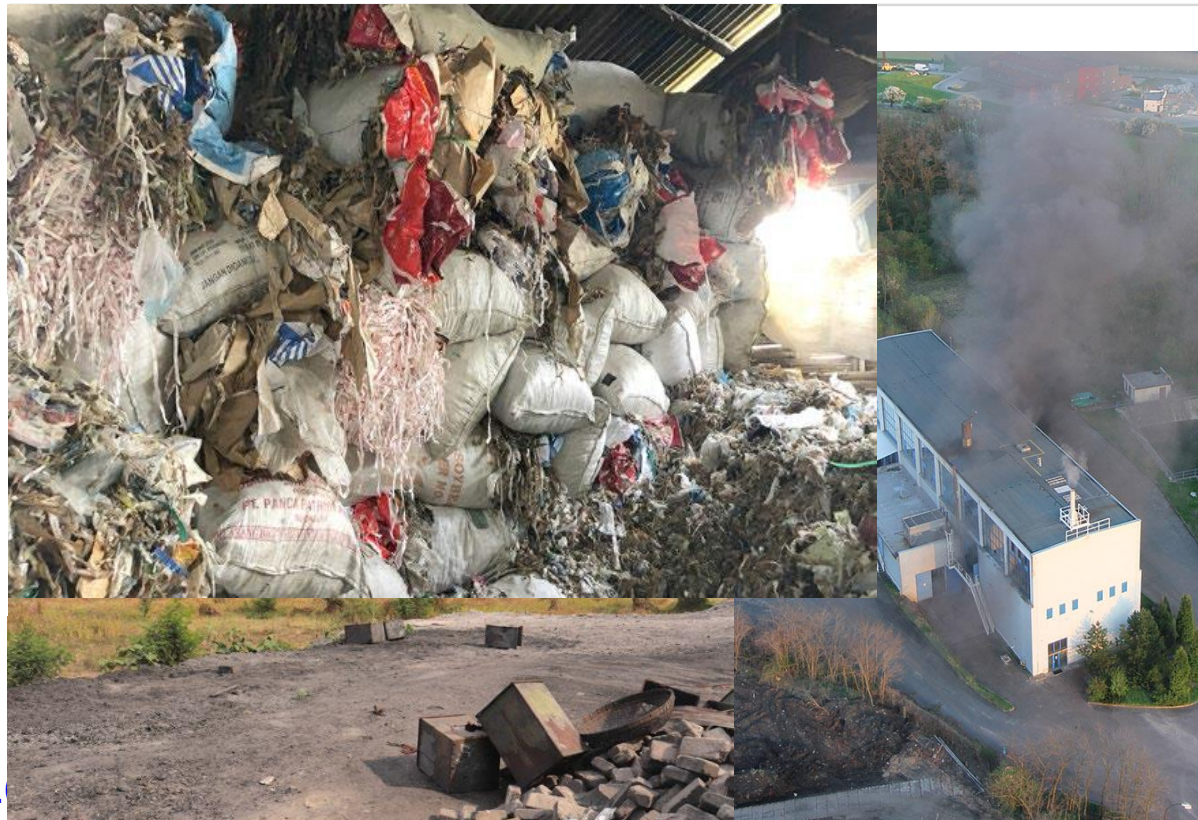
IPEN Global Egg Study – Waste Incinerators

- **24 of 26 egg samples (92.3%) around waste incinerators** in 12 countries (Cameroon, China (3), Czech Republic (3), Gabon, Ghana (3), India, Indonesia (6), Kenya, Moldova, Philippines (5), Slovakia, and Turkey) exceeded the EU limit for PCDD/Fs and dl-PCBs with a mean of **43.1 pg** TEQ/g fat.
- Eggs in Tropodo/Indonesia where **plastic wastes** were used as **fuel for tofu boilers had 234 and 172 pg TEQ/g fat**. And **two chicken flocks in Java, around lime kilns burning plastic waste as a fuel had 212 and 119 pg TEQ/g fat**.
- **This highlight that co-incineration of plastic waste in non-BAT facilities result in environmental contamination and human exposure risk via chicken/eggs.**
- The free-range chickens at both locations had access to ashes stored openly next to the kilns or used for paving sidewalks. The ashes contained PCDD/Fs at levels of 120 – 1300 ng TEQ/kg. **These ashes were 10 to 100 times below Basel provisional low POP content of 15,000 ng TEQ/kg**.





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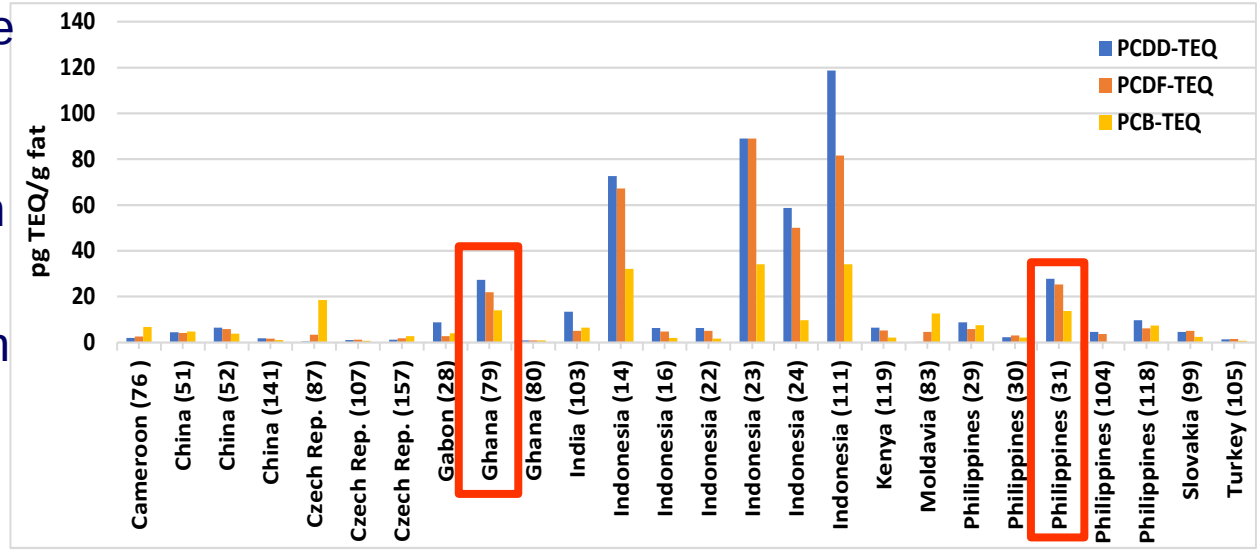
IPEN Global Egg Study – Waste Incinerators

- Two other highly PCDD/F contaminated pooled egg sample **(66.8 TEQ/g fat)** were collected near a **hospital waste incinerator in Aguado, Philippines** which has been operated for more than 20 years with medical waste known to contain a high share of PVC.
- Similarly, high levels (63.1 pg TEQ/g fat) were also found in pooled eggs of a flock near a batch type hospital waste incinerator in Ghana. **The mixed bottom and fly ashes with a level of 551 ng TEQ/kg** PCDD/Fs were dumped close to the incinerator where chickens also had access (Petrlik et al. 2022).
- Ash with 500 ng TEQ/kg is **30 times below the current provisional low POP limit of the Basel Convention of 15,000 ng TEQ/kg. However eggs from chickens are 30 times above regulatory limit.**



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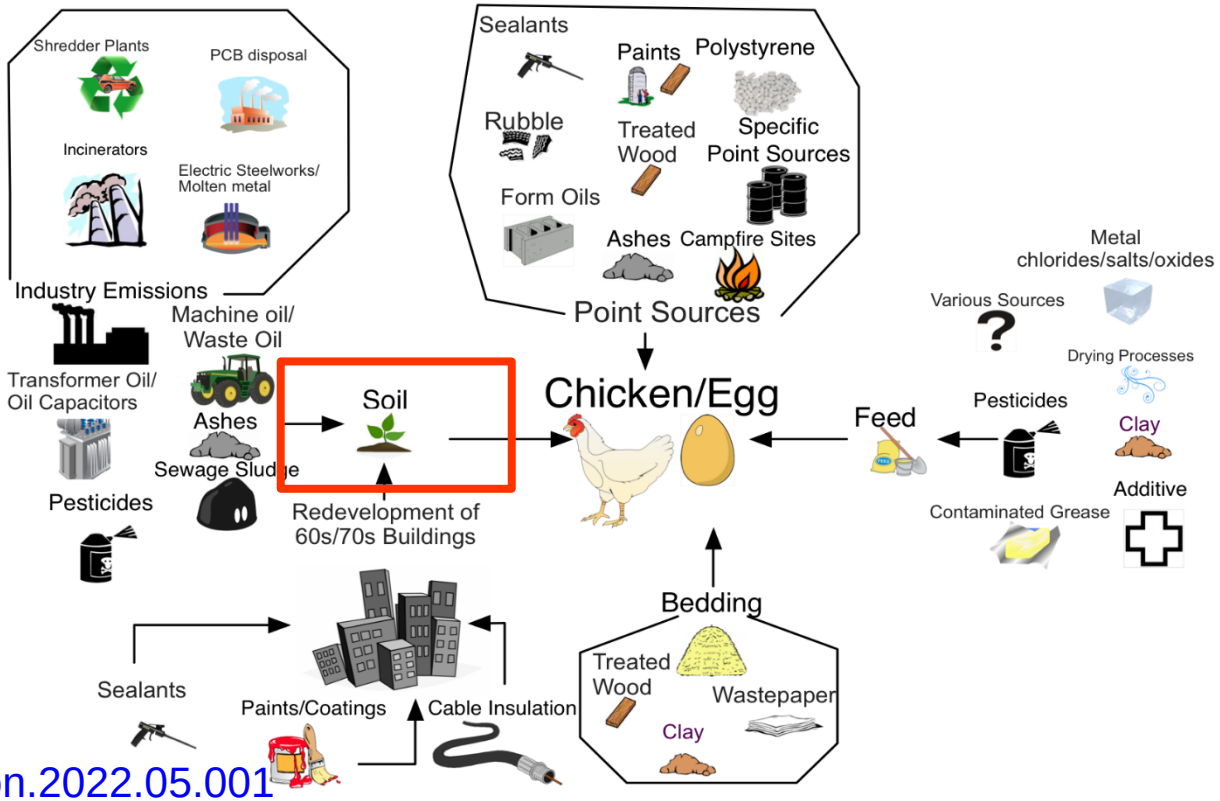
Science finding: Low PCDD/F & PCB levels in soil are already problematic for chicken egg/meat production – Policy action need

What are critical soil levels for impacting an egg above regulatory limit?

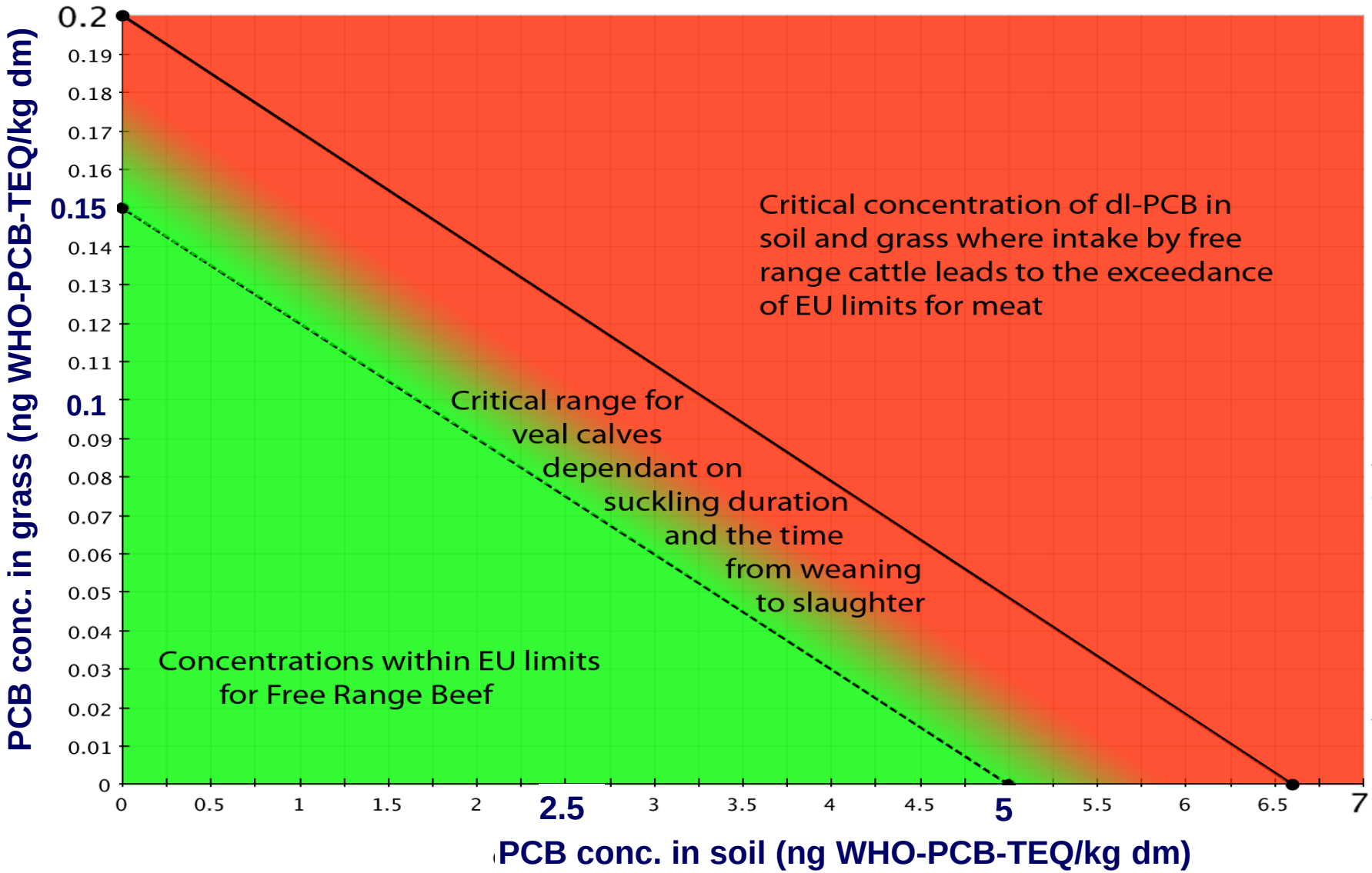
- With a total uptake of 25 pg (50 pg) TEQ/day a chicken reaches the current EU-limit of 2.5 pg (5 pg) for PCDD/F (sum PCDD/F-PCB) TEQ/g fat in egg.
- Free range chicken which spend a lot of time outdoor have a soil uptake of approx. 11-30 g soil/day.
- With a carry over of approx. 50% for TEQ-relevant PCB & PCDD/F the problematic levels in soils **for free range chicken** to reach EU limit for eggs (and meat) are approx. **3 to 7 ng TEQ/kg for ∑PCDD/F+dl-PCB**
- This **problematic soil levels are extremely low** and **are exceeded in many areas of industrial emissions and can also be exceeded in cities or residential areas** (e.g. from ashes, pesticides, open burning or deposition).
- **The current provisional low POPs limit established by the Basel Convention of 15,000 ng TEQ/kg is orders of magnitude too high for residues and needs to be re-evaluated and lowered.**



Weber et al. (2018) Environ Sci Eur. 30:42. https://rdcu.be/bax79 ;
Weber, Bell et al. (2019) Environ Pollut. 249, 703-715.
Petrlik et al. (2022) Emerging Contam. https://doi.org/10.1016/j.emcon.2022.05.001

Problematic dl-PCB levels in grass and soil for cattle

Deduction of critical **dl-PCB levels in grass and soil for suckling cattle herds** (intake 10 kg grass/day with 3% soil; based on **critical total intake of 2 ng dl-PCB TEQ/day**) to reach EU regulatory limits.



Also for milk & milk products the soil levels should be <5 ng TEQ/kg considering the TDI from milk and milk products. Weber et al. (2018) 20 Jahre Biomonitoring in Bayern. Umwelt Spezial (2018). Herausgeber Bayerisches Landesamt für Umwelt.

Weber et al. (2018) Environ Sci Eur. 30:42. https://rdcu.be/bax79

Control/limit of PCDD/PCDF and dl-PCBs in fertilizers/biosolids

Fertilizer (including biosolids or ashes from biomass) can be a dioxin/POP source for agriculture.

- Therefore e.g. Germany developed regulatory limits for fertilizers (DüMV 2019) including limits for PCDD/Fs & dl-PCBs. Also a proposal for a fertilizer regulation in the EU has been developed (JRC).
- A **"Basel low POP content" of 15,000 ng TEQ/kg can mislead authorities in managing ashes/waste.**
- **And the limit has been derived with wrong assumptions** (Swedish EPA 2011; Weber et al. 2019; Lopez & Proença 2020; Wu et al. 2020).

Regulation	Pollutant	Limit value	Application/remark
Germany	a) PCDD/F + dl-PCB	**30 ng TEQ/kg**	All with exemption of b)
Germany	b) PCDD/F + dl-PCB	**8 ng TEQ/kg**	b) pasture land and production of feed & farmland without plowing
EU (2019)	PCDD/F	**20 ng TEQ/kg**	Fertilizer to land (JRC proposal)
Basel „low POP content"	PCDD/F	**15,000 ng TEQ/kg**	Misleading for further use; flaws in derivation!

EU (2019) JRC report EU fertilizer; ISBN 978-92-76-09888-1, doi:10.2760/186684, JRC117856
Swedish EPA (2011). *Low POP Content Limit of PCDD/F in Waste*. Report 6418; ISBN 978-91-620-6418. Lopes H, Proença S (2020) Appl. Sci. 2020, 10, 4951 https://doi.org/10.3390/app10144951; Wu et al. Emerg. Contam. 6, 235-249. https://doi.org/10.1016/j.emcon.2020.07.001; Weber et al. (2019) Environ Pollut. 249, 703-715. DüMV (2019) Düngemittelverordnung vom 5. Dezember 2012 (BGBl. I S. 2482), d

- **Need of science based unintentional trace limits for PCDD/F, PCB (and PFOS/PFOA) in fertilizer.**

Flaws in the original derivation of the PCDD/F low POP content

The low POP limit was derived from a study of BIPRO for the European Union (BIPRO 2005). However the risk assessment by BIPRO was flawed (Swedish EPA 2011) and this low POP content is not protective:

- The BIPRO risk assessment assumed that a PCDD/F concentration of **30 pg WHO TEQ/g** fat is acceptable in eggs. However the consumption of one egg of just 4 pg WHO-TEQ/g fat per day (7.5 g fat) is enough to contribute total WHO TDI or EFSA TWI for a child of 15 kg.
- Further the **study estimated** that their assumed critical PCDD/F concentration of **30 pg WHO-TEQ/g fat** in **eggs correspond to a soil** concentrations of **1000 ng TEQ/kg** (BIPRO 2005). **However chicken eggs produced on soils with 1000 ng TEQ/kg result in eggs of ~800 pg TEQ/g (Weber et al. 2018; 2019).**
- This demonstrates that the BIPRO assessment significantly underestimated the risk and the basis for low POPs limits was inappropriate (by a factor of ~250; factor 7.5 for egg levels & factor 3 for accumulation).
- Consequently the calculation from which the 15,000 ng TEQ/kg low POP limit was originally derived is wrong by a factor of 250 and the current low POPs limit is far too high.
- For biosolids and other fertilizer **the limits set by the German fertilizer regulation seems appropriate**.

BIPRO (2005) Study to Facilitate the Implementation of Certain Waste Related Provisions of the Regulation on Persistent Organic Pollutants (POPs) ENV.A.2/ETU/2004/0044; **Swedish EPA (2011).** *Low POP Content Limit of PCDD/F in Waste*. Report 6418; ISBN 978-91-620-6418.; **Wu et al. (2020**) Emerg. Contam. 6, 235-249. https://doi.org/10.1016/j.emcon.2020.07.001; **Weber et al. (2018)** Environ. Sci. Eur., 30, 42 https://rdcu.be/bax79; **Weber et al. (2019)** Environ Pollut. 249, 703-715.

3.4 Conclusions and policy recommendations

3.4.1 Overall conclusion on egg and soil contamination and related human exposure

3 4.2 Preliminary conclusions on time trends

3.4.3 Stop transgressing the global boundary for “Novel Entities”

Recommendations on waste management

3 4.4 **Recommendation to improve management of POPs wastes and tracking of pollution in the POPs life cycle**

3.4.5 **Recommendation of improved management of plastics and e-waste** and stop of thermal treatment in non-BAT facilities by effective implementation of conventions

Recommendations on inventory of emission sources and contaminated sites

3.4.6 Systematic inventory of sites and potential contamination around emission sources within the inventory activities of Stockholm Convention

3.4.7 Systematic monitoring of human exposure from contaminated sites to reduce and minimize exposure

3.4.8 Capacity building for monitoring in developing countries including bioassay

Recommendations on legislative limits

3.4.9 **Recommendation on re-evaluation of soil limit values**

3.4.10 **Recommendation for industrial emissions and for low POPs limits** in particular for fertilizer and other soil amendments (approx. 10 ng TEQ/kg)

3.4.11 Recommendation for unintentional trace content limits for pesticides/chemicals

Addressing farmers and consumer needs

3 4.12 **Measures to control exposure**

3.4.13 **Compensation of farmers and consumers by applying PPP**

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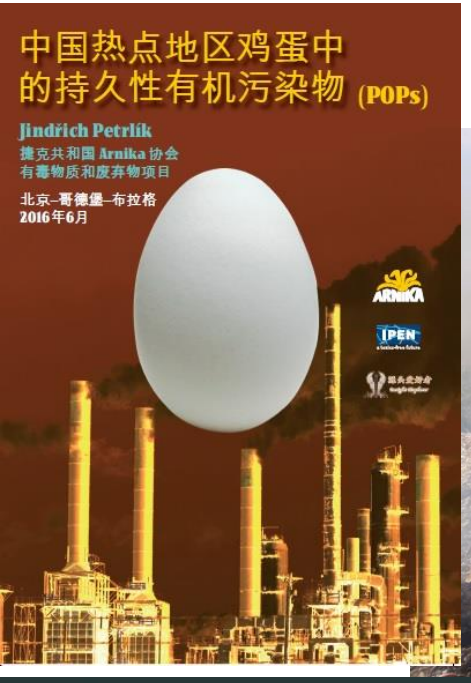

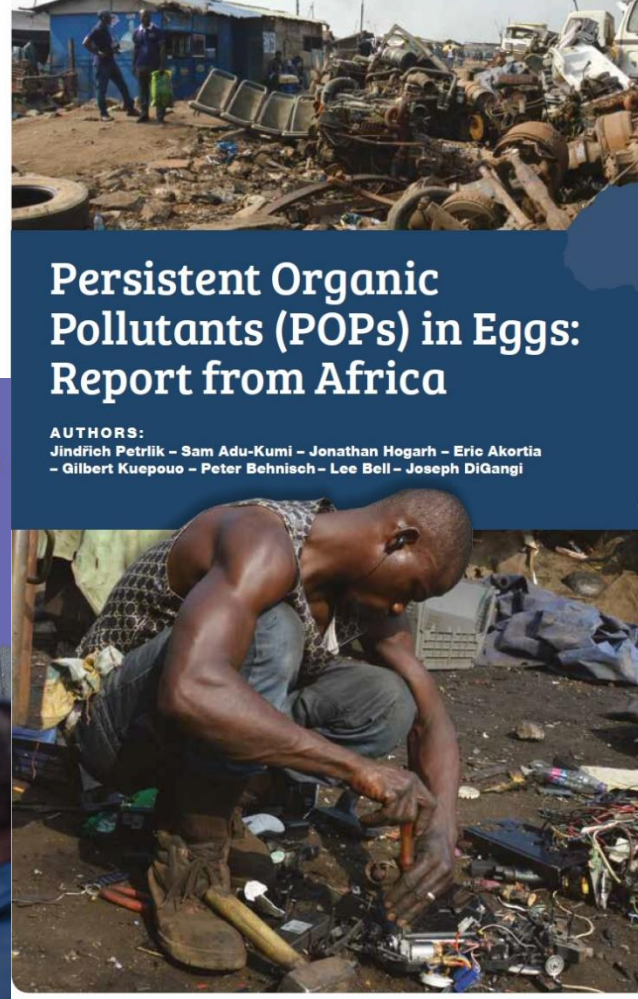

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