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Sustainable use of pesticides in a changing climate

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Sustainable use of pesticides in a changing climate

CA21234 COST Webinar 29 May 2024; Roger Holten PhD, Norwegian Institute of Bioeconomy Research NIBIO

- Introduction
- Pesticide use in the world
- Pesticides in the environment
- Climate change and implications for pesticide use
- How to mitigate potential risks
- Conclusions

Introduction

- Pesticides (i.e. Plant Protection Products): Prevents, destroys, or controls a harmful organism ('pest') or disease, or protects plants or plant products during production, storage and transport

- Without the use of crop protection products loss of fruits, vegetables and cereals could amount to approx. 78, 54 and 32 % respectively (Lamichhane et al., 2016)

- Pesticide use contributes to reduced biodiversity (Zaller et al., 2022, Kumar et al., 2024).

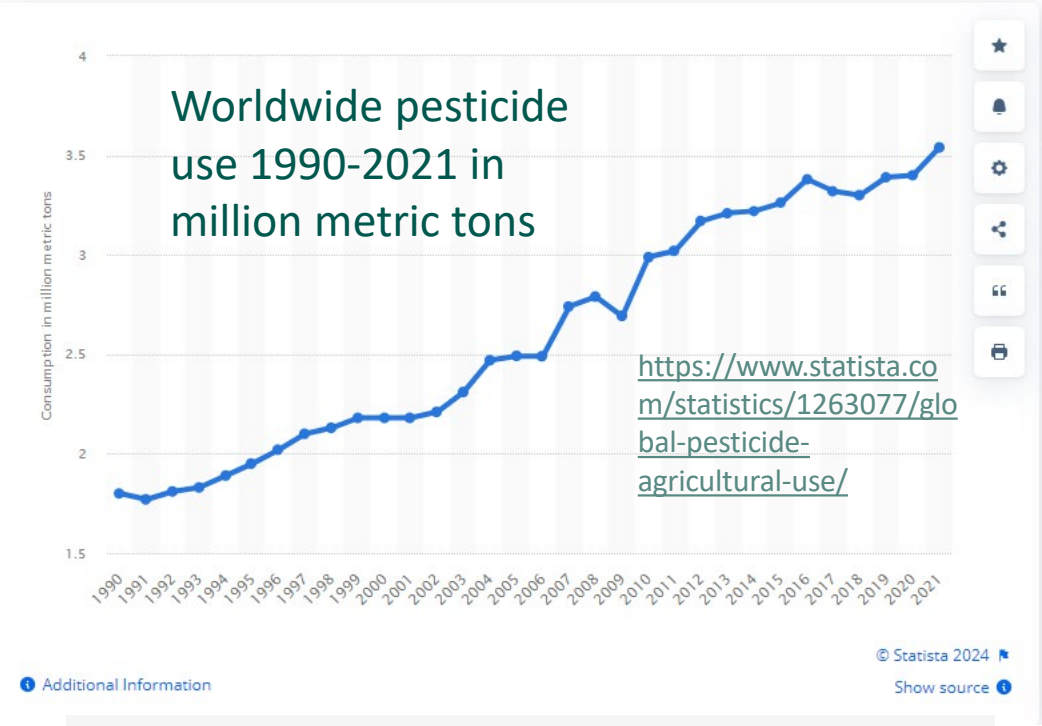
- A general goal within the EU to reduce the use by 50 % by 2030 (Sustainable Use Regulation, Farm to Fork and Biodiversity). Climate change not mentioned.

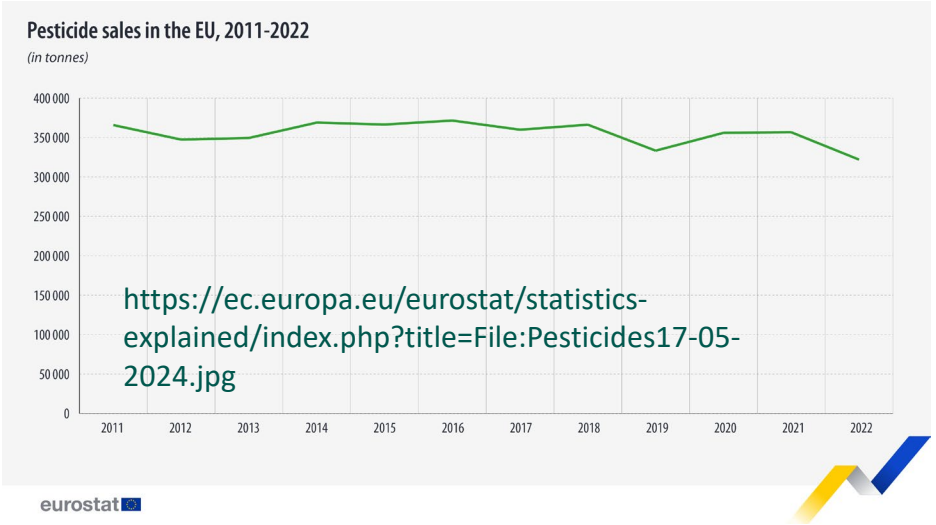
Photos: Erling Fløistad/NIBIO

Use of pesticides in the world today

- Global pesticide use: approx. 3.5 mill tons per 2021 (FAO)
  - Brazil: 720 000 t, USA: 457 000 t
- EU: approx. 320 000 tons of active substance used in 2022. Europe in total: approx. 500 000 tons (FAOSTAT)
- Norway: approx. 700 tons active substance per year (2017-2021) (Mattilsynet, 2022)

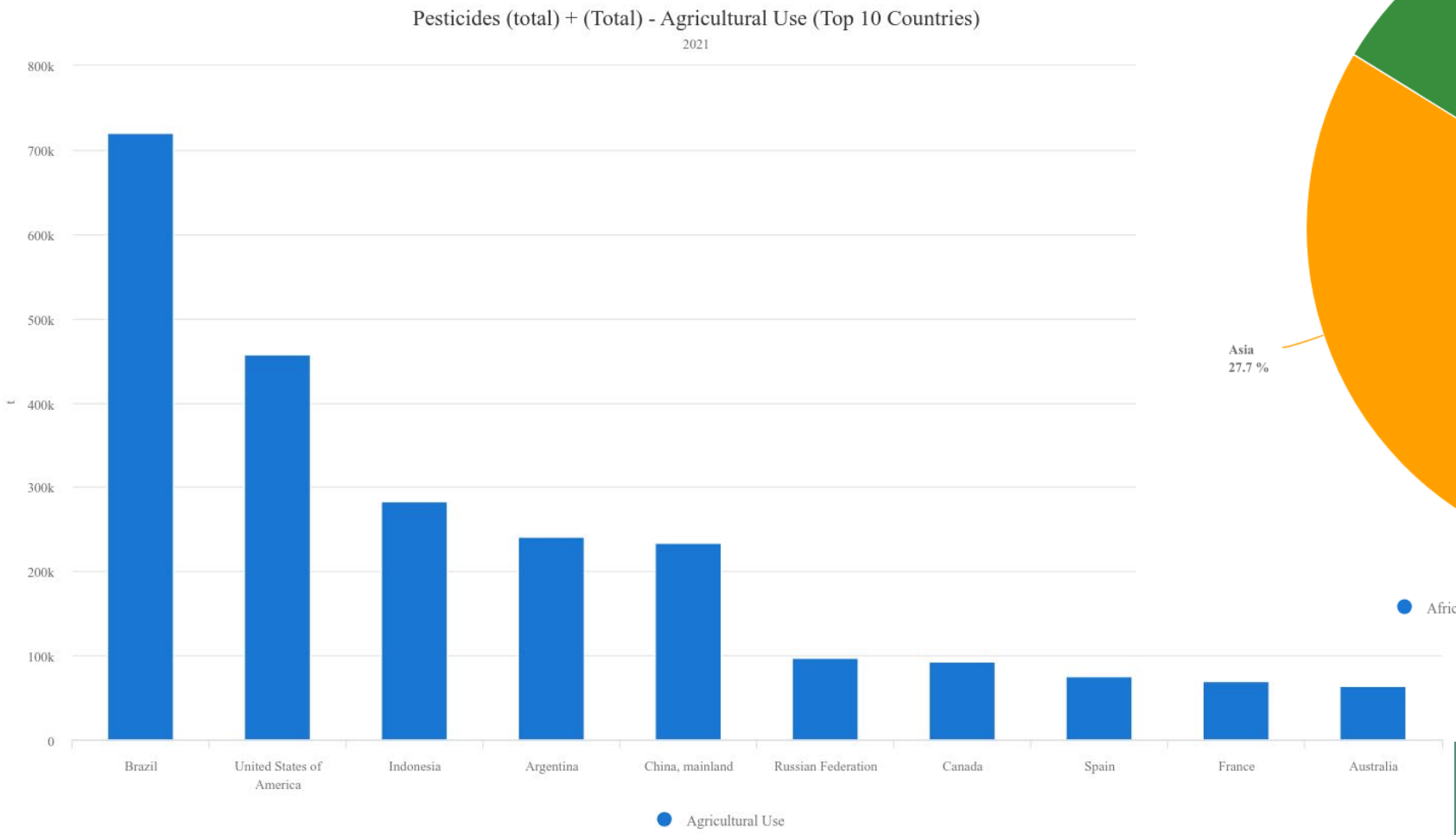
- China biggest producer of pesticides: 2.5 mill tons (2022)

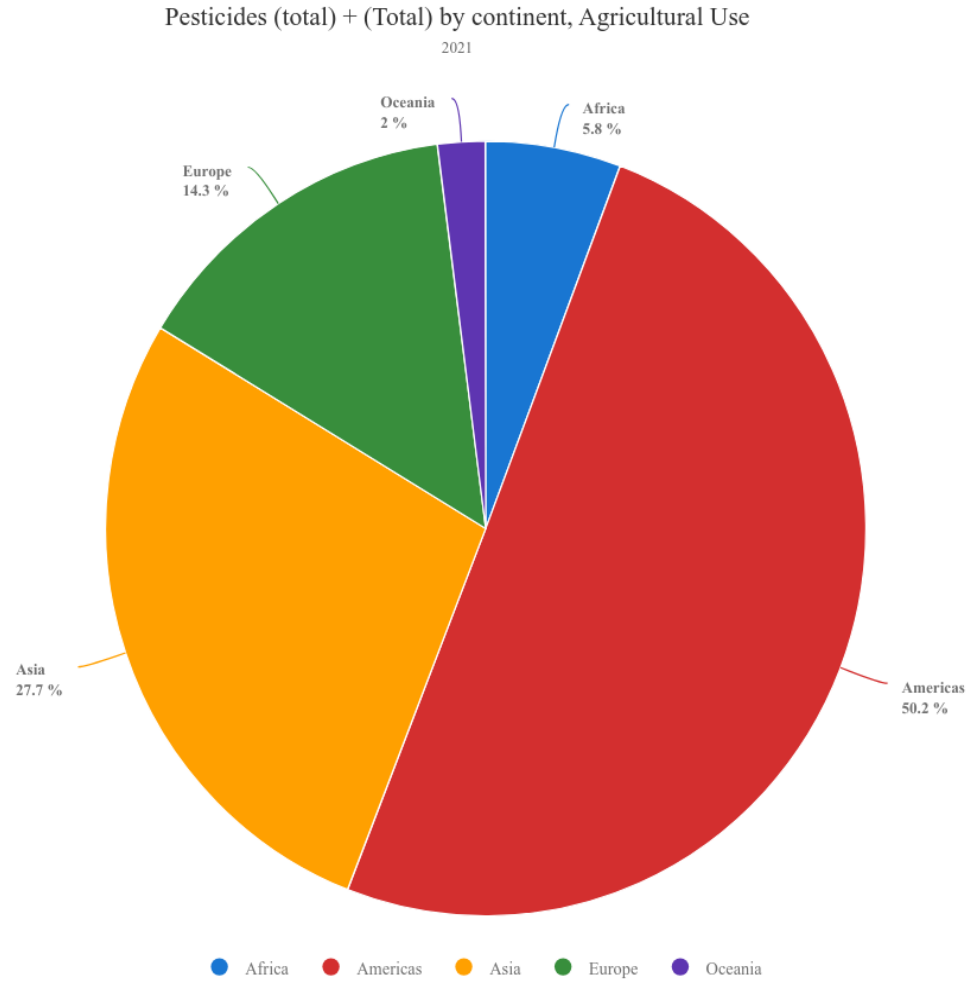




❑ Use of pesticides in the world cont.

- Leading countries in agricultural consumption of pesticides worldwide in 2021 (in 1,000 metric tons)
  - Source: https://www.fao.org/faostat/en/#data/RP/visualize





Source: FAOSTAT (March 18, 2024)

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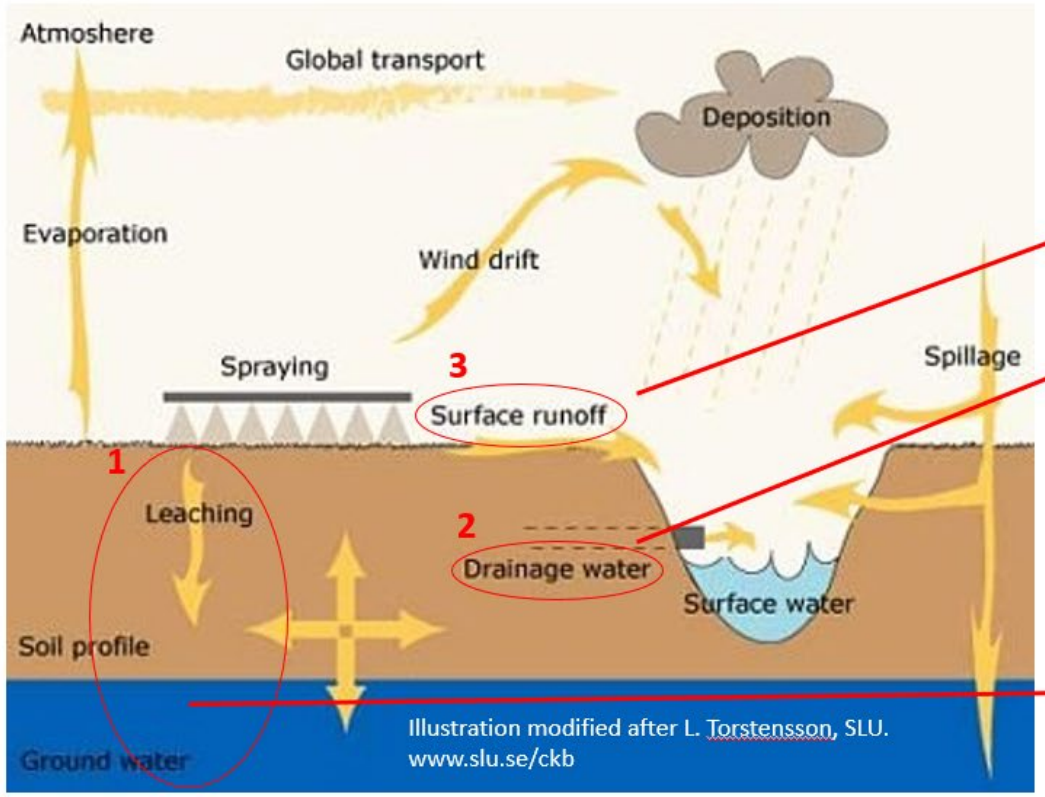
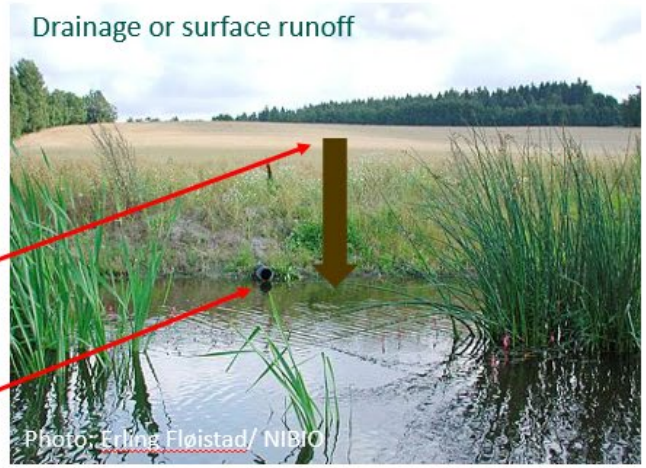
Environmental exposure and risk assessment of pesticides





Point sources: filling and cleaning

Photos from: https://www.gardsdrift.no/gjor-det-selv-vedlikehold/korrekt-vask-av-sproyta

Climate change and implications for pesticide fate and behaviour

- Climate changes in general:
  - For bigger parts of Europe: Warmer and/or wetter (more extreme rainfall episodes).
    - Leading to more surface runoff and erosion.
    - Higher temperatures -> higher degradation
    - Less degradation in dry soil
  - For Scandinavia: in addition, more frequent freezing and thawing episodes.
    - Leading to more surface runoff and erosion and/or leaching due to cracking

Delcour, I., Spanoghe, P., Uyttendaele, M., 2015. Literature review: impact of climate change on pesticide use. Food Res. Int. 68, 7–15.
Ali, E., et al., Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press , pp. 2233–2272.. https://www.ipcc.ch/report/ar6/wg2/.

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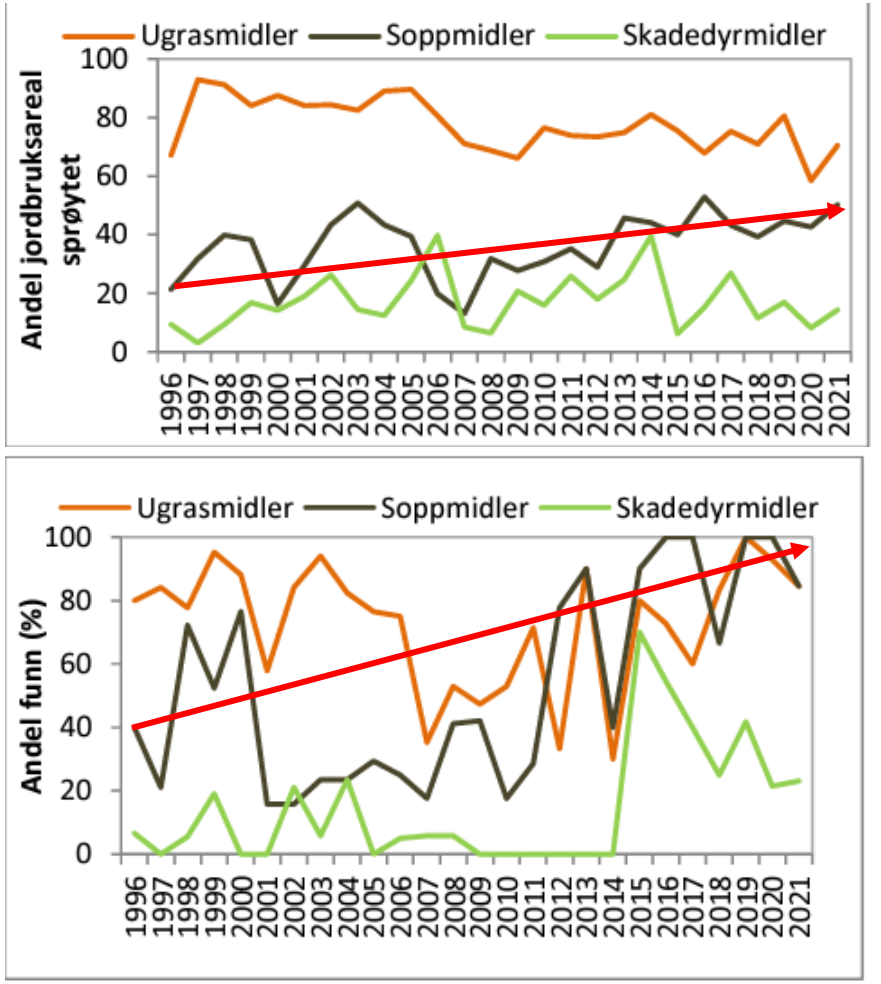
Climate change and implications for pesticide use

- Warmer and wetter climate
  - ➔increase in fungi attacking crops, already increased use and increased findings in the environment in some countries (e.g. Norway)
  - ➔pests, weeds, insects and fungi spreading to new areas
  - ➔need of new pesticides and or more frequent spraying
  - ➔ increased pest resistance challenges



Delcour, I., Spanoghe, P., Uyttendaele, M., 2015. Literature review: impact of climate change on pesticide use. Food Res. Int. 68, 7–15.
Duchenne-Moutien and Neetoo, 2021 Climate Change and Emerging Food Safety Issues: A Review
Schneider et al., 2022, The effect of climate change on invasive crop pests across biomes
Skendžić et al., 2021, Effect of Climate Change on Introduced and Native Agricultural Invasive Insect Pests in Europe

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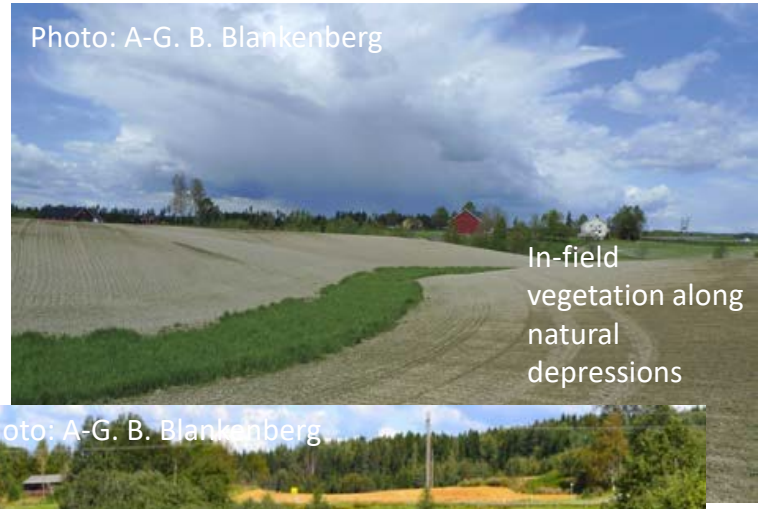
How to mitigate (increased) use and loss of pesticides?

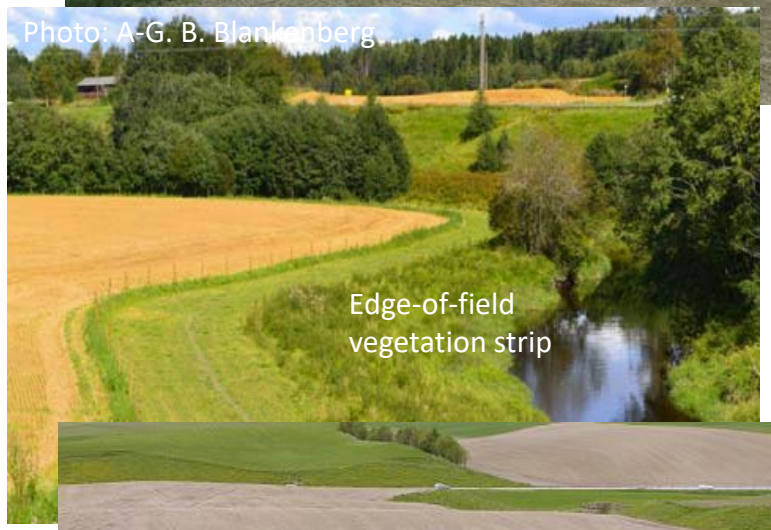
Mitigation with regard to:

- Pesticide use
  - Politics, regulations (data requirements), reduction goals, taxation, monitoring
  - Training of farmers
  - Integrated pest management
    (IPM, prevention, avoidance, monitoring, suppression)
  - More efficient use of existing pesticides (application rates, mixtures, application times)
  - Increased use of Low-Risk Pesticides (acetic acid, bicarbonate, micro-/macroorganisms etc)
  - Alternatives to chemical plant protection (mechanical methods, heating etc)
  - Alternative application methods (GPS, point/precision application, drones)

- Crop and soil management
  - Develop new and more pest resistant crop plants (e.g. use of CRISPR?)
  - Crop rotation
  - Flower/vegetation strips in field edges
  - Open up creeks and streams along fields
  - Use of cover crops in winter to reduce pesticide, nutrient and soil loss
  - Reduce soil tilling
    - Spring ploughing one of the best practises with regard to pesticide loss (although may increase preferential transport of pesticides during winter/spring)
    - Autumn ploughing leaving bare soil throughout winter is worst case (although better with regard to reducing weeds the following year)

- Pesticide loss in the environment
  - Take climate change in account in registration process of pesticides, i.e. exposure modelling with climate projections.
  - Reduction in autumn pesticide use (appl. rates, precision farming/spot treatment).
  - Cover vegetation during winter, e.g. ryegrass, clover.
  - Vegetated filter strips/buffer zones/vegetated depressions (in-field or edge-of-field)
  - Sedimentation ponds and constructed wetlands, *for both surface runoff and drainage runoff*
  - Case by case assessment on farm level with regard to pesticide use -> important with good advisory services.

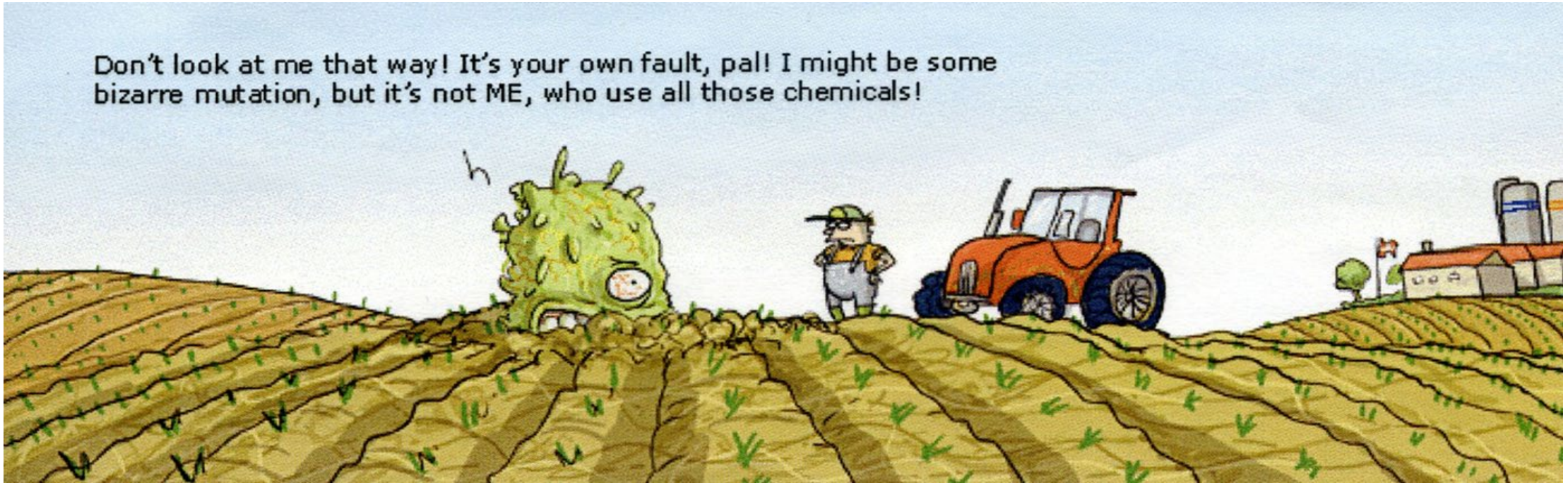




Summary

- Climate changes and their effect on pesticide use and fate and behaviour has not been investigated in detail.
- Focus on alternative pest management practices, incl. low-risk alternatives
  - Traditional pesticide use will stay with us in the foreseeable future.
- All management practices have pros and cons.
- One best management practice for pesticide use on frost exposed soil which covers all conditions does not exist.
- Depending on local conditions, a case by case assessment must be made where a range of factors must be addressed.
- Complex picture - Modelling tools can be of great help when addressing many factors.

Thank you for your attention



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