Plant breeding as a driver of socio-economic and environmental sustainability

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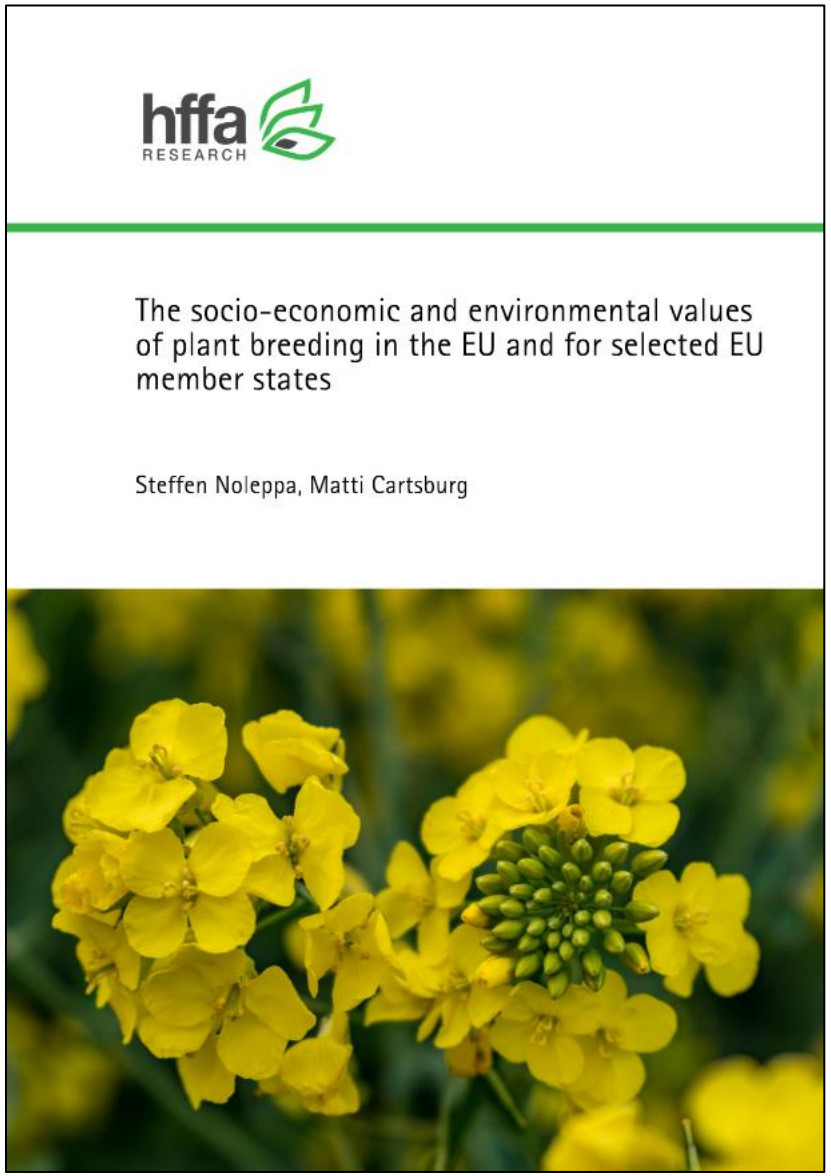
Content

- **Ex-post evaluation (2000-2019)**:
  - → Yield developments and importance of plant breeding for EU productivity growth
  - → Modelling results referring to the year 2020
- **Ex-ante assessment (2020-2039)**
- **Case study analyses** for the impact of New Plant Breeding Techniques (NPBT)
- **Recommendations** for private business and policy-making

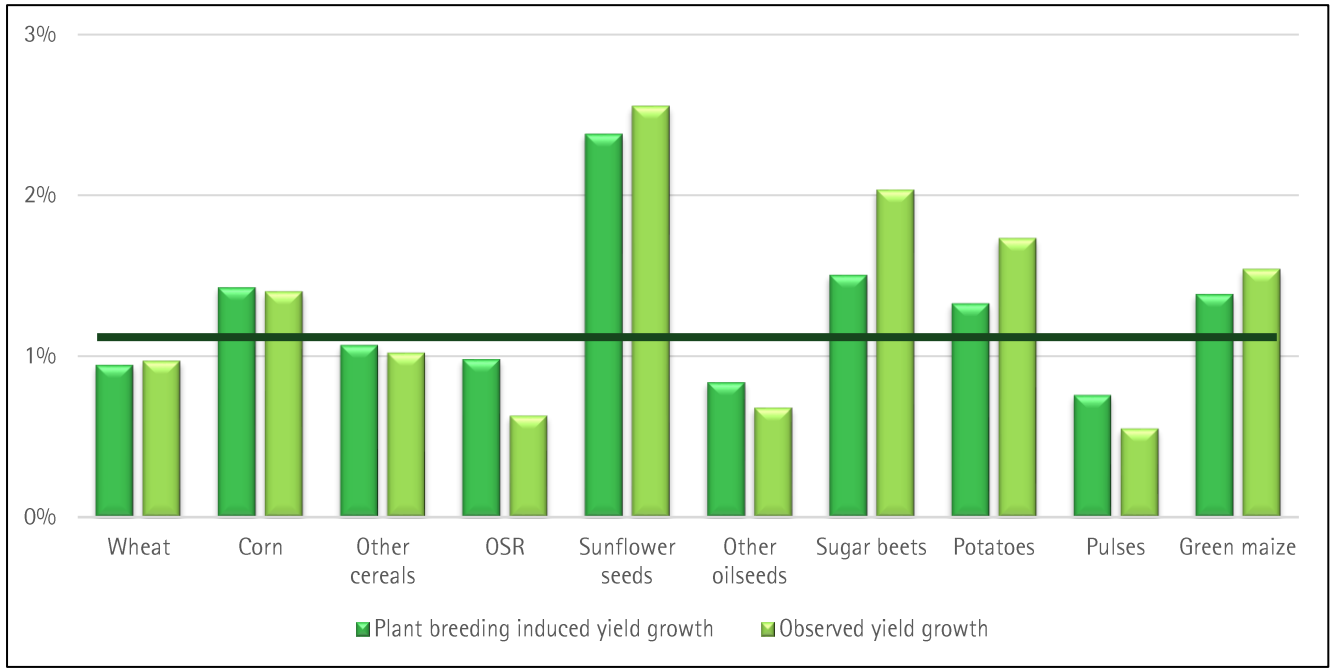


The socio-economic and environmental values of plant breeding in the EU were calculated for effects on …

- **Yield growth**
- Market supply
- Market prices
- Food availability
- **Trade**
- **Sector / farm income**
- GDP
- Jobs
- **Land use / net virtual land trade**
- **GHG emissions**
- **Biodiversity**
- Water use

Plant breeding is responsible for approximately 66 percent of annual productivity growth

Plant breeding-induced vs. real yield growth per year

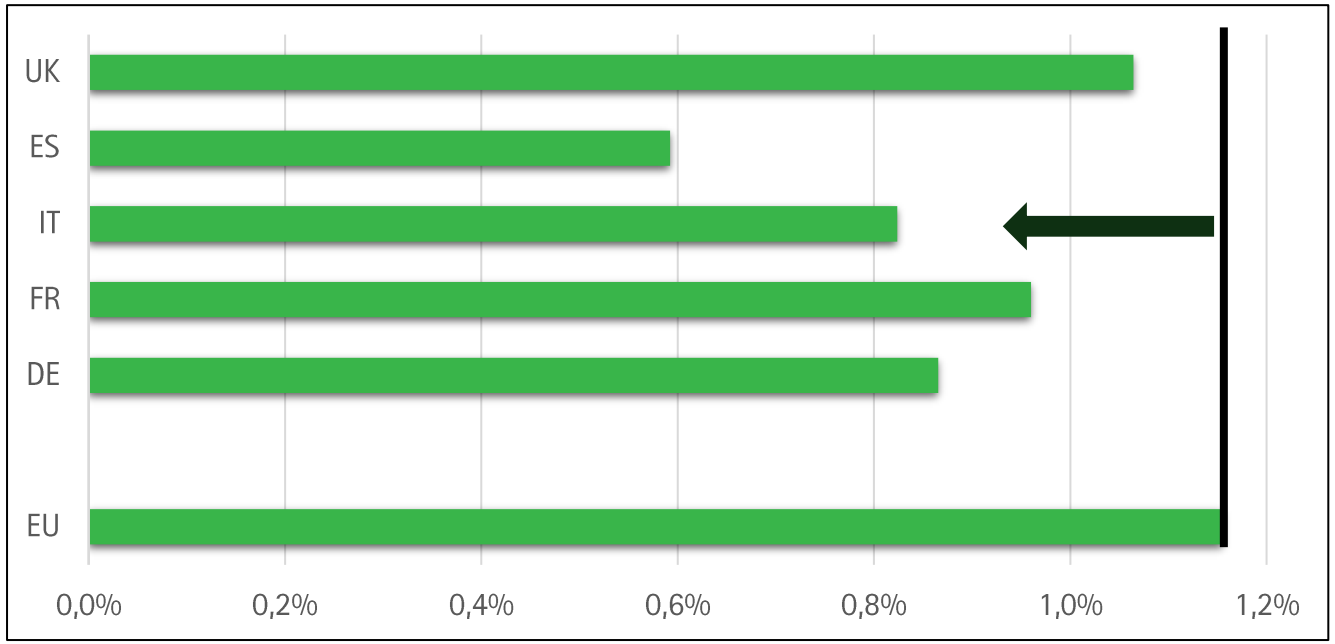


- Shares of plant breeding in innovation-induced yield growth are between 59 and 75 percent.
- On average, weighted by hectare:

  → **1.16 percent per annum** productivity growth through plant breeding.
- Plant breeding has a tremendous impact on EU arable farming.

Plant breeding is responsible for approximately 66 percent of annual productivity growth

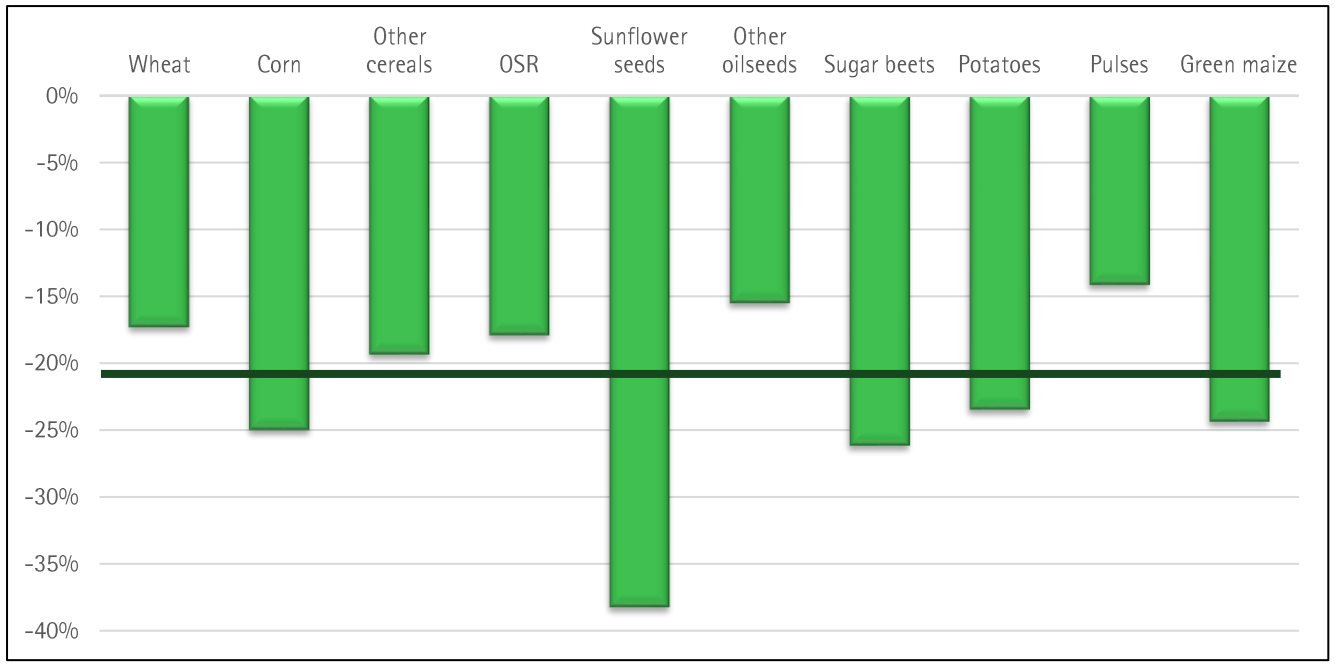
Plant breeding-induced yield growth by member state



- Plant breeding-induced yield growth is below EU average in many "old" EU member states.
- Hence, it is likely (well) above average in "new" member states.
- Why? – EU accession in/after 2005:
  → Improved market access
  → Increased incentives (PBR, royalty fees, etc.)

Without 20 years of plant breeding in the EU yields would be more than 20 percent lower

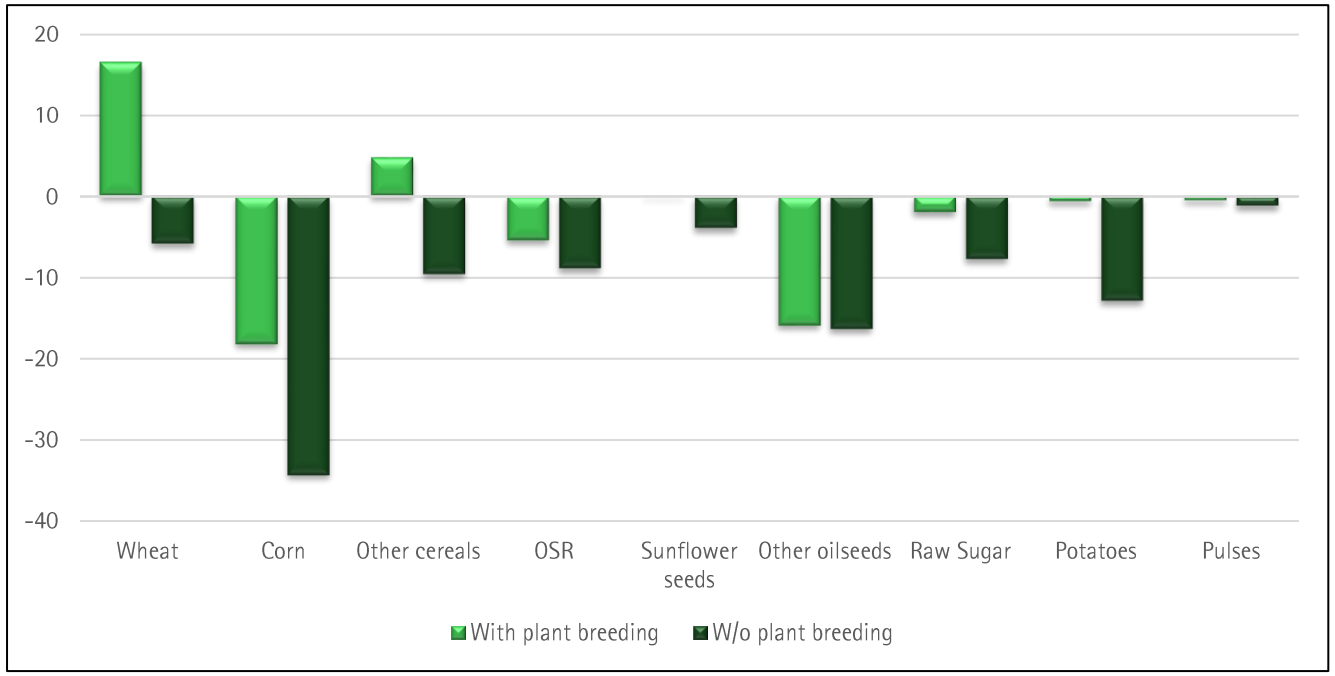
Yield shock (2020) w/o EU plant breeding (2000–2019)



- Without 20 years of plant breeding, yields in EU arable farming today would be significantly lower.
- On average, hectare-weighted, **a minus of 20.6 percent** would have occurred.
- Considerable amounts of wheat, corn, etc. would be missing!

Without 20 years of plant breeding the EU would become a major net importer

Net trade with and w/o plant breeding (in million tons)



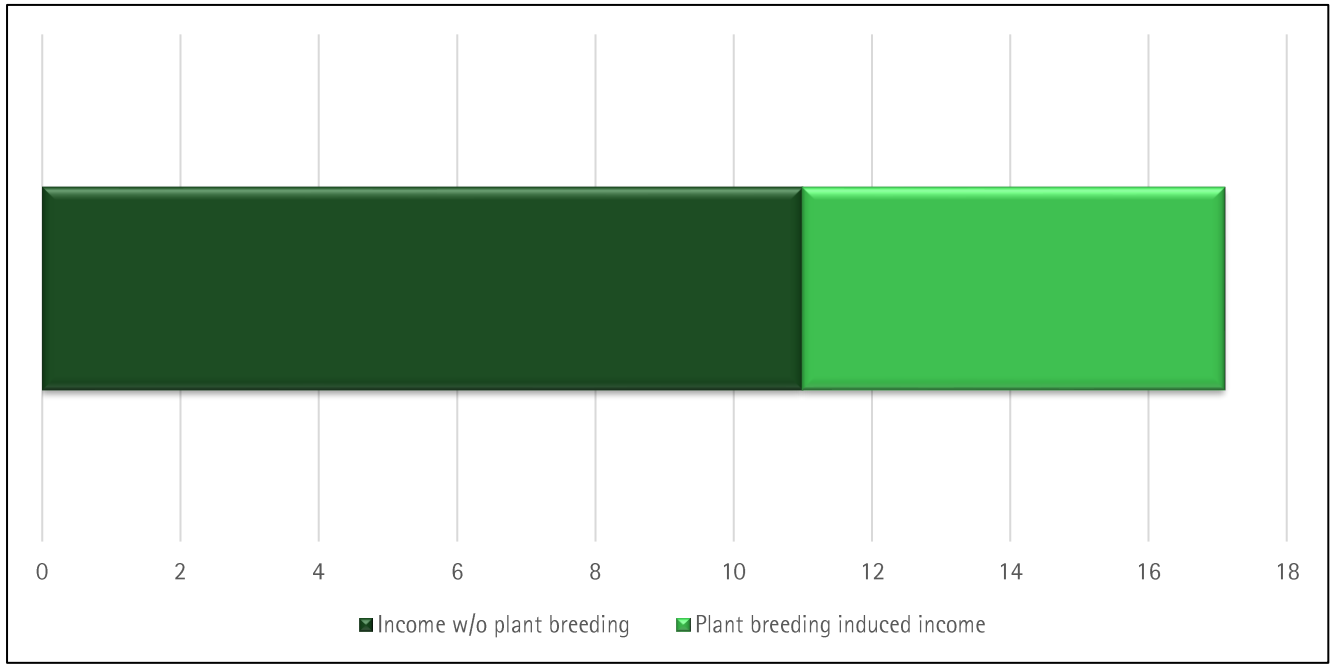
- Without 20 years of plant breeding, the EU would become a net importer in all arable crops:

  → **including wheat and other cereals**

- International competitors would gain in competitiveness and increase their market shares.

Without 20 years of plant breeding EU arable farmers would have a considerably lower income

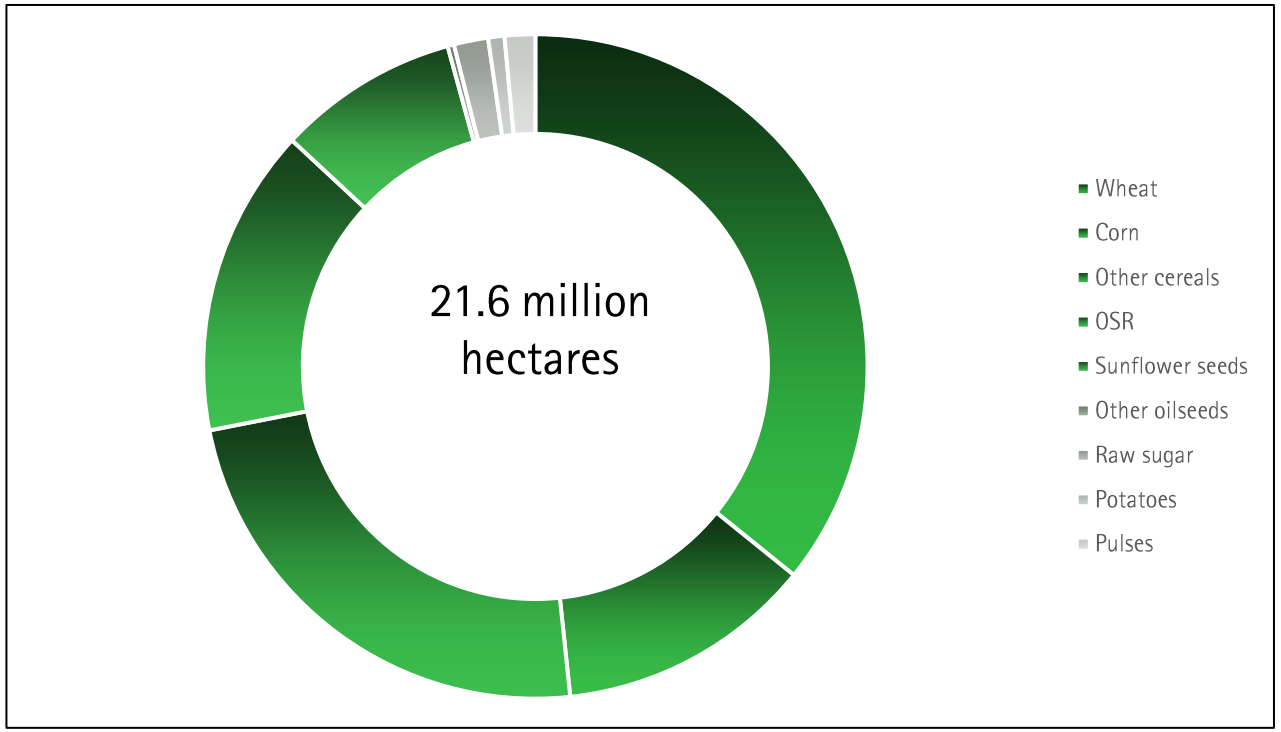
Income with and w/o plant breeding (in 1,000 EUR/AWU)



- Without 20 years of plant breeding, the current annual income of an EU arable farmer would be **6,100 EUR lower** (i.e., one third of 17,100 EUR).
- In terms of the agricultural value added, approximately **14 billion EUR** would be missing today.

Without 20 years of plant breeding in the EU 22 million hectares of additional land would be needed

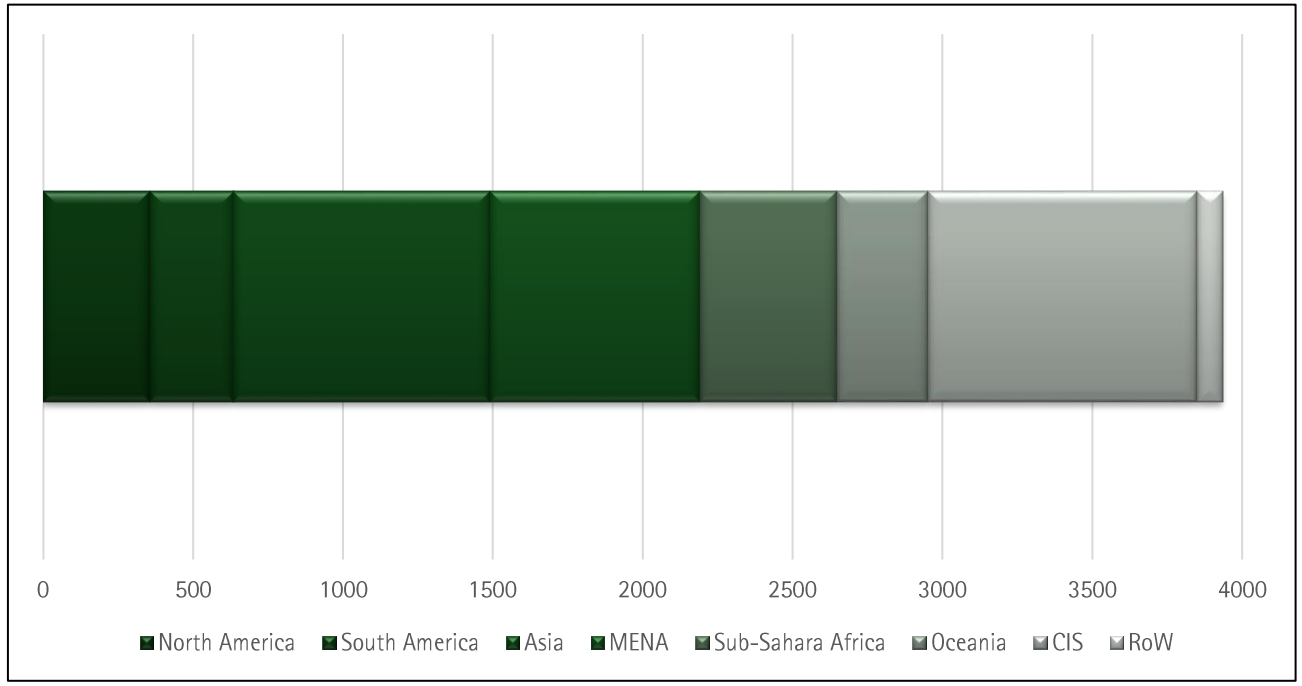
Additional global land use w/o plant breeding in the EU



- Without 20 years of plant breeding scarce global resources would additionally be exploited:
  - → N. Am.: 2.4 million ha
  - → S. Am.: 1.8 million ha
  - → Asia: 2.9 million ha
  - → MENA: 3.6 million ha
  - → SSA: 2.3 million ha
  - → Oceania: 2.7 million ha
  - → CIS: 5.3 million ha
  - → RoW: 0.5 million ha

Without 20 years of plant breeding in the EU almost 4 billion tons of additional GHG would have been emitted

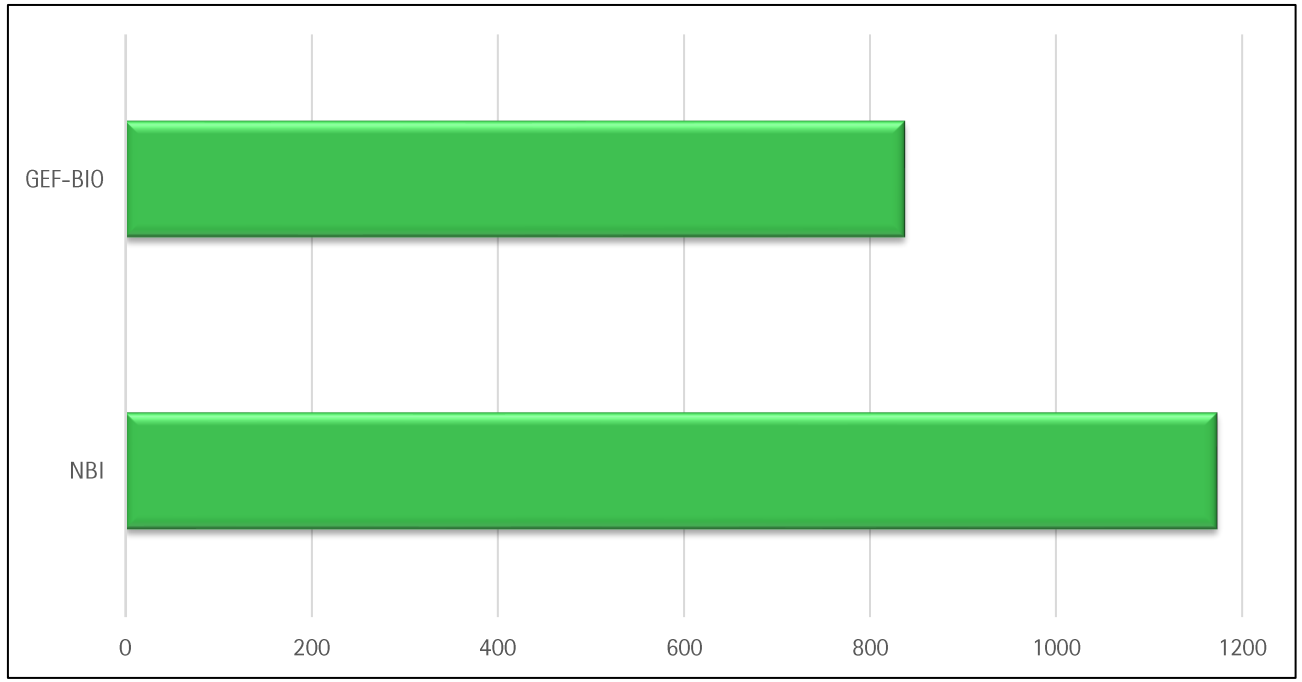
Avoided global GHG emissions due to EU plant breeding (in million tons of CO_2-equivalents)



- Almost 4.0 billion tons of CO_2 emissions did not occur due to avoided land use effects:
  - → Being a one-time-only effect, it equals 4-5 times the annual German GHG emissions.
  - → Annualised it is as large as the **yearly GHG emissions of The Netherlands**.

20 years of plant breeding in the EU helped avoid significant biodiversity losses

Avoided global biodiversity losses due to EU plant breeding (in million biodiversity "points")



- 830 million "points" are equal to biodiversity found in 8.3 million hectares of Brazilian habitats:

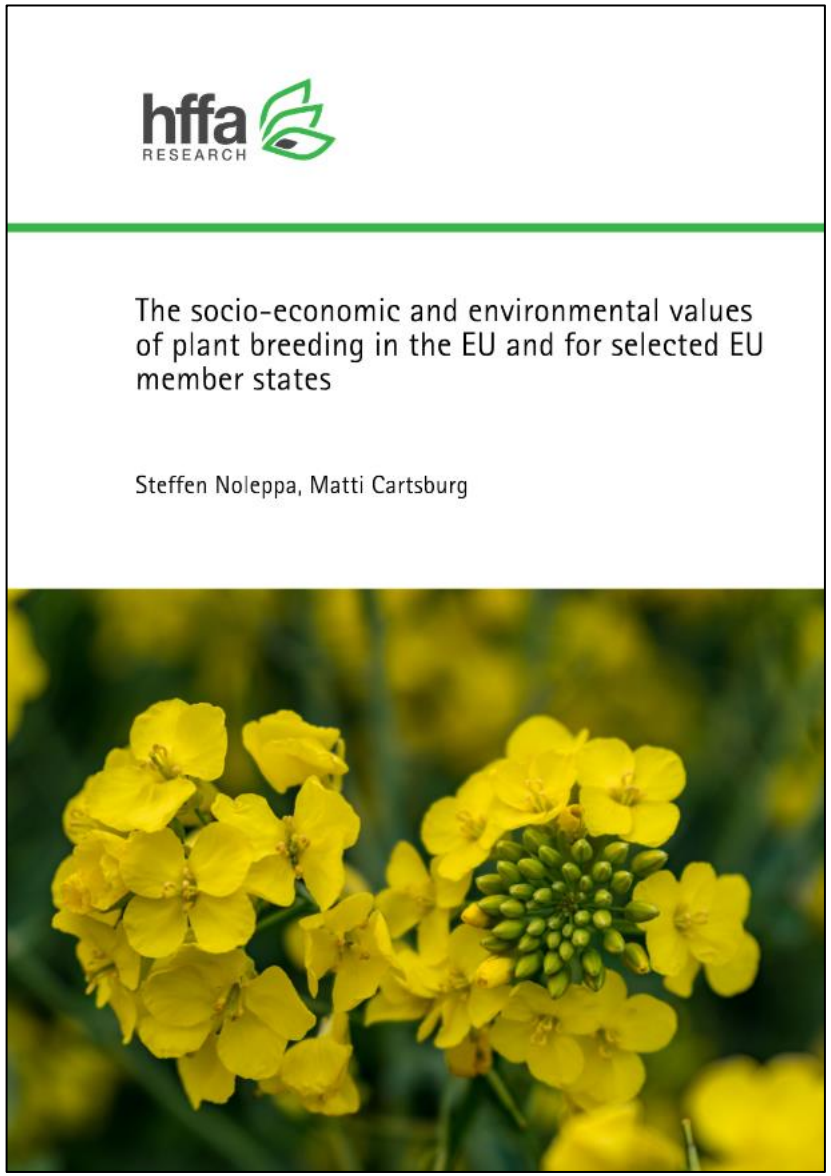
  → Compensation for **11 years of deforestation/savannah loss.**

- Similarly, 1,180 "points" are equal to biodiversity found in 11.8 million hectares of habitats in Indonesia:

  → Compensation for **26 years of deforestation/grassland loss.**

Summary on plant breeding values

- Plant breeding increases yields.
- Plant breeding adds further improvements.
- By doing so, plant breeding:
  - → Increases **economic** prosperity
  - → Strengthens **social** livelihood
  - → Protects **environmental** assets
- Plant breeding supports **sustainability**!
- **Plant breeding should speed up!**



NPBT can speed up breeding and help achieve goals with respect to economic and environmental sustainability

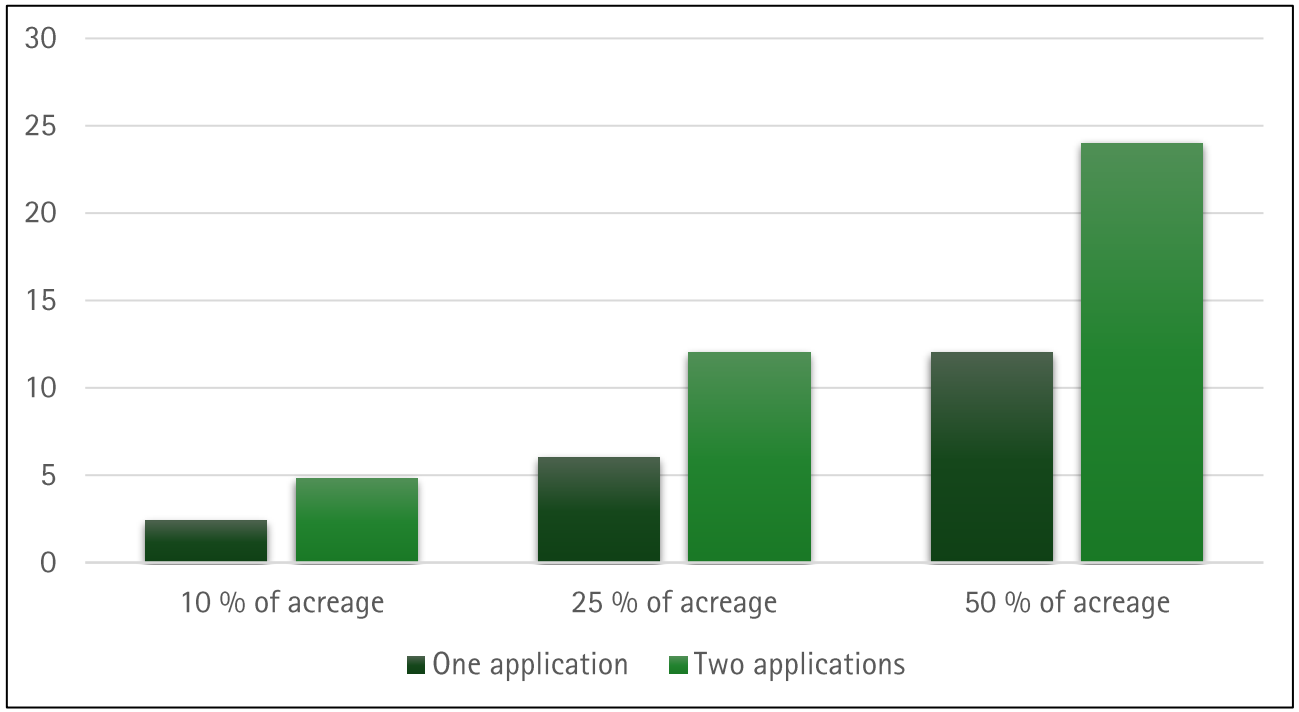
- **Scenario:**
  - → Conservative calculation: Saving two years of variety development
  - → Speed up plant breeding progress per time unit by 18 percent
  - → Not only 1.16 but 1.34 percent plant breeding-induced yield progress per annum in few years from now
  - → Until 2040: an extra yield increase of 2.6 percent

- **Positive effects:**
  - → Provide extra food for almost 20 million more humans
  - → Avoid global GHG emissions of roundabout 350 million tons
  - → Preserve biodiversity living in about 2.0 million hectares (global average)

  - → Various contributions towards meeting the objectives of various strategies of the EU as well as the SDGs

NPBT can help reduce the number of fungicide applications in wheat by fungi-resistant varieties

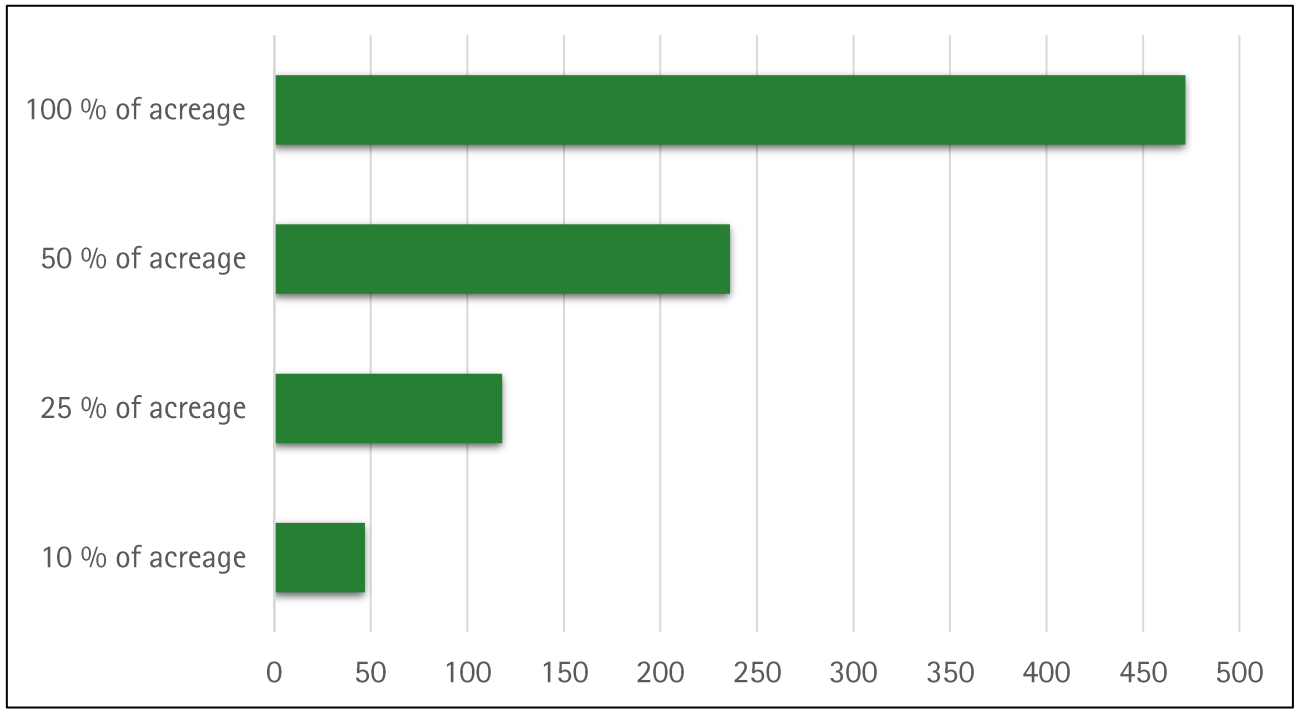
Avoidable fungicide applications in wheat (in millions)



- Example - PILTON:
  - → Breeding for multiple fungi resistance
  - → May avoid fungicide application
- Assumptions:
  - → One (two) application(s) less per season at current acreage
- Potential effects at EU level:
  - → Up to **25 million applications** less in EU wheat alone
  - → Thousands of tons of fungicides can be substituted.

NPBT can help avoid pre-harvest losses in oilseed rape by increasing pod shatter resistance in new varieties

Avoidable land use for oilseed rape (in 1,000 hectares)



- Example - Project John Innes Centre:
  - → Breeding for reduced susceptibility to pod shattering
  - → May avoid seed losses and subsequent voluntary seeds
- Assumptions:
  - → Avoid yield losses of 9.0 percent
- Potential effects at EU level:
  - → **500,000 hectares** are almost one tenth of currently used area
  - → Lower pressure on land supports e.g. mitigation of GHG emissions

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Recommendations

- **For private decision-making**:
  - → Plant breeding is an extremely important area of R&D, and plant breeders must take responsibility by investing even more into innovation.
  - → Targets: higher yields but also, e.g., resistances, agronomic traits, orphan crops etc.
- **For public decision-making**:
  - → Must encourage and not hinder plant breeders to further invest
  - → Strengthen R&D as well as fundamental research
  - → Support public awareness raising through interdisciplinary research and evidence-based information campaigns
  - → Establish differentiated regulatory framework based on proportionate and non-discriminatory safety considerations
  - → Enforcement of plant breeders' rights to assure future innovation and benefits

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Thank you.