CropBooster-P

Roadmap to future-proof Europe's plants

Societal Needs and Expectations

European Commission
Horizon 2020
European Union funding for Research & Innovation

Public engagement with society stakeholders

- Deepening on earlier focus groups (presented by Jess) with a focus on societal response
- Assess societal stakeholders' values, needs and expectations
- Analyse their perception regarding
  - Important crop improvement strategies (needs) and
  - NPBTs role in crop improvements (expectations)

- Interviewed 30 societal stakeholders
  - 7 online workshop focus groups: mid-November 2020 and late January 2021
  - 7 from Italy, Spain, France and Portugal (Mediterranean)
  - 8 from Belgium, Netherlands, Switzerland, Germany, Greece and Lithuania (NW Europe)
  - 15 from Romania (Eastern Europe)
  - plant breeders (n=6), agri-food researchers (n=14), reporters (n=1), farmer/politician (n=1), businesses (n=1) and (inter/non-) governmental organisations (n=7)

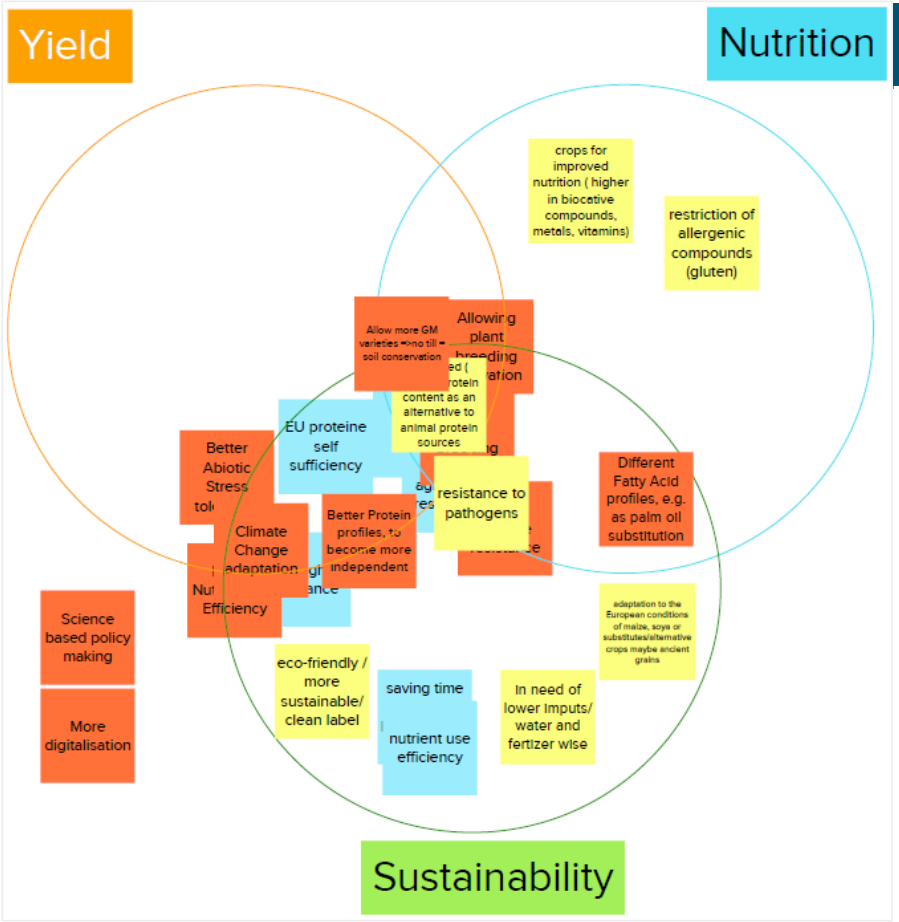
Selected results – Main challenges perceived

- Increasing crop yields to meet the **demand of a growing population** and a changing European market
- **Rural-urban migration** and changing labour dynamics were significant problems exacerbated by the pandemic

"… we have to provide farmers with new ways to make agriculture viable; otherwise, we are going to have a huge problem…" – Eastern European Workshop

- **Climate change** was seen causing (a)biotic stress in crops, leading to crop losses and reduced yields

Selected results – Strategies for future proofing crops



Participant 1: Orange post-it	Participant 2: Yellow post-it	Participant 3: Blue post-it
Allow more GM varieties	Improve protein content as an alternative animal protein source	Bio-aggressor techniques
Allow plant breeding innovations	Resistance to pathogen	New breeding techniques
Better disease resistance	Adaptation to EU conditions	EU protein sufficiency
Better abiotic stress tolerance	Lower input and fertilisers	Drought resistance
Climate change adaptation	Eco-friendly/ sustainable/clean label	Less fertiliser use
Better nutrient use efficiency	Restrict allergenic compounds	Nutrient use efficiency
Better protein profiles	Improve crop nutritional profile	
Different fatty acids		
Digitisation		

Selected results – Strategies for future proofing crops

- Regarding crop improvement strategies, societal stakeholders in most focus groups discussed the need to
  - **increasing protein content** as an important plant breeding strategy pivotal for reducing Europe's protein imports.
  - **improving fatty content** in plants that grow in Europe's climate and soils could help achieve palm oil independence and reducing deforestation in South America

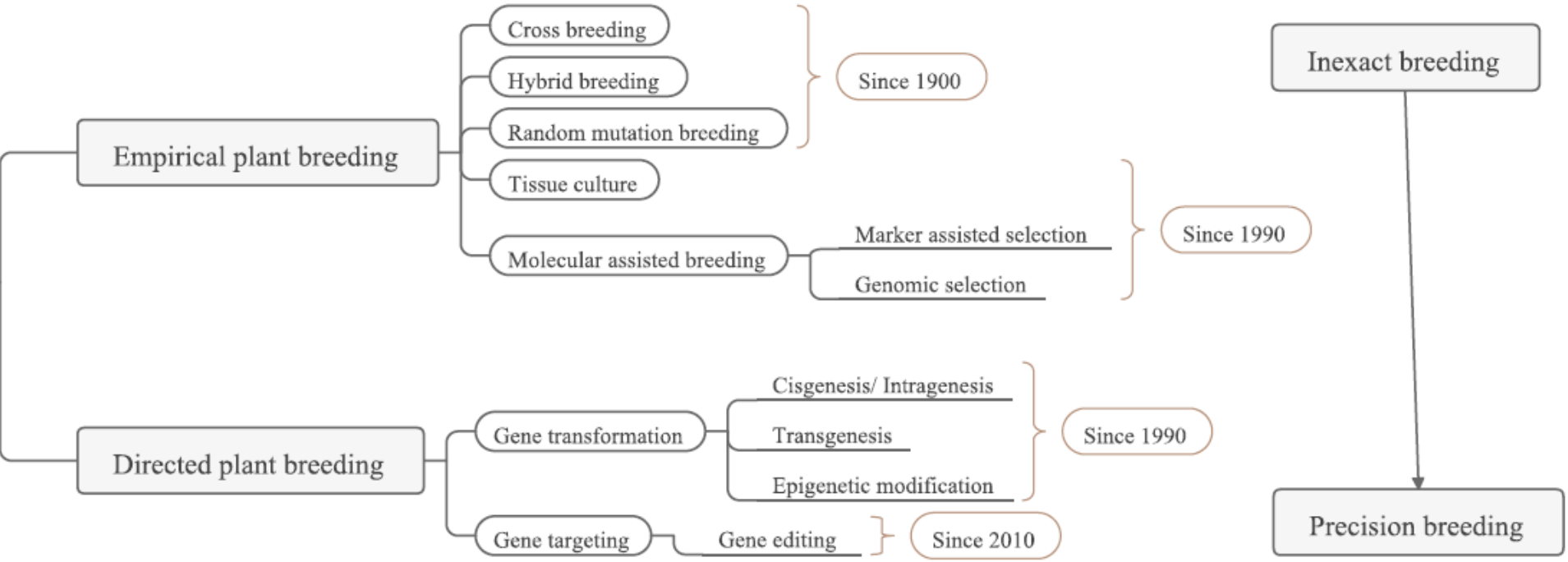
"… we see a huge amount of imports of soybean and other proteins into Europe… and I think becoming more independent of those imports, it is advisable." North West European Workshop Focus Group #1

Selected results – Strategies for future proofing crops

- Strategies that aimed at **effective and efficient use of resources** were essential
- In particular, they mentioned the need to improve
  - water use efficiency
  - nutrient use efficiency and
  - Photosynthetic efficiency in crops

"… and by increasing it [nutrient use efficiency] you don't have to add fertilisers with nitrogen and phosphorus." – Mediterranean Workshop Focus Group #2

Societal stakeholders views on NPBTs



Selected results – Views on NPBTs

- They cited those techniques that seek to develop new plant varieties **must be regulated**.
- They **expect** classical Genetic Modification (trans-genesis and similar) and precision breeding techniques to be regulated separately.
- Current **regulation was outdated** and treated new plant breeding techniques as traditional genetic modification.

"I think the very hesitant approach of the EU, about the regulation of these techniques, does not contribute to consumer confidence in these technologies." – Societal Stakeholder North West European Workshop Focus Group #3

Selected results – Acceptability of NPBTs

- **Favour innovation** but expressed their **scepticism** and views on whether the public would accept them
- Contested the **acceptability** of a few techniques, particularly those for which they perceived, the risks, outweigh, the benefits to the natural ecosystem.
    - Techniques such as random mutation breeding, GMOs specifically transgenic crops, were **criticised** as being imprecise.

"… by using these chemical agents and radiation, you create so many mutations that might also create many unintended mutations. The organic movement sees potential risk in using this technique." – North West European Workshop Focus Group #3

Selected results – Expectations regarding NPBTs

- Raised the **issue of safety and traceability** as being of critical importance to avoid genetic modification pitfalls.
- They mentioned that to gain **consumer acceptance** there has to be communication with society and citizens on
    - the problems the agriculture sector faces,
    - plant breeding outcomes**,**
    - the potential negative consequences (risks) &
    - the benefits to the consumer

"It is vital to inform the society and consumers because theses discussions can help scientists explain the safety of this method, and avoid the mistakes made during GMO's development." – North West European Workshop Focus Group #2

Summary of the results

- Impacts of **climate change** and **meeting the food demands** of a growing population
- **Increasing** i) water-use efficiency, ii) protein content and iii) photosynthesis in **combination** with farm-level strategies such as promoting sustainable local farming, reducing food waste, increasing resiliency to biotic and abiotic stresses are crucial future-proofing
- The most critical **factors limiting the acceptance** of NPBTs is the lack of i) precise regulation, ii) openness and transparency in communicating the risk and benefits of NPBTs and iii) general lack of communication between plant scientists, agri-businesses, consumers and policy-makers

Conclusion

- **Combine** crop improvements, farm-level and food systems strategies to meet local and global food demand and ensure sustainability, resilience and quality
- Take a **pro-active** approach in regulating NPBTs
- **Foster innovation, openness and transparency** among plant scientists, agri-businesses, consumers and policy-makers in the development and deployment of new plant genetic material

How to use the scenarios in CropBoosterP – from static opinions to simulating development

Setting the option space for yield, nutrition and sustainability

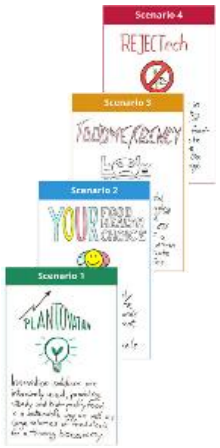
CropBooster "As is" 2019

technologies

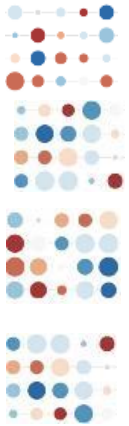
EU crops

WP 1

Future worlds 2050



Alternative outcomes



Multidimensional assessment of the option space

WP 2

Economic, Social and Environmental Impact

WP 3

Societal Needs and Expectations

WP 4

International Cooperation

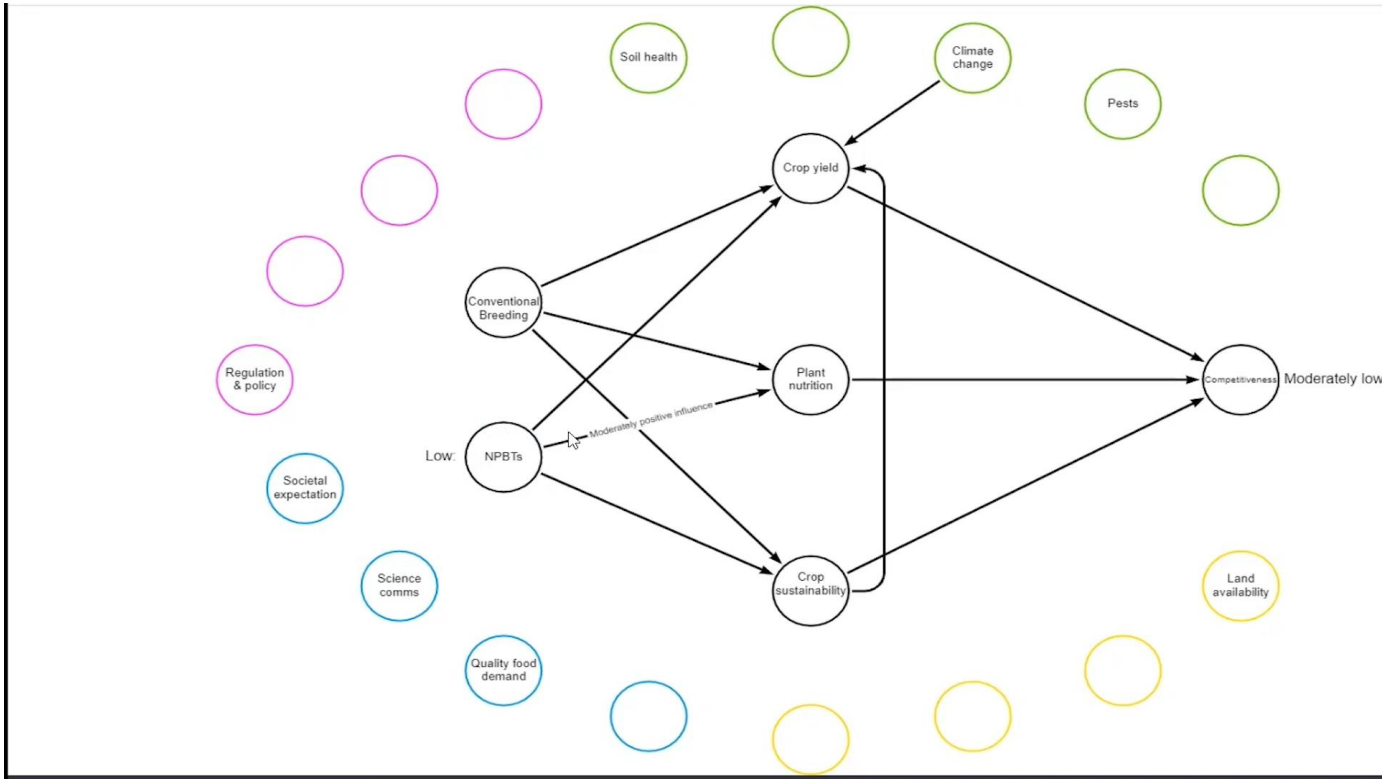
Strategy Development

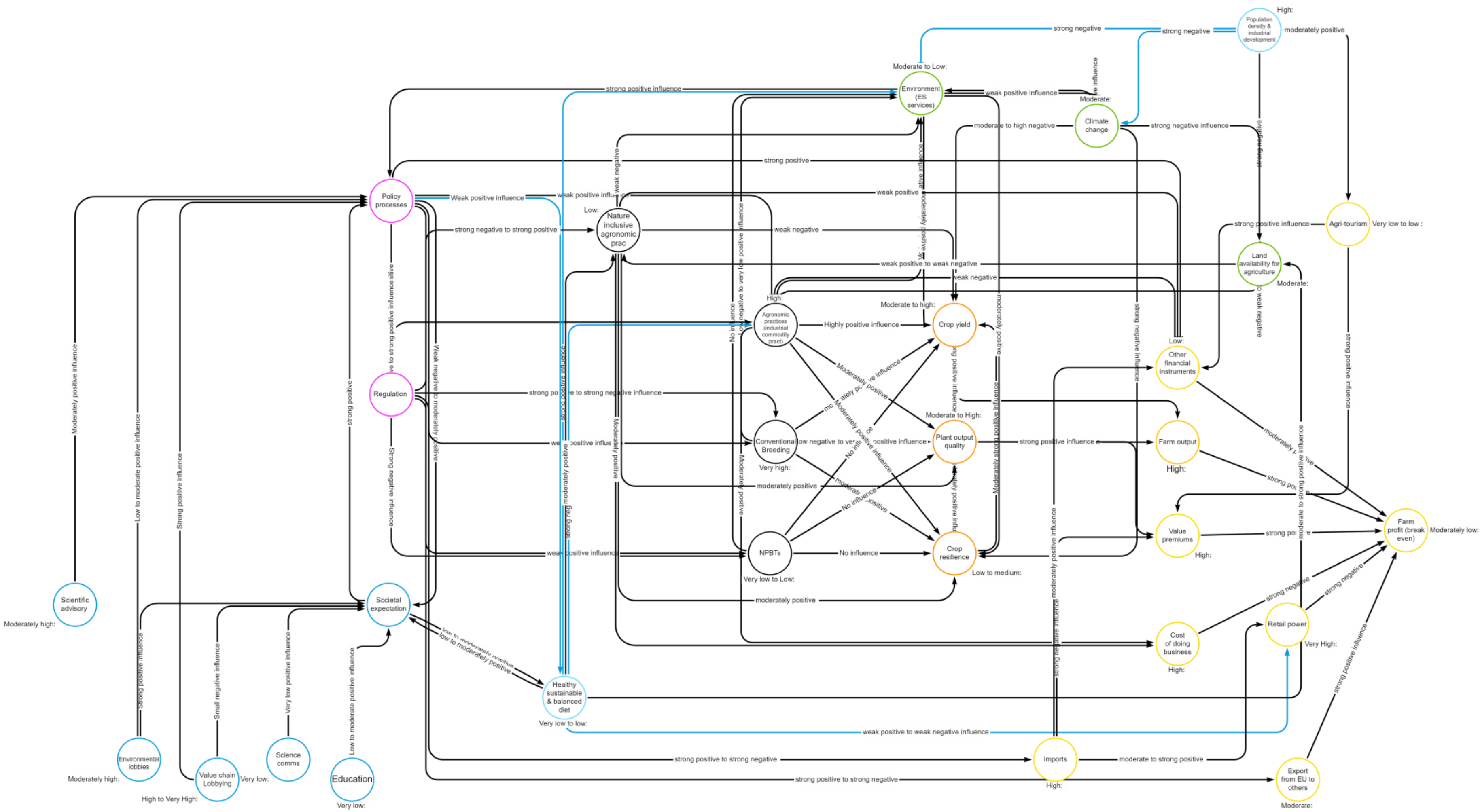
- Roadmap to future proof the EU crops
- Improved societal awareness and engagement
- Taking into account how the future may develop
- In depth anticipation of economic, social and environmental impacts

A cognitive map of European agri-food systems

- To build a cognitive map of the current agri-food system
- Six CropBooster-P partners from WPs 1 to 3
- They had expertise in plant science, agronomy, environmental science, agri-business, marketing and consumer science
- To develop the agri-food system map we organised three focus groups sessions taking us about 60 person-hours to create the cognitive map

A cognitive map of European agri-food systems





Population density & industrial development
High:
moderately positive
strong negative
Environment (ES services)
Moderate to Low:
Climate change
Moderate:
weak positive influence
moderate to high negative
strong negative influence
strong positive influence
Policy processes
Weak positive influence
weak positive influence
strong negative to strong positive
Nature inclusive agronomic prac
Low:
weak negative
strong positive
weak positive
Agri-tourism
Very low to low :
Land availability for agriculture
Moderate:
weak positive to weak negative
Agronomic practices (industrial commodity pract)
High:
Highly positive influence
Crop yield
Moderate to high:
Other financial instruments
Low:
Regulation
Conventional Breeding
Very high:
Plant output quality
Moderate to High:
strong positive influence
Farm output
High:
moderately positive
NPBTs
Very low to Low:
No influence
Crop resilience
Low to medium:
Value premiums
High:
Farm profit (break even)
Moderately low:
Cost of doing business
High:
Retail power
Very High:
strong negative
Societal expectation
Scientific advisory
Moderately high:
Moderately positive influence
Low to moderate positive influence
Strong positive influence
Strong negative influence
Healthy sustainable & balanced diet
Very low to low:
low to moderately positive
weak positive to weak negative influence
Environmental lobbies
Moderately high:
Value chain Lobbying
High to Very High:
Very low:
Small negative influence
Science comms
Very low positive influence
Education
Very low:
Low to moderate positive influence
strong positive to strong negative
Imports
High:
moderate to strong positive
Export from EU to others
Moderate:

Current states of system variables

Crop yield	*Moderate to high*
Plant quality output	*Moderate to high*
Crop resilience	*Low to*
Farm output	

Ecosystem services & functioning	*Low to moderate*
Climate change	*Moderate*
Agriculture land availability	*Moderate*

Value premiums	*High*
Cost of doing business	*High*
Farm profitability	*Moderately low*

Assessing the impact NPBTs under various CropBooster-P priorities

- Compare baseline against seven target outcomes
  - Assess the impact of each CB option (3)
  - Assess the impact of combined technology deployment under the four CB scenarios (4)

		Moderately high	Moderately high	Moderate	High	Moderate
		Cropy yield	Plant Quality	Crop resilience	Farm output	Farm profitability
Baseline scenarion		0.712	0.788	0.687	0.768	0.721
Technology deployment I	Yield	0.788	0.791	0.697	0.779	0.723
Technology deployment II	Nutritional quality	0.723	0.843	0.697	0.778	0.724
Technology deployment III	Crop resilience	0.733	0.799	0.765	0.773	0.722
Technology deployment IV	Yeild and Nutritionl quality	0.788	0.843	0.697	0.786	0.7263
Technology deployment V	Yeild ansd crop resilience	0.796	0.799	0.765	0.781	0.724
Technology deplyment VI	Nutritional quality and Crop resilience	0.733	0.849	0.765	0.78	0.725
Technology deplyment VII	YNS	0.796	0.849	0.765	0.788	0.7268
	Scale	0.5-0.7	0.6-0.8	0.7-0.9	0.8-1	
		small increase	moderate increas	large increase	very large increase	

Assessing the impact NPBTs under various socio-ecological and technological scenarios

- Our aim was to assess the socio-ecological impacts NPBTs under potential future scenarios

Scenarion Reject tech		***C1***	***C2***	***C3***					
	Identify three concepts you want changed in the systems for this scenario	*Agronomic practicies*	*Convential breeding*	*Nature inclusive agro practices*	*Imports*	*Climate change*	*Exports*	*Science advisory*	
	What is the new state of the concept? Describes using lingustic terms	*Low to moderate*	*High*	*High*	*Very high*	*Moderlately high*	*Very low*	*Relative*	
Scenarion Food emergency		***C1***	***C2***	***C3***					
	Identify three concepts you want changed in the systems for this scenario	*NPBTs (influence crop resilience & yield*	*Climate change*	*Ecosystems services*	*Land availability/use*	*Agronomic practice (Industrial)*	*Exports*	*Imports*	*Science advisory*
	What is the new state of the concept? Describes using lingustic terms	*Very high*	*Very high*	*Very low*	*High*	*Very high*	*Very low*	*Very high*	*Relative*
Scenarion Consumer choice		***C1***	***C2***	***C3***					
	Identify three concepts you want changed in the systems for this scenario	*NPBTs (influences plant quality)*	*Nature inclusive agro practices*	*Climate change*	*Agronomic practice (Industrial)*	*Healthly sustainable*	*Societal expectation*		
	What is the new state of the concept? Describes using lingustic terms	*Very high*	*Moderate*	*State same as baseline (influnce changed)*	*State same as baseline (influnce changed)*	*High to very high*	*State same as baseline (influnce changed)*		
Scenario Plant-o-vation		***C1***	***C2***	***C3***					
	Identify three concepts you want changed in the systems for this scenario	*NPBTs (all three CB options priortised)*	*Climate Change*	*Agronomic practice (Industrial)*	*Nature inclusive agro practices*	*Scientific advisory*			
	What is the new state of the concept? Describes using lingustic terms	*Very High*	*Moderate*	*Very High*	*Moderate*	*State same as baseline (influnce changed)*			

Baseline vs Plantovation

Farm productivity variables	Initial state in fuzzy linguistics	Relative change	Absolute change
Baseline			
Crop yield	*Moderate to high*	0.699	*High to moderately very high*
Plant quality output	*Moderate to high*	0.783	*High to moderately very high*
Crop resilience	*Low to moderate*	0.675	*Moderate to high*
Farm output	*High*	0.766	*Very high*
Plantovation			
Crop yield	*Moderate to high*	0.808	*Moderately very high to very high*
Plant quality output	*Moderate to high*	0.877	*Moderately very high to very high*
Crop resilience	*Low to moderate*	0.799	*Moderately high to moderately very high*
Farm output	*High*	**0.793**	*Very high (high certainty)*

Baseline vs Plantovation

Ecologicial variables	Initial state in fuzzy linguistics	Relative change	Absolute change
Baseline			
Ecosystem services & functioning	*Low to moderate*	0.223	*Very low to moderately very low*
Climate change	*Moderate*	0.62	*Moderately high*
Agriculture land availability	*Moderate*	0.394	*Moderately low*
Scenario I - Plantovation			
Ecosystem services & functioning	*Low to moderate*	0.332	*Moderately very low to low*
Climate change	*Moderate*	0.63	*Moderately high*
Agriculture land availability	*Moderate*	0.393	*Moderately low*

Baseline vs Plantovation

Economic variables	Initial state in fuzzy linguistics	Relative change	Absolute change
Baseline			
Value premiums	*High*	0.656	*Moderately very high*
Cost of doing business	*High*	0.764	*Very high*
Farm profitability	*Moderately low*	0.721	*Moderately high*
Scenario I – Plantovation			
Value premiums	*High*	**0.672**	*Moderately very high (more certain)*
Cost of doing business	*High*	0.764	*Very high*
Farm profitability	*Moderately low*	**0.728**	*Moderately high (more certain)*

Summary

- NPBTs moderately increase farm productivity and reduces agriculture's impact on ecosystem services and functioning
- NPBTs also contribute to a very small increase in farm output, value premiums and farm profitability
- So why does it only increase farm profitability ever so slightly?
    - Does globalisation and the reducing land availability increase costs of doing business?
    - Does that much power lie with retail to suppress farm profitability?
    - Also we don't know the influence of NPBTs in changing the influence that agronomic practices has on the cost of business

Thank You!