

CropBooster-P

Work Package 2: Update

19.11.2020

Prof. Jess Davies,
Lancaster University

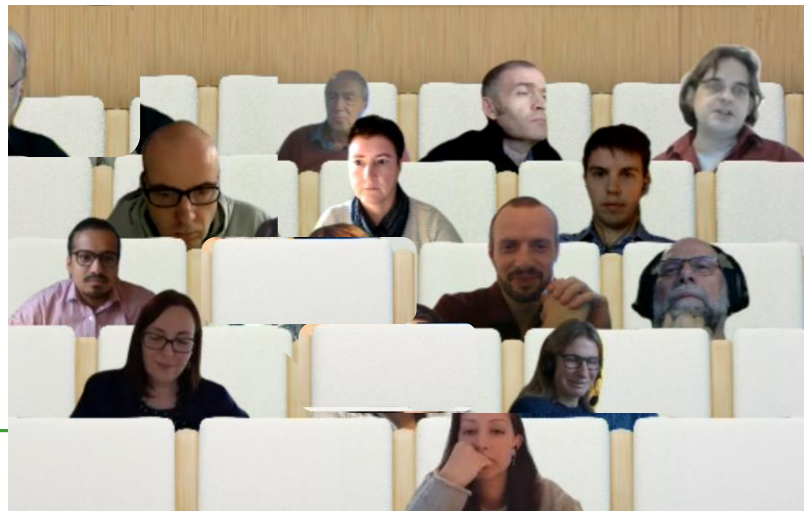
@ProfJessDavies
#CropBoosterP



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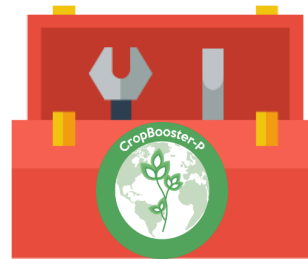
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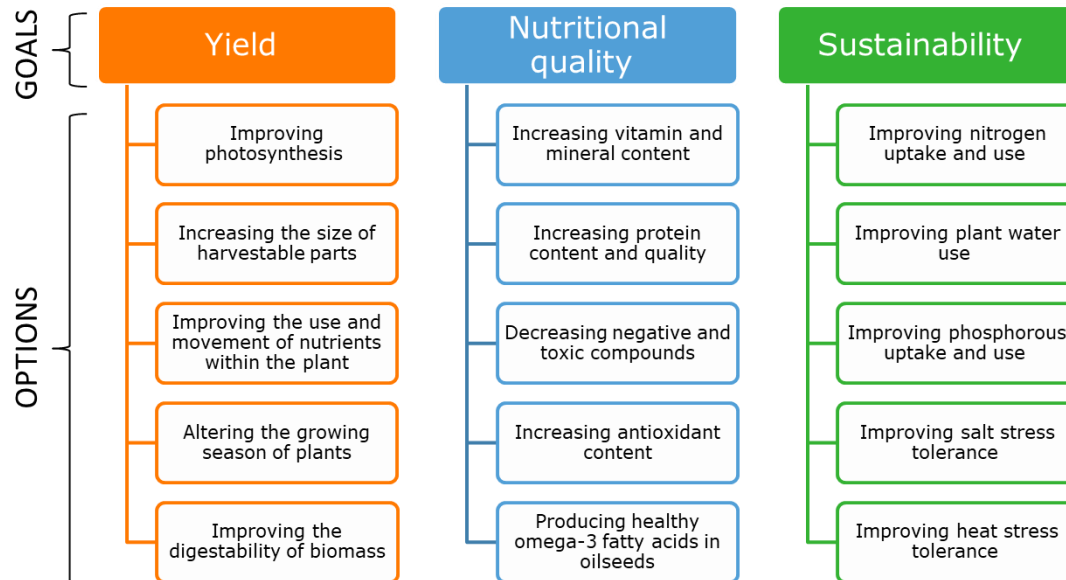


Our part in the Cropbooster project

Assess the **potential economic, social and environmental impact** of our toolbox of plant improvement options for improving yield, sustainability and nutritional quality.



Toolbox of “cropboosting” options compiled by leading plant scientists



Our part in the Cropbooster project

Helping to understand the role of crop improvements in a food system under pressure

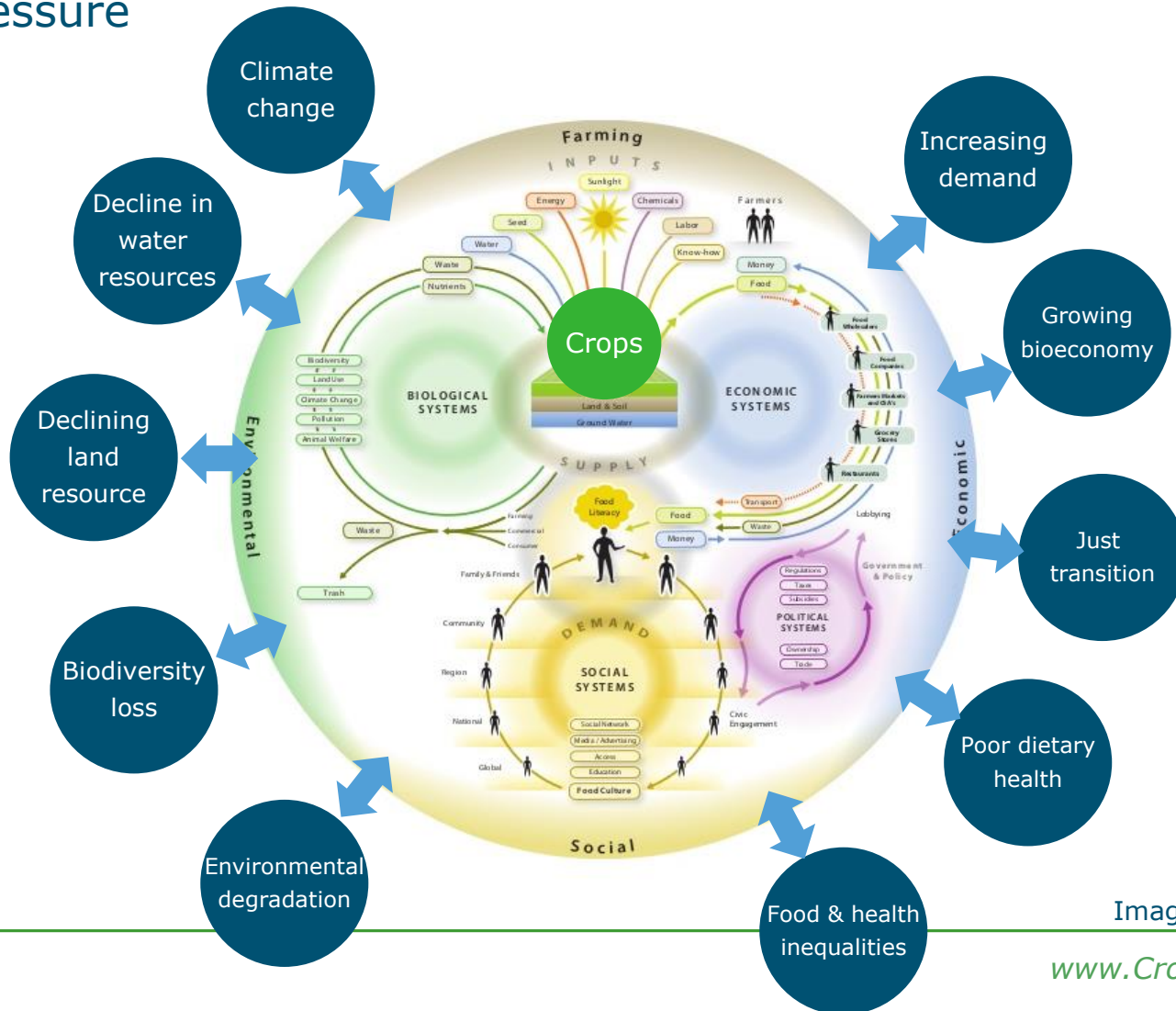
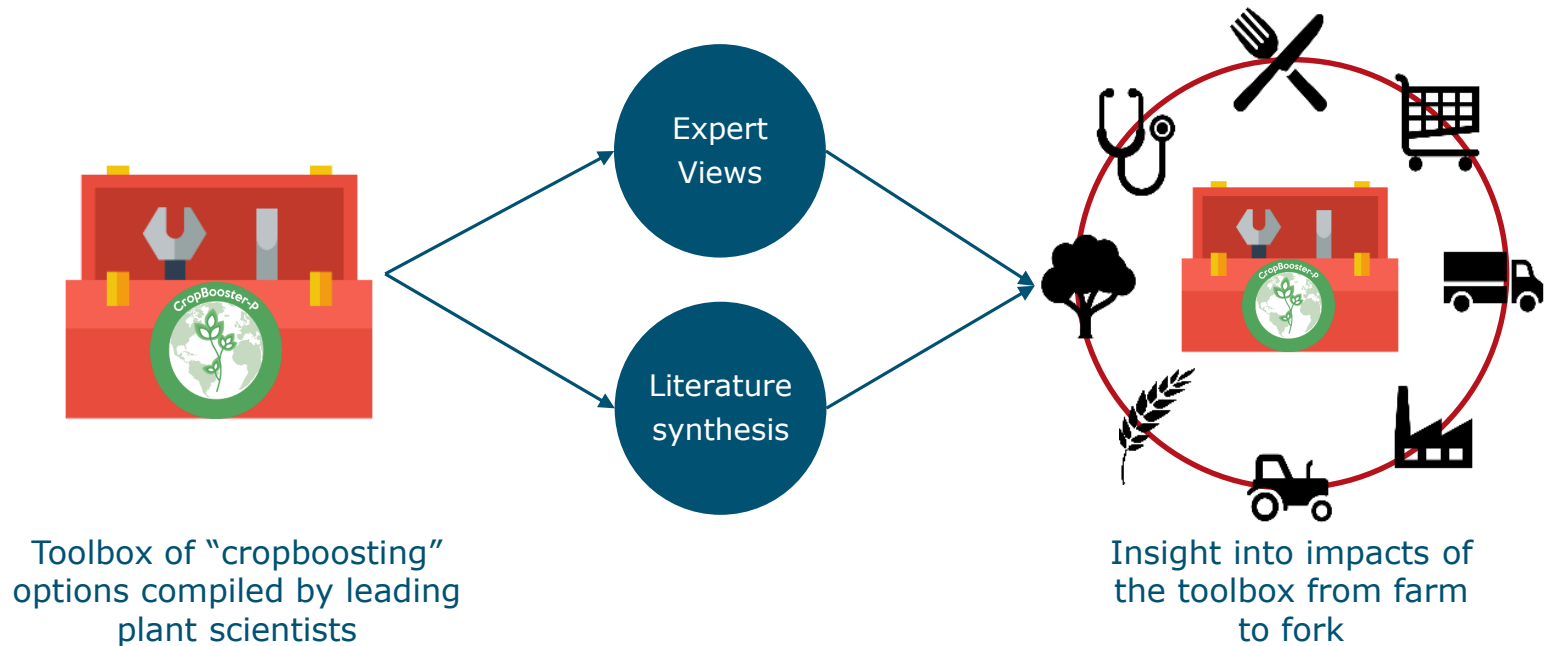


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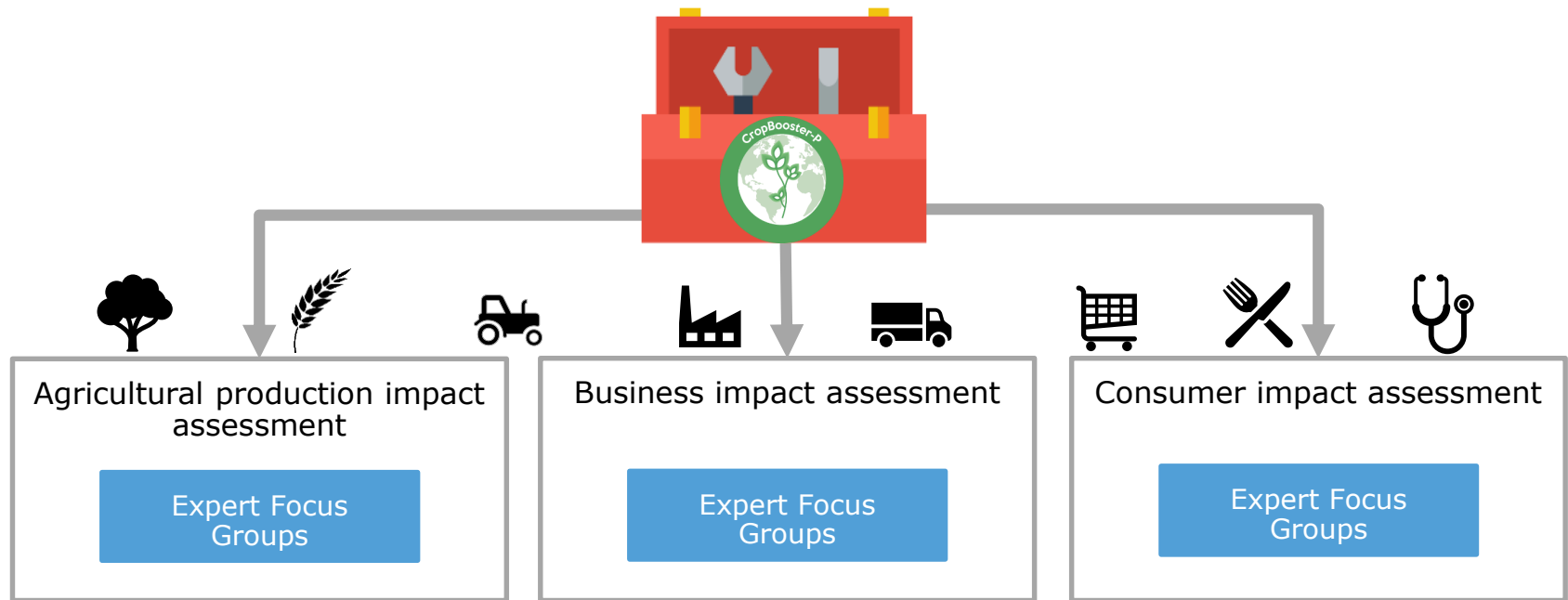
www.CropBooster-P.eu

Our part in the Cropbooster project

Assess the **potential economic, social and environmental impact** of our toolbox of plant improvement options for improving yield, sustainability and nutritional quality.



Methodology



- Qualitative data collection from experts across the food system
- Priorities and impacts



Expert focus groups



Hosted total of **24 hours of focus groups**, with **35 expert participants**

YIELD

IMPROVING PHOTOSYNTHESIS

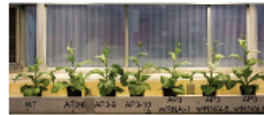


Photosynthesis is the process of turning the energy from the sun into usable energy in the form of sugar.

This option includes a range of breeding technologies that aim to increase the efficiency of photosynthesis.

YIELD

EXAMPLE: Improving photosynthesis for more biomass



By reducing the amount of energy the plant spends on respiration, scientists were able to increase plant biomass by 40% in tobacco (South et al., 2019).

OPTION CARD #16

NAME: _____



Description: _____

NUTRITION

INCREASING PROTEIN CONTENT AND QUALITY



Protein is an essential part of the human diet and is made of amino acids. Certain types of protein are useful because they contain high levels of specific amino acids that humans need to build muscle.

This option includes a range of breeding technologies that aim to increase the protein content of crops whilst maintaining yield.

NUTRITION

EXAMPLE: Improving protein content of wheat



The *NAM-A1* gene has been linked to grain protein content in wheat (Jauy et al., 2006). By boosting this gene, it is possible to improve grain protein content in cereal crops.

SUSTAINABILITY

IMPROVING PLANT WATER USE



Lack of water affects plant productivity and can decrease crop quality.

This option includes a range of breeding technologies that aim to improve uptake of water from soil, reduce water loss in the plant and help it use water more efficiently.

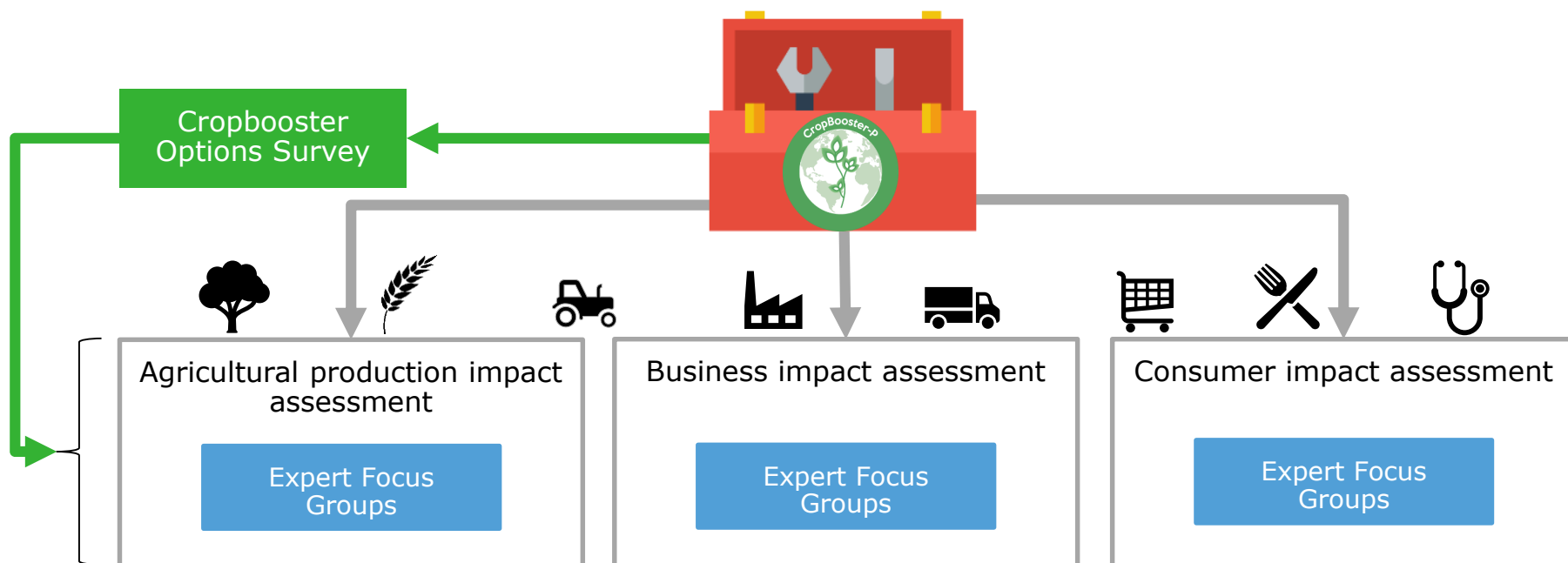
SUSTAINABILITY

EXAMPLE: Improving roots to cope with water stress



Larger root systems can extract more water and nutrients under stress conditions in crops – improving root systems could improve plant stress tolerance (Ye et al., 2018).

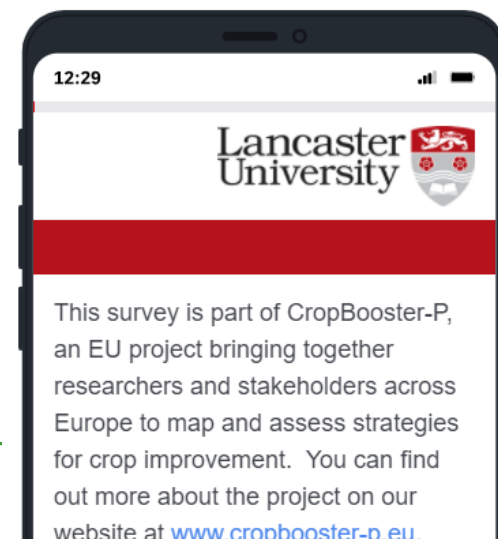
Methodology



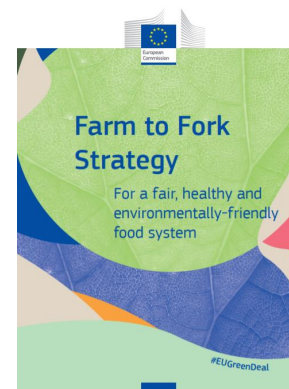
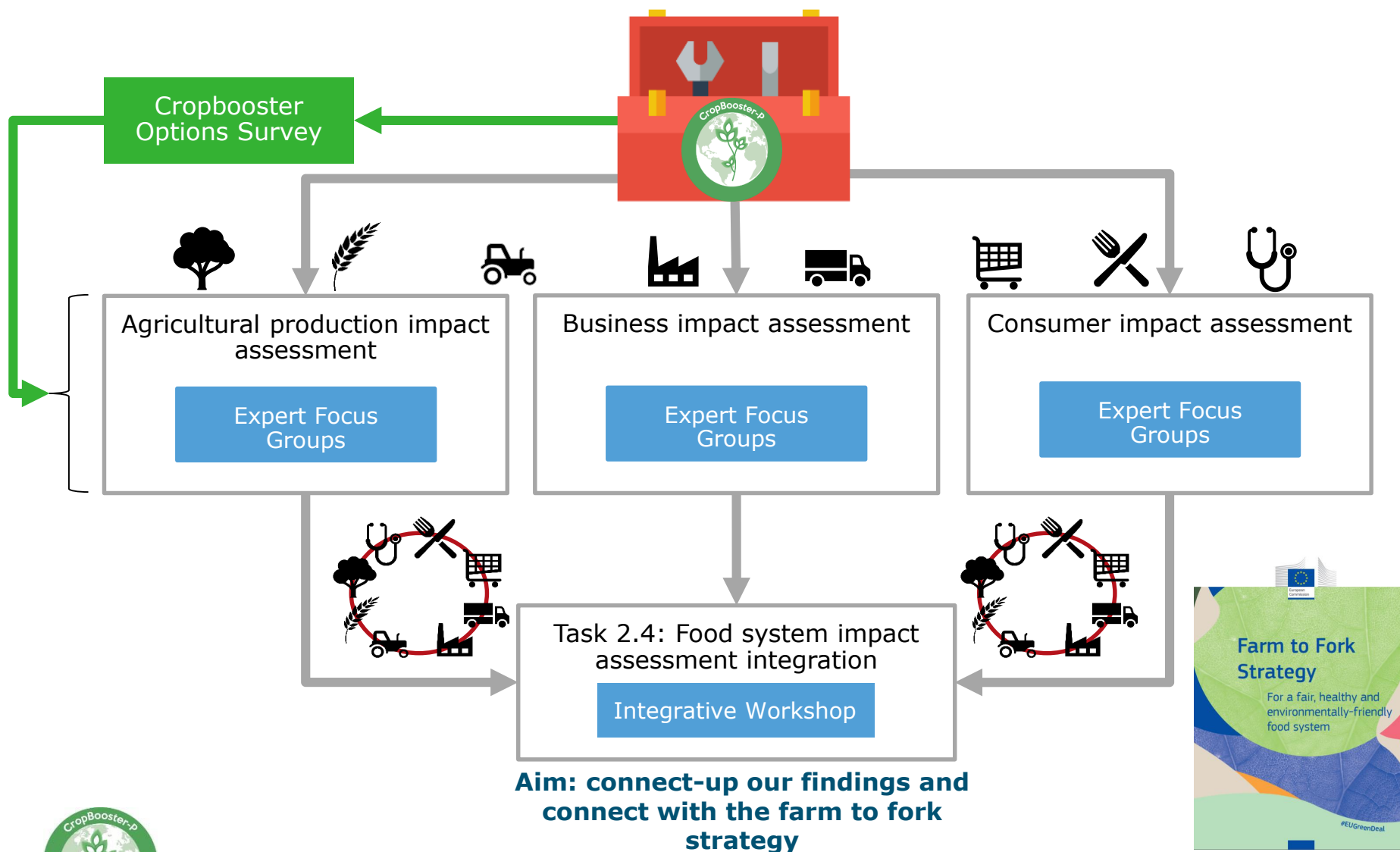
Survey in English, French & German

>200 participants

Quantitative data on priorities for crop improvement



Methodology



Today

Some of the WP2 team will share with you some of our findings from the:

- Expert workshops
- Survey
- Integrative workshop

And highlight the next steps for the workpackage.

What we would like from you:

- Your feedback and thoughts on the findings that help us shape the outputs further
- Identify unforeseen linkages into the next WPs



Workshop Results

Dr Abhishek Nair
Wageningen University
#CropBoosterP



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Workshop: Goals

- Gain an expert's understanding of
 - main challenges for the food and agriculture sector
 - crop boosting priorities
 - Social, economic and environmental impacts
 - other possible strategies that should be considered
- Advise European policy makers about technologically-possible and socially-acceptable crop improvement strategies



Workshop: Breakdown

Focus groups



Farm level	4
Agri-business	2
Consumer	3

Experts



Farm-level	16
Agri-business	11
Consumer	8

Workshops



Farm-level
(May 2020)



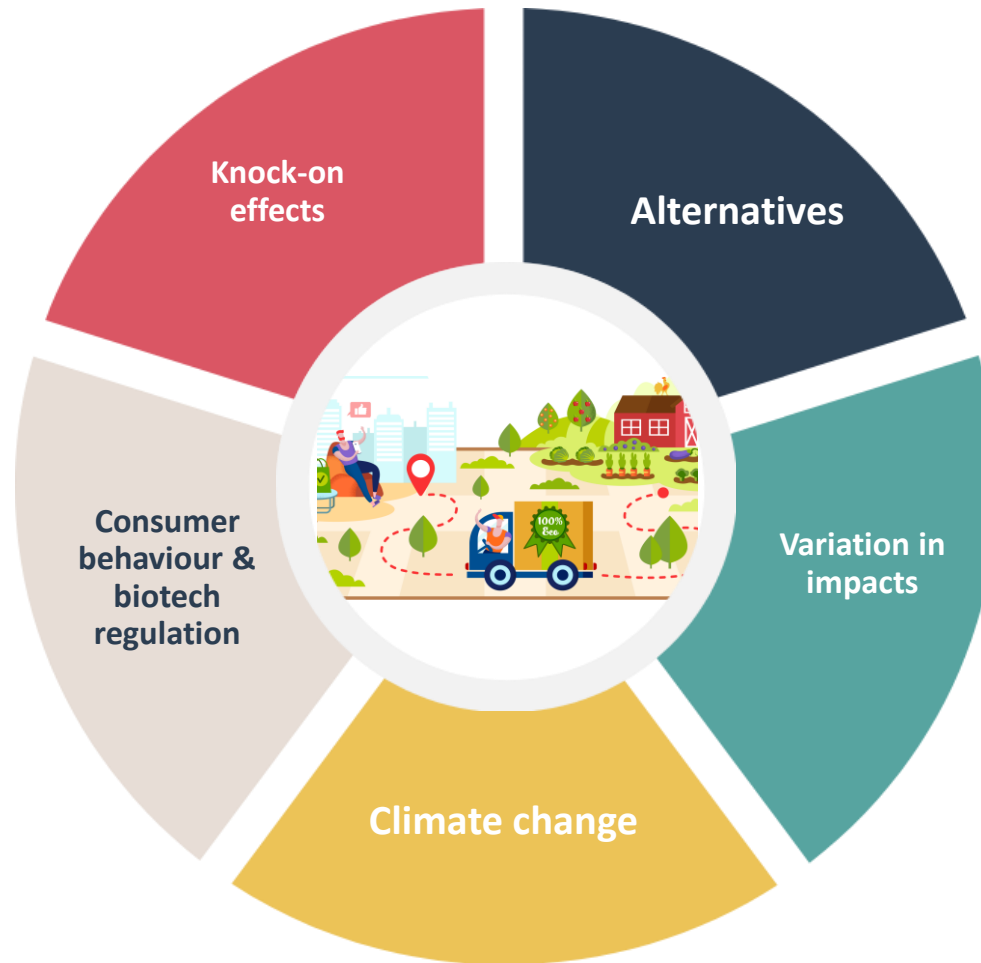
Agri-business
(May 2020)



Consumer
(June 2020)



Key themes



Knock-on effects

- Experts raised concerns regarding trade-offs associated with crop boosting option such as altering the growing season, increasing size of harvest parts, and decreasing negative and toxic compounds



Knock-on effects



"...decreasing the negative and toxic compounds and elements. I would be extremely careful... need to remember that these negatives are there for a reason, which is about the natural preservation [against] some-kind-of pest or insect..."

– Agri-business expert

Knock-on effects

"I'm not excited about increasing the size of harvestable parts, and the reason being, increasing the size has negative impacts on quality or taste profile"

– Consumer



Alternatives



- Participants questioned whether the aims of particular CropBooster options were best met through crop improvements or some other type of intervention.

Alternatives

"I don't think any of these are important for human nutrition, because I don't think it's the plant's fault that we have malnutrition as a problem in Europe, be it lack of or too much. It is how we eat and what we choose to eat."

- Farm-level representative



Alternatives



"I think that urban agriculture is becoming very important right now for food security in European cities, and there's a huge movement in that. I think the aspects of urban agriculture in adapting crops to would be interesting." – Consumer

Variation in impacts

- Concerns regarding geographical variation in impact of particular cropboosting options



Variation in impacts



"We have to keep in mind that different regions have different needs and different characteristics. When we talk about sustainability, we tend to use a general European concept that cannot be applied the same way in the northern, in the center or in the southern parts."

- Farmer-level expert

Variation in impacts

"... in Europe [nutrition] is not really the issue. So, I wonder if this will be much more relevant for Southeast Asia and African crops..."

– Plant breeder



Climate change

- The impact of climate change and
- the need for crop improvement options that respond to it



Climate change



"... is issues around climate change and making sure that future agricultural production practices are compatible with the concerns that climate change brings."

– Consumer

Climate change

"So the probably upcoming effects of climate change and the desertification of many places in the European Union. That will be something important to consider, very, very important."

- Farmer-level expert



Consumers and GM regulation



- A theme shared between agri-business and consumer group representatives was the regulation and consumer acceptance of biotechnology
- These were acknowledged to be a significant barrier to certain crop improvement strategies

Consumers and GM regulation

"...you think a range of breeding technologies... you think yes, that sounds really good. And when you dig deeper it's a genetic modification, there's going to be a lot of resistance from a consumer perspective to GM crops." – Consumer #4

– Consumer



Consumers and GM regulation



"... it's also a big problem that if, again, coming back to these new kind of breeding technologies, if Europe is allowed to import these foods or products made from these foods, then our farmers just don't stand a chance, I think."

– Plant breeder

Summary

- Consider potential trade-offs
- Target local or regional crop improvement challenges
- Directly address the multiple challenges posed by climate change
- Target issues *best* addressed through crop improvement, rather than those for which competing alternative interventions exist
- Not to solely rely on biotechnology



Survey Results

Dr Jonathan Menary
Lancaster University
#CropBoosterP



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The three cropboosting goals

Goals

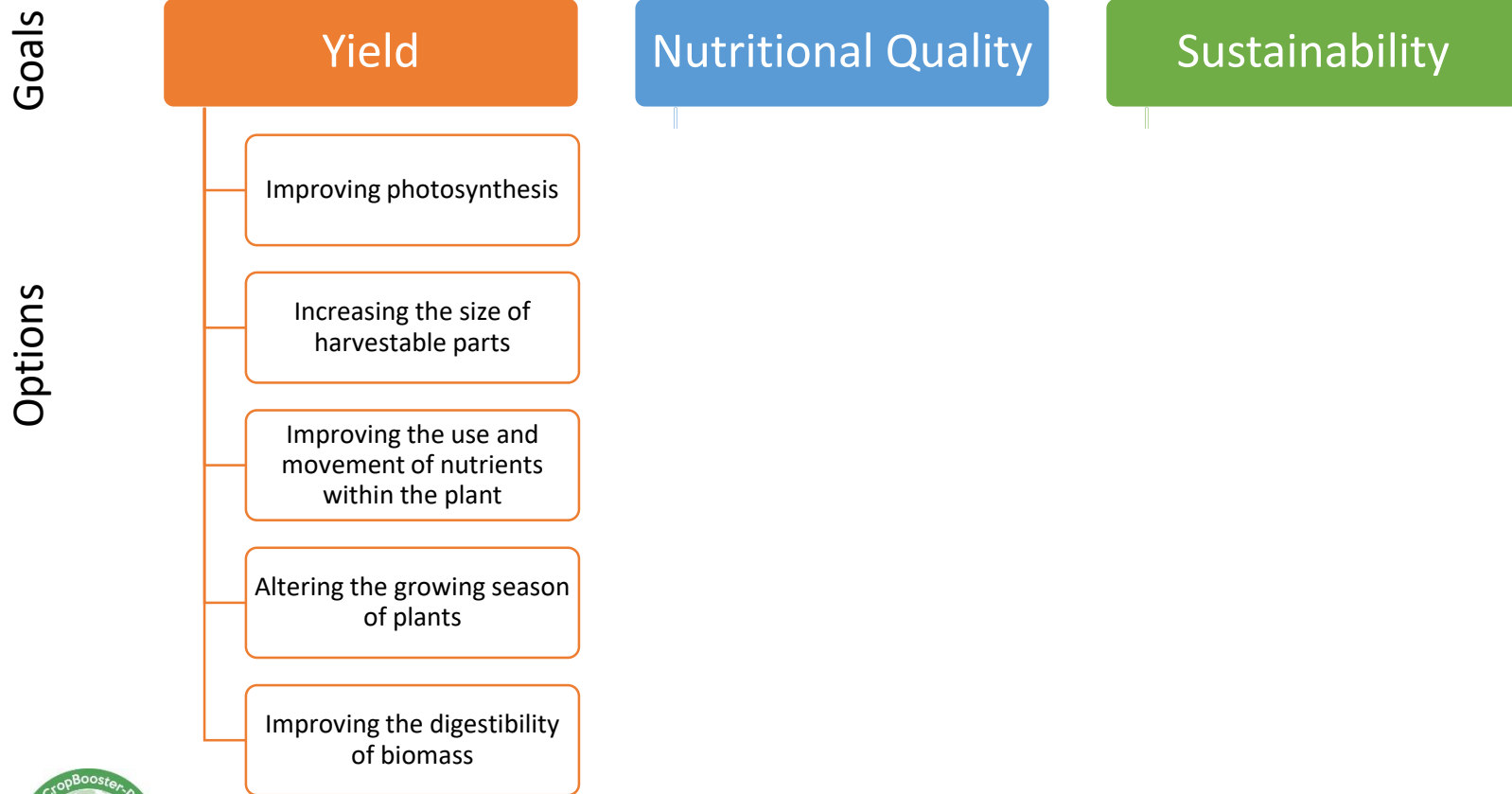
Yield

Nutritional Quality

Sustainability



The 15 cropboosting options



The 15 cropboosting options

Goals

Options

Yield

Improving photosynthesis

Increasing the size of harvestable parts

Improving the use and movement of nutrients within the plant

Altering the growing season of plants

Improving the digestibility of biomass

Nutritional Quality

Increasing vitamin and mineral content

Increasing protein content and quality

Decreasing negative and toxic compounds

Increasing antioxidant content

Producing healthy omega-3 fatty acids in oilseeds

Sustainability



The 15 cropboosting options

Goals

Options

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Sustainability

Improving Nitrogen uptake and use

Improving plant water use

Improving phosphorous uptake and use

Improving salt stress tolerance

Improving heat stress tolerance



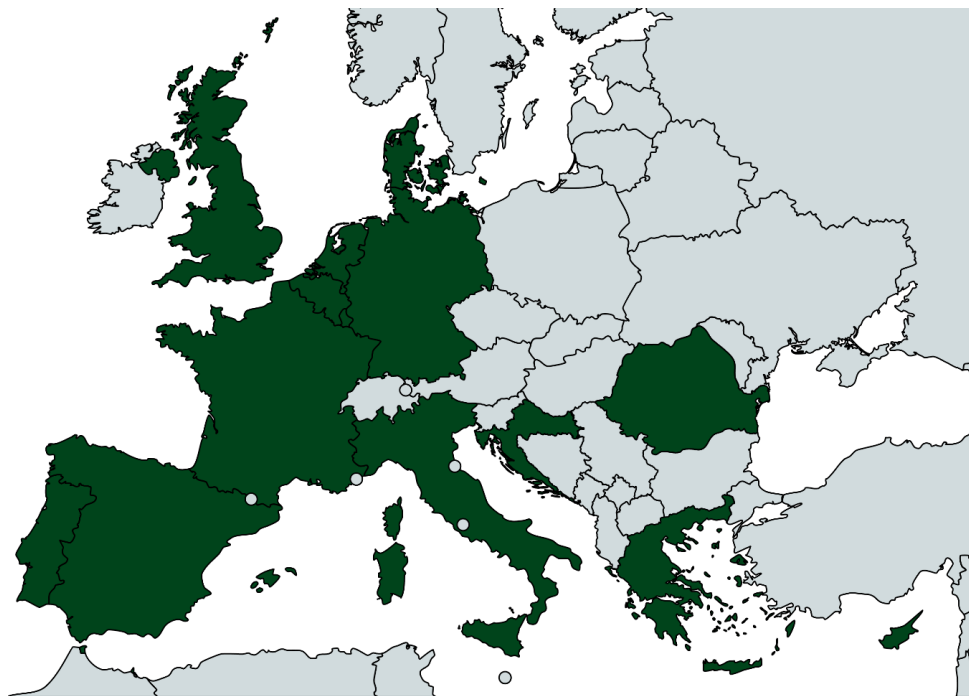
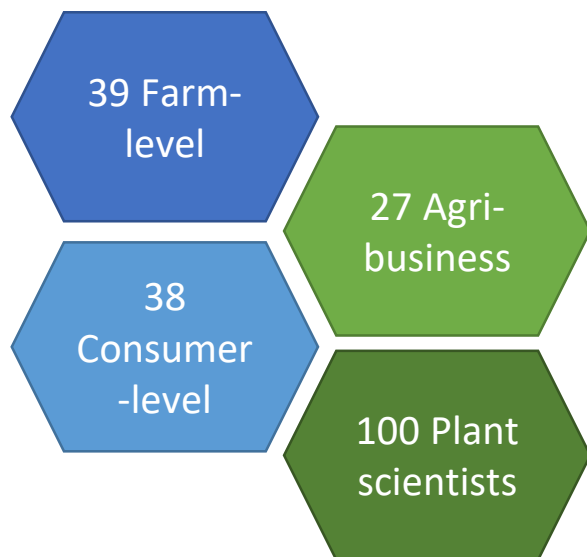
Survey aims

1. Which goals – Yield, Nutrition, Sustainability – do people feel are most important?
2. Which options are most important?
3. Do different stakeholder groups have different opinions?



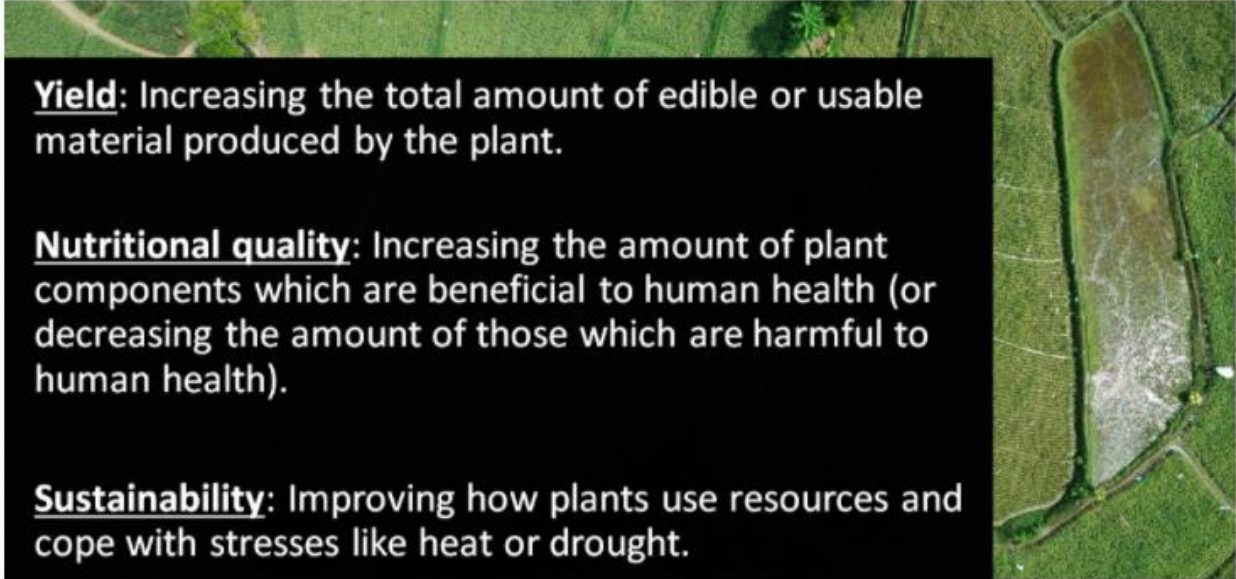
Survey uptake

- Online April – May 2020
- Available in French, German, English
- >200 responses



Part 1: Prioritising goals

Please rank the following goals in terms of importance to future-proofing European crops, with 1 being most important and 3 least important.



Yield: Increasing the total amount of edible or usable material produced by the plant.

Nutritional quality: Increasing the amount of plant components which are beneficial to human health (or decreasing the amount of those which are harmful to human health).

Sustainability: Improving how plants use resources and cope with stresses like heat or drought.



Part 1: Prioritising goals

	Farm-level	Agribusiness	Consumer-level	Plant scientists
Yield	19%	44%	16%	26%
Nutrition	12%	19%	8%	15%
Sustainability	70%	38%	76%	60%

"...All must be sustainable in longer term. These are not mutually exclusive and we should be aiming to have them all"

Yield: Increasing the total amount of edible or usable material produced by the plant.

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Sustainability: Improving how plants use resources and cope with stresses like heat or drought.



Part 2: Option importance

Please indicate how important you feel this option is for future-proofing European crops:

IMPROVING PLANT WATER USE



Lack of water affects plant productivity and can decrease crop quality.

This option includes a range of breeding technologies that aim to improve uptake of water from soil, reduce water loss in the plant and help it use water more efficiently.

Very
unimportant

Unimportant

Neither
important
nor
unimportant

Important

Very
important

Don't
know



Part 2: Option importance

Sustainability

Improving plant water use

Improving heat stress tolerance

Improving Nitrogen uptake and use

Improving Phosphorous uptake and use

Improving salt stress tolerance



Part 2: Option importance

		Farm-level	Agribusiness	Consumer-level	Plant Scientists
Sustainability	Improving plant water use	92%	96%	97%	97%
	Improving heat stress tolerance	90%	73%	94%	74%
	Improving Nitrogen uptake and use	85%	85%	92%	85%
	Improving Phosphorous uptake and use	79%	85%	80%	85%
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	Increasing the size of harvestable parts	41%	38%	42%	39%



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	Producing healthy omega-3 fatty acids in oilseeds	53%	50%	60%	51%



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Next steps

What impact might making these improvements have on economy, society and environment?

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The EU Farm to Fork Strategy

Dr Jonathan Menary
Lancaster University
#CropBoosterP

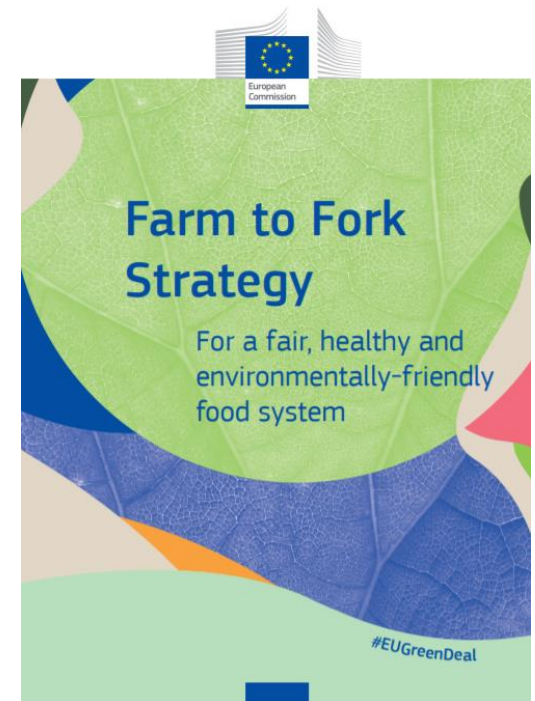


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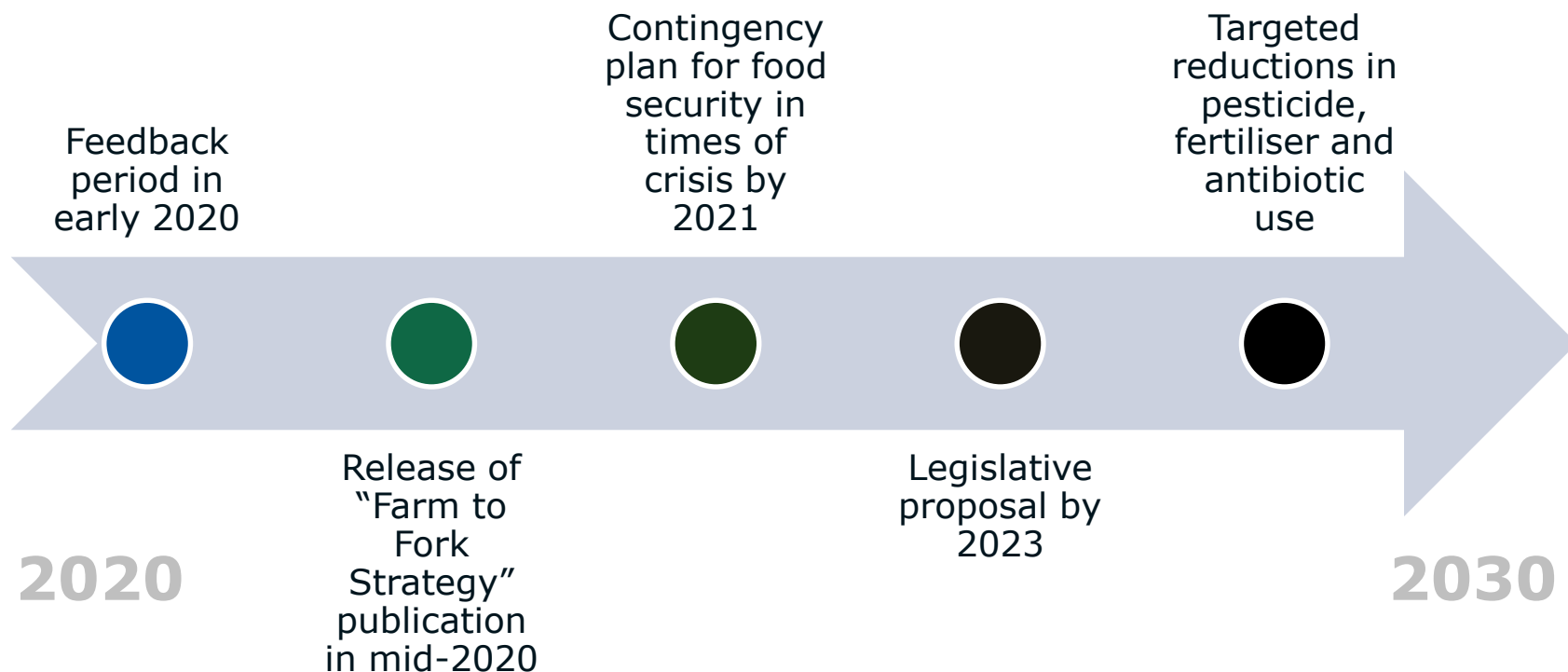
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What is the Farm to Fork strategy?

A broad initiative to provide "a healthier and more sustainable EU food system is a cornerstone of the European Green Deal."



Timeline



What are the aims?

- Ensure the food chain has a **neutral or positive** environmental footprint
- Ensure everyone has access to **safe, nutritious and sustainable food** that protects plant and animal health and welfare
- Ensure sustainable food becomes the most affordable, whilst **generating fairer economic returns** in the supply chain

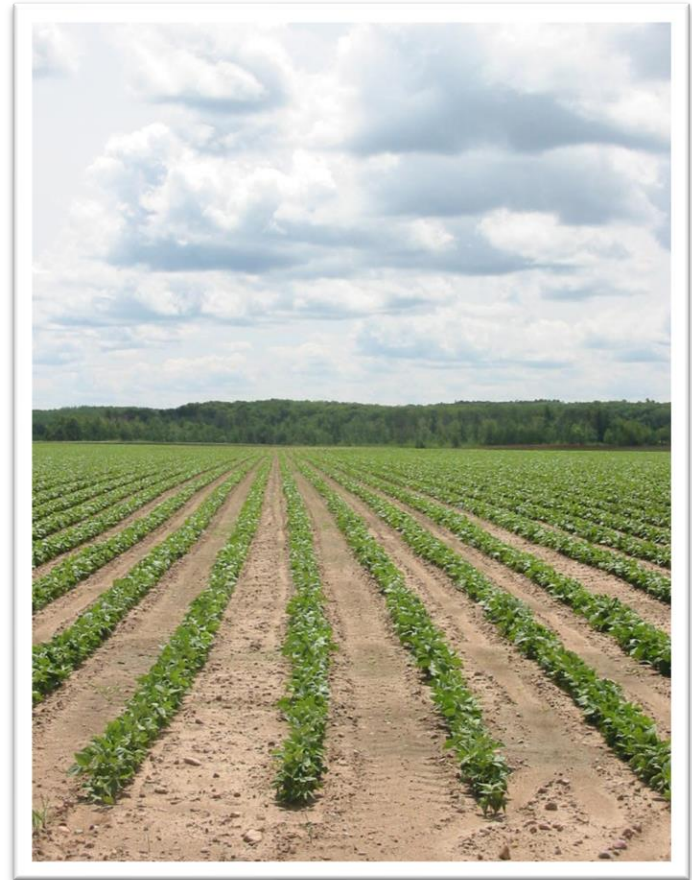


Photo: Adam Roscoe, Flickr



How will it meet these aims?

2030 Targets



Integrative workshop | October 2020

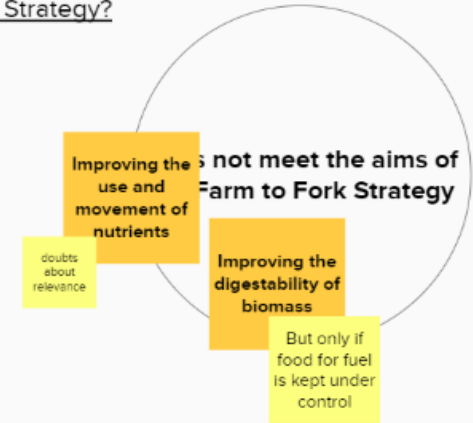
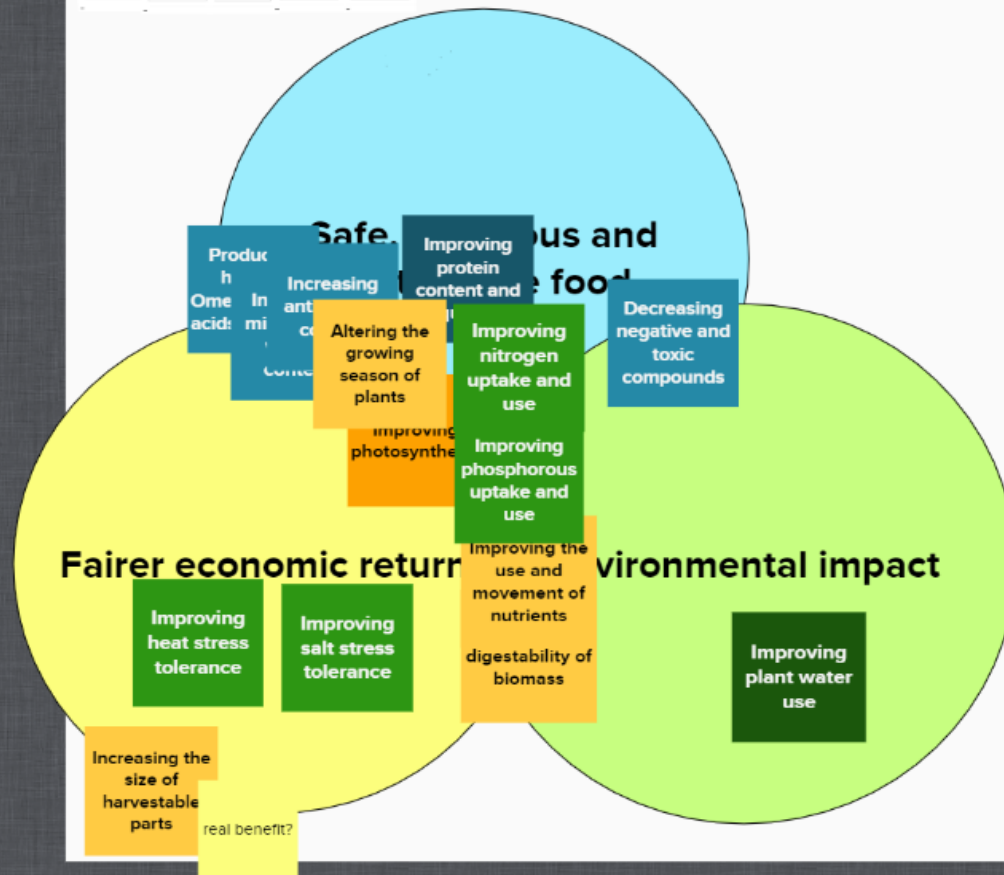
- Engage new and past participants, as well as CropBooster-P colleagues, with the WP findings
- Identify synergies and tensions between our CropBooster options and the Farm to Fork strategy
- 40 participants from across agri-food sector



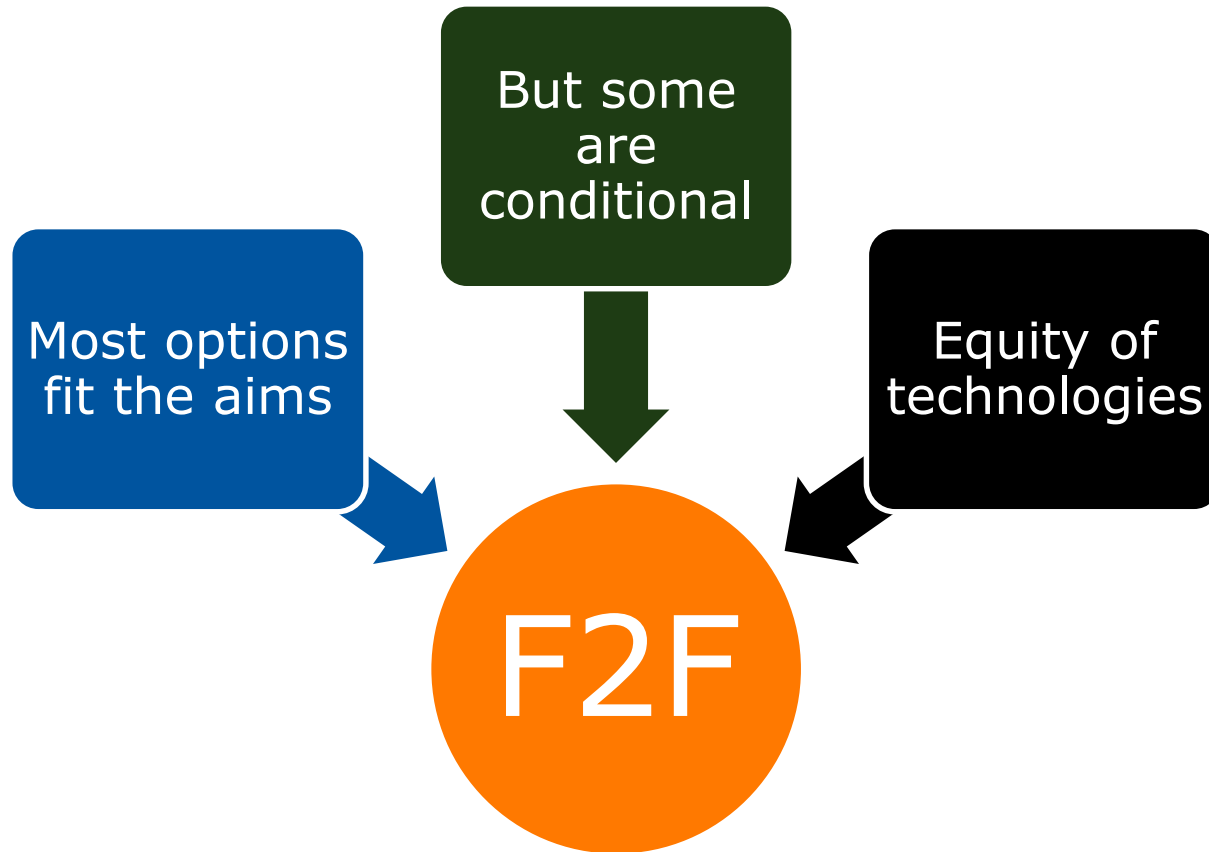
Integrative workshop | October 2020

How do the CropBooster options align with the Farm to Fork Strategy?

1. CropBooster 1 Improving the use and movement of nutrients	2. CropBooster 2 Improving the digestibility of biomass	3. CropBooster 3 Improving the use and movement of nutrients	4. CropBooster 4 Improving the digestibility of biomass	5. CropBooster 5 Improving the use and movement of nutrients
6. CropBooster 6 Improving the use and movement of nutrients	7. CropBooster 7 Improving the digestibility of biomass	8. CropBooster 8 Improving the use and movement of nutrients	9. CropBooster 9 Improving the digestibility of biomass	10. CropBooster 10 Improving the use and movement of nutrients
11. CropBooster 11 Improving the use and movement of nutrients	12. CropBooster 12 Improving the digestibility of biomass	13. CropBooster 13 Improving the use and movement of nutrients	14. CropBooster 14 Improving the digestibility of biomass	15. CropBooster 15 Improving the use and movement of nutrients



Integrative workshop | October 2020



WP2 Next Steps

Dr Arnout Fischer
Wageningen University
#CropBoosterP

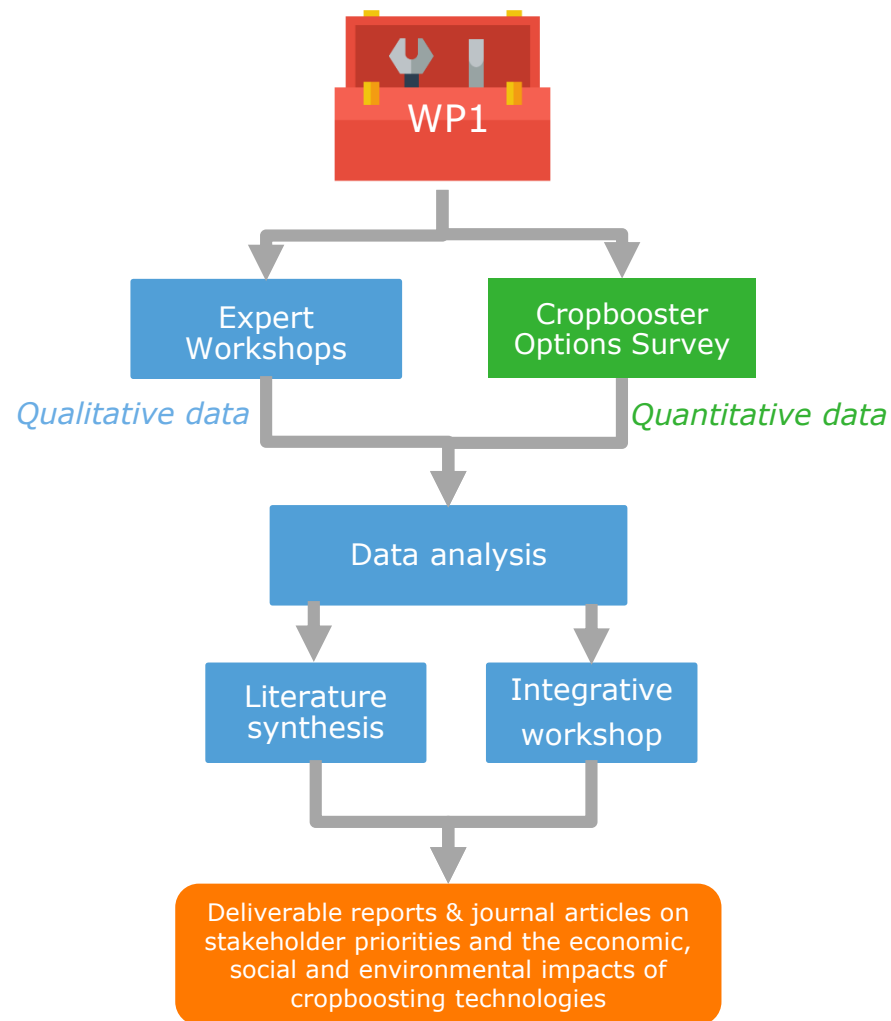


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Next steps

- Literature syntheses – what are the impacts of our top ranked cropboosting options



Next steps – Literature Synthesis

What are the potential economic, environmental and social impacts of these options?






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Next steps - Literature Synthesis

What's involved:

- Rapid Review approach most appropriate

Rapid Review vs. Systematic Review		
	Timeline of 1-6 months	Timeline of 1+ years
	Limited number and complexity of key questions	Comprehensive key questions
	Abbreviated search	Sensitive, systematic search
	Narrow criteria that may be redefined, single reviewer	Inclusive, predefined criteria, dual and full-text review
	Descriptive summary of findings, characteristics of studies, may include critical appraisal	Qualitative/quantitative synthesis of findings, meta-analysis possible, comprehensive critical appraisal

Deliverable and Planned Papers

D2.4 Integrative Report, due May 2021

Planned Journal Papers

1. Methods paper
2. Expert workshop/Survey Insights paper
3. Syntheses papers

Proposed authorship strategy:

- Lead researcher first author, followed by the other researchers
- All participants of WP2 as co-authors
- Task leader last author

Policy Brief?

CropBooster and the Farm to Fork Strategy Brief?



Thank You!

