High Value Biorenewables

HVB Workshop:

How biotechnology can unlock higher value from UK break crops

16 May 2023

REPORT

UKRI Biotechnology and Biological Sciences Research Council

Introduction

Building on the HVB report: *UK Grown: How biotechnology can unlock higher value products from UK crops*[1], this workshop aimed to explore opportunities to use biotechnology to deliver higher value from novel break crops. Delegates were drawn from academia and industry researchers working on break crops, biotechnology experts, agriculture specialists, innovators, consultants, and policy professionals.

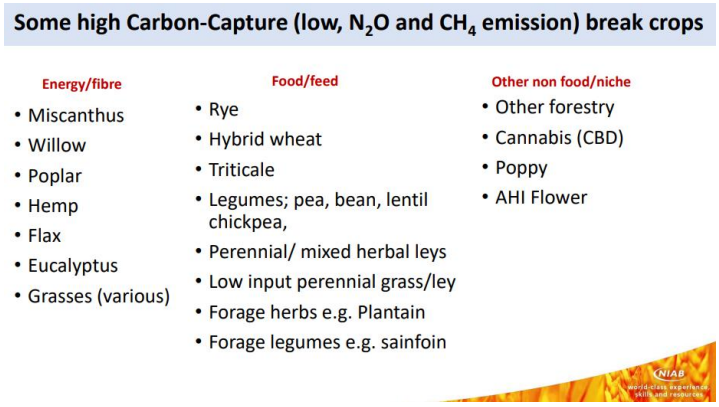
This report focuses on the workshop's discussion session where delegates were asked to consider the main targets for using biotechnology in new or existing break crops, what should the UK's priorities be with a focus on policy and funding, and how networks can help to address some of the challenges.

Slides from the presentations on break crops are shared on the Network's website[2].

The potential of industrial biotechnology for improving break crops

There is huge potential for using industrial biotechnology to significantly improve the outputs for agriculture and the UK is well-placed with expertise to meet these challenges. The discussions were focussed on the use of break crops and how industrial biotechnology can be used to improve economic returns and/or environmental benefits.

The UK Grown report[1] lists numerous examples of crops that could be used for high value products; research is needed to examine whether different candidate crops would be good break crops. The workshop talks provided a wealth of information about break crops. Lydia Smith's presentation from NIAB detailed the benefits of break crops, such as: positive impacts on soil characteristics, break disease carry-over and the potential to offer farmers diversified crop products. This slide shows some of the high carbon-capture break crops:



Targets for biotechnology interventions were discussed and include increasing yields of break crops to improve both biomass and carbon capture; increasing value through improving yield of molecules of interest; and the potential to decrease the agricultural chemical inputs into the land. The importance of linking economic value with environmental benefits was emphasized, creating solutions for agriculture, industry and consumers.

[1] https://www.highvaluebiorenewables.net/news/uk-grown-review/
[2] https://www.highvaluebiorenewables.net/events/hvb-break-crops-workshop-how-biotechnology-can-unlock-higher-value-from-uk-break-crops/

Alternative break crops could increase biodiversity, but this would need to be monitored to ensure there are no unintended consequences of the alternative crops. In addition, the effect of break crops on the soil microbiome and the potential to manipulate the microbiome to improve crop outputs needs research to enable evidence-based selection of break crops. However, it was noted that development of disease resistance programmes is needed before introducing new crops.

Development of evaluation tools for break crops were discussed, particularly in selecting a crop for a particular purpose. For example, to assist with selecting the right crop for different UK regions, a database of agronomy features such as yield, crop requirements or environmental potential to increase biodiversity would be useful. In addition, the development of predictive tools to assess whether crops could grow in a specific location (speeding up field trials) could be usefully deployed where there is no existing data. Databases on the metabolite profiles of crops would also assist in evaluating the potential to develop co-products from biomass.

In addition to industrial biotechnology interventions, there is a need to address the mechanical challenge of harvesting and down-stream processing, reducing the processing time compared to conventional methods. For example, the retting process which uses bacterial action to form industrial fibres - there are opportunities for novel products to come from research in this area. In addition, the importance of making use of the waste streams from break crops was discussed; this is where data on crop metabolites could be used to identify market opportunities.

Overall, the main opportunities for break crop biotechnology research are to reduce agrichemical inputs into the land, with potential for environmental and commercial benefits. In addition, access to data to provide evidence for which crops to use for specific purposes is also a priority.

Policy changes required to enhance break crop opportunities

The discussions on policy recognised the opportunities and challenges for the UK, and focused on the areas such as precision breeding, land management, regulatory policy, markets, and communications.

There is an opportunity now for the UK to diverge from the EU on gene editing and other regulated areas. The Precision Breeding Act[3] is very positive offering considerable opportunities, but there was caution expressed over registration and how it should not be restrictive.

It was felt that the current subsidy structure does not encourage innovation in agriculture. Environmental Land Management (ELM) is the new UK subsidy for farmers after leaving the EU. ELM potentially has a role to play in the introduction of break crops through small scale horticulture. Subsidies for low carbon alternatives would help to level the playing field with existing crops by linking economic value with environmental benefit.

There are specific cases where policy impacts would make a significant difference – for example, licensing of industrial hemp could be transferred from the Home Office to DEFRA where they are better resourced for understanding the regulatory issues and opportunities relating to agriculture.

A further policy angle could be the support for markets, considering the question, ‘what do we import that we could grow?’ We could learn from neighbouring countries to introduce crops to the UK. With coordination, large companies may be able to use their leverage to provide the required market. There is a need to attract more private investment, which could be achieved through tax incentives.

[3] Genetic Technology (Precision Breeding) Act 2023 (https://bills.parliament.uk/bills/3167)

The benefits of break crops should be better communicated to users, supply chains, researchers, and the public to highlight:

- Benefit to the UK economy
- Potential to reduce agricultural inputs
- Potential to replace fossil-based feedstocks for chemical and material production
- Reduction of imports
- Opportunity to produce high value biorenewables

Moving forward, clarity on regulatory pathways, ELMs, markets, and policy is required to stimulate investment and innovation. Policy makers should be included in networking events to continue the dialogue between the community and government.

Funding priorities to realise break crop opportunities

The discussion ranged from funding landscape gaps to understanding what sort of data is required to make a business case for funding.

Overall, there is a perceived gap in funding opportunities between Research Councils and Innovate UK. One potential solution could be to increase opportunities via follow-on funding to continue Research Council funded programmes through development and scale up. Whilst there is Innovate UK funding available, the requirement for a 30-50% contribution from industry can be limiting for businesses of all sizes. A lower threshold or an increase in allowable in-kind contribution would enable more diverse projects to be initiated. It was suggested that given the risk involved in some early-stage projects, they may need 100% funding to get them underway. Alternatively, or perhaps in combination with grant funding, loans could be offered to support this development.

Defra has already established the Farming Innovation Pathway funding opportunity in association with Innovate UK [4] but this is very much farmer/grower push.

There are also gaps in the processing pipeline making it difficult to find places to process quantities of less than 10 tonnes, and it was unclear whether databases of facilities and available equipment were kept up to date. There seems to be a gap in funding of this scale as well. Demonstration facilities accessible to growers and early-stage starter programmes would be valuable. In addition, exploring the use of a cooperative approach involving several users to enable capital purchases required would be beneficial.

Developing a 'Minimum Viable Business Case' was discussed as a requirement for investment in early-stage innovations to demonstrate the translation of an idea to a product. Training and access to technoeconomic analysis (TEA), life cycle analysis (LCA), intellectual property and freedom to operate searches would help to develop such a case. Systematic desk-based TEA at an optimised scale for growing, processing, and logistics to cover regional, modular, or shared facilities would be valuable.

Specific funding suggestions included:

- Seeding funding opportunities of up to £50k to explore an idea and develop a partnership
- Feasibility studies of £50-100k for up to 1-year projects

[4] https://farminginnovation.ukri.org/

- Financial support to engage with EAMU[5], e.g., £150k projects of up to 2 years
- Funding for farmers to diversify - trials should be 3-4 years to be significant
- Crop development pilot projects exploring e.g., agronomy, weeds, tillage
- Subsidies to increase break crop use on-farms, potentially using the 'set aside' model

For a project to be realised on-farm, participants felt that the whole supply chain needs to be involved and mechanisms should be explored to promote this such as engaging organisations that farmers interact with such as the NFU or AHDB.

The role of networks in supporting cross sector working

Networks such as High Value Biorenewables help to establish a community of researchers, farmers, suppliers, and end users. Networking events are valuable to make connections and promote knowledge exchange, which is particularly needed for the complex pathway to introducing novel crops. By promoting co-creation, industry insights on quality requirements and specifications will be captured from the outset, saving time in the development process.

Opportunities to meet industrial partners are essential for other players along the value chain to understand the end market(s) and product needs. Furthermore, 'business wrap around' experts e.g., financiers and investors, regulatory specialists, as well as those with LCA, TEA and IP expertise are useful additions to networking events, although it was recognised that they may have a lower interest in attending unless it related to business opportunities. With diverse stakeholders, there is a need for people who can 'translate' between the various groups.

It should be noted that the HVB website supports a searchable members database and a services database. HVB members can provide information about their skills as well as products, services, facilities etc. for other members to find.

There is an opportunity to promote uptake of novel crops by teaching the next generation of farmers about their benefits in agricultural college. A joint programme on break crops could be introduced through a college network. Participants also commented about whether outreach activities to explain the benefits of break crops need to be extended to include the public as well, such as via media outlets including Countryfile. Straight forward messaging with effective images should be used to market break crops, including the benefit for the farmer.

Whilst it is outside the scope of HVB, there was a discussion on information resources and the benefits of collating and publishing information about each candidate crop including:

- **Crop information**: chemical composition and list of potential products, including those under development, specific agronomic details including regional data and regulatory guideline links, TEA and case studies that demonstrate value, existing growers who can offer advice, supplier/distributer information.
- **Commercial and market opportunities:** specialists in specific technologies, with information on how existing technology/equipment can be used or adapted for different crops, opportunities to valorise waste streams/co-products; market information including international markets, IP landscape analysis, types of technologies available under license.

[5] Extension of Authorisation for Minor Use: https://www.hse.gov.uk/pesticides/pesticides-registration/applicant-guide/extension-of-use-introducti.htm

The main contribution of the Networks in Industrial Biotechnology and Bioenergy is to facilitate interactions between the research base and the supply chain. Special interest groups focused on topic areas would provide opportunities to work on some of the challenges and benefit the community.

Recommendations

1. **Building networks:** knowledge exchange and co-creation are essential in development of novel crops, therefore building and supporting a community through networking events, such as workshops is important. We suggest that funding should be available for continuation of networks that link research to industry.
2. **Communication** and education around novel break crops must be improved in both the farming community and general public – this would perhaps fall within DEFRA's remit.
3. **Funding:** the structure of funding needs consideration so that outputs from Research Council funded projects can be progressed to a stage that prepares them for Innovate UK grants. **Investment** is needed and could be encouraged through tax incentive schemes.
4. **Regulatory** matters such as ELMs need greater clarity, policy is required to stimulate investment and innovation and should be administered by the appropriate Government department. Policy makers should prioritise attendance at networking events to learn about barriers and how to maximise opportunities.
5. **Data**: the importance of collating and sharing data is always a predominant theme during network discussions. Funding should be made available to support data infrastructure.
6. **Skills:** there are gaps in training which networks can assist with. For example, TEA and LCA are key assessments and the skills and resources to undertake these are required. Training funds are important to allow researchers from academia and industry to develop these skills.
7. **Research** calls focussed on developing new break crops would enable exploration of the information already available, such as the UK Grown Report. Understanding disease resistance for promising novel crops is particularly important.
8. **Environmental** benefits arising from break crops should be further explored to highlight benefits to the soil microbiome, lowering the agrichemical inputs and potential to protect biodiversity.

As a network, HVB will continue to:

- Explore themes that enable the research base to work with a wide range of sectors, facilitating networking and enabling design of new research and technology to support the UK economy.
- Offer training funds for developing new skills.
- Support our technology and services database on the HVB website.
- Communicate the outputs of projects and activities that we fund to our stakeholders including BBSRC and relevant Government Departments.

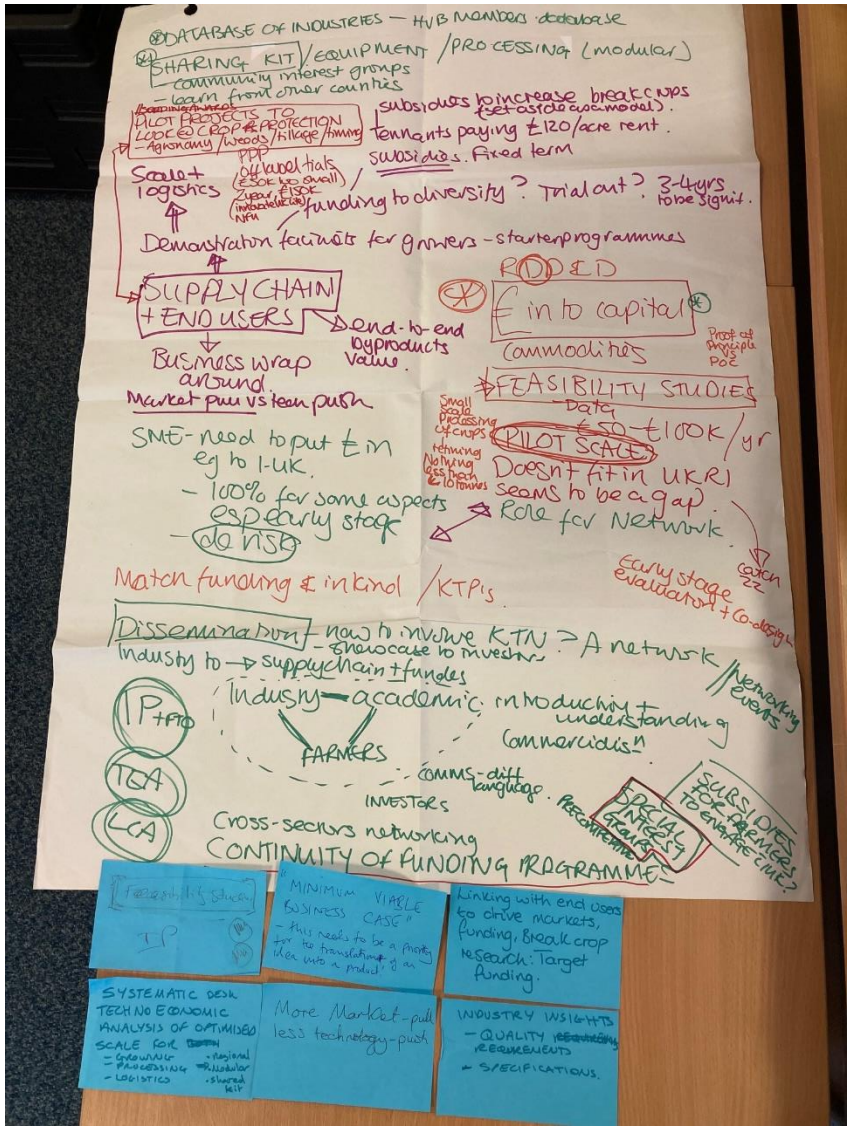
Appendices

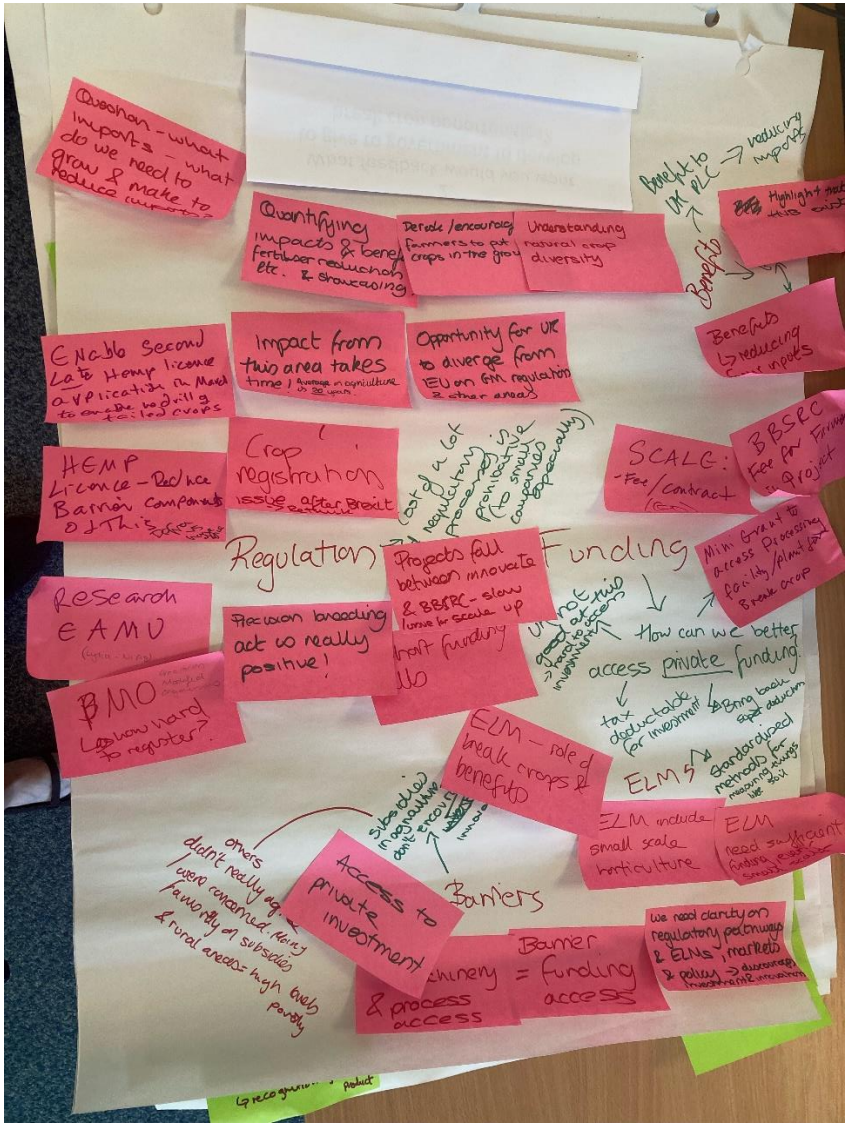
Appendix A: Participant List

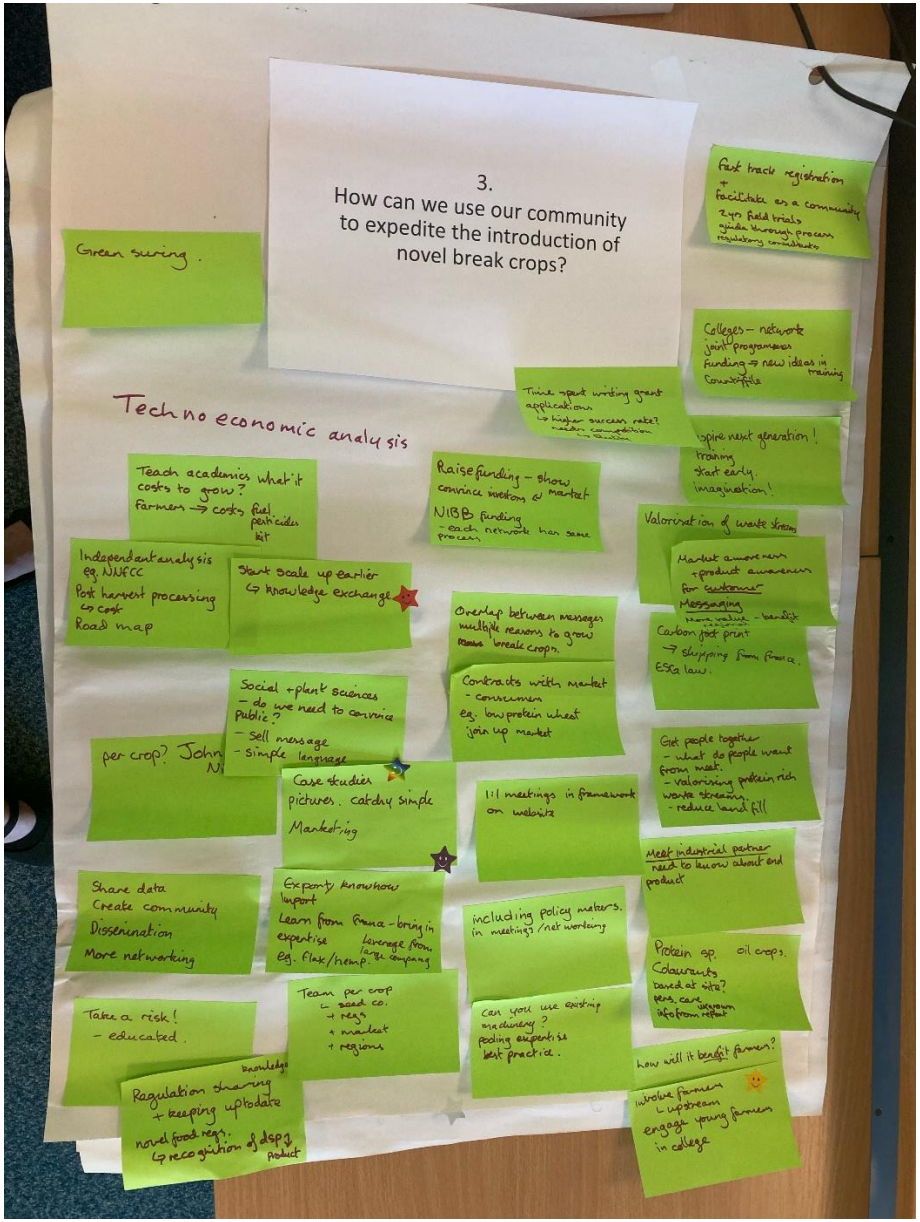
Many thanks to all the participants of the workshop who shared their expertise and contributed to the discussions.

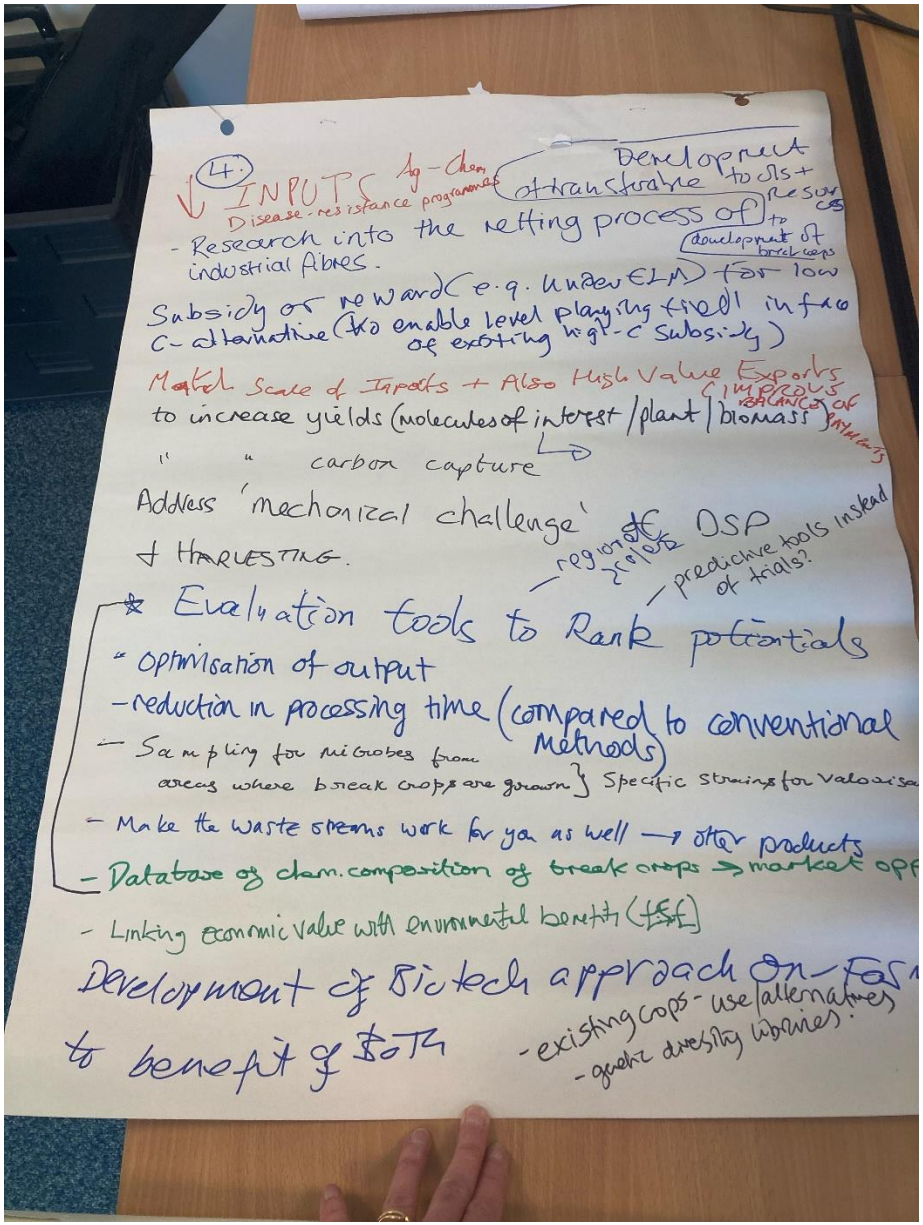
Name	**Affiliation**
Adrian Brennan	Durham University
Chenyu Du	University of Huddersfield
Claire Flanagan	PNO Consultants Ltd
Paul Fraser	Royal Holloway University of London
Andrew Goddard	Freeland Horticulture Ltd
Ian Graham	University of York
Darren Greetham	University of Leeds
Samantha Grover	Nature's Crops International Ltd
Claire Halpin	University of Dundee
John Hardy	Lancaster University
Mary Jenkinson-Finch	BBSRC
Andy Jones	Fibra
Malcolm Jones	Naturiol Bangor Ltd
Mike Lewis	Heugh Farm
Peter Luebcke	Bell & Loxton Innovations Ltd
Judith Mitchell	University of York
Johnathan Napier	Rothamsted Research
Heather Oldfield	Elsom Seeds
Deborah Rathbone	Biorenewables Development Centre
Jess Redgrave	ClimaFibre
Andrew Shearer	Bell and Loxton Innovations Limited
Helen Shiels	Biorenewables Development Centre
Parimala Shivaprasad	University of Nottingham
Raymond Sloan	Biorenewables Development Centre
Lydia Smith	NIAB
Lukie Tolhurst	Lucid Insight Ltd
David Turley	NNFCC
Ana Winterrs	Aberystwyth University
Thilo Winzer	University of York
Charlay Wood	University of York
HVB Team and Facilitators	
Joyce Bennett	University of York
Caroline Calvert	University of York
Gail Shuttleworth	Biorenewables Development Centre
Stephanie Simpson	University of York
Joanna Sparks	Aston University

Appendix B: Flip chart images – Funding, Policy Community, Industrial Biotechnology






3.
How can we use our community to expedite the introduction of novel break crops?
Green sucing.
Fast track registration + facilitate as a community 2 yrs field trials guide through process regulatory consultants
Colleges – network joint programmes Funding ⇒ new ideas in training Consortia
Time spent writing grant applications ⇒ higher success rate? readers consultation
Techno economic analysis
Inspire next generation! training start early. imagination!
Teach academics what it costs to grow? Farmers ⇒ costs fuel pesticides kit
Raise funding – show convince investors & market NIBB funding - each network has same process
Valorisation of waste streams
Market awareness + product awareness for customer Messaging
Independant analysis eg. NUFCC Post harvest processing ⇒ cost Road map
Start scale up earlier ⇒ knowledge exchange
Overlap between messages multiple reasons to grow break crops.
Carbon foot print → shipping from France. ESG law.
Contracts with market - consumers eg. low protein wheat join up market
Social + plant sciences – do we need to convince public? - Sell message - simple language
per crop? John
Get people together - what do people want from meat. - valorising protein rich waste streams. - reduce land fill
Case studies pictures. catchy simple Marketing
1:1 meetings in framework on website
Meet industrial partner need to know about end product
Share data Create community Dissemination More networking
Export knowhow Import Learn from France - bring in expertise eg. flax/hemp. Leverage from large company
including policy makers. in meetings / networking
Protein sp. oil crops. Coloursants based at site? yes, care uptake from retail
Team per crop ⇒ seed co. + regs + market + regions
Take a risk! - educated.
Can you use existing machinery? pooling expertise best practice.
How will it benefit farmer?
Regulation sharing knowledge + keeping up to date novel food regs. ⇒ recognition of dsp product
involve farmers ⇒ upstream engage young farmers in college


(4.)
INPUTS
Ag - clean
Disease - resistance programmes
Development of transferable tools + Resources
- Research into the retting process of industrial fibres.
to development of break crops
Subsidy or reward (e.g. under ELM) for low C- alternative (to enable level playing field in face of existing high C subsidy)
Market Scale & Inputs + Also High Value Exports (improve balance of payments)
to increase yields (molecules of interest / plant / biomass)
" " carbon capture
Address 'mechanical challenge' of OSP & HARVESTING.
regional trials
predictive tools instead of trials?
★ Evaluation tools to Rank potentials
- optimisation of output
- reduction in processing time (compared to conventional Methods)
- Sampling for microbes from areas where break crops are grown } Specific strains for Valorisa
- Make the waste streams work for ya as well → other products
- Database of chem. composition of break crops ⇒ market opp
- Linking economic value with environmental benefit (ESG)
Development of Biotech approach on Fas
to benefit of both
- existing crops - use alternatives
- genetic diversity libraries.