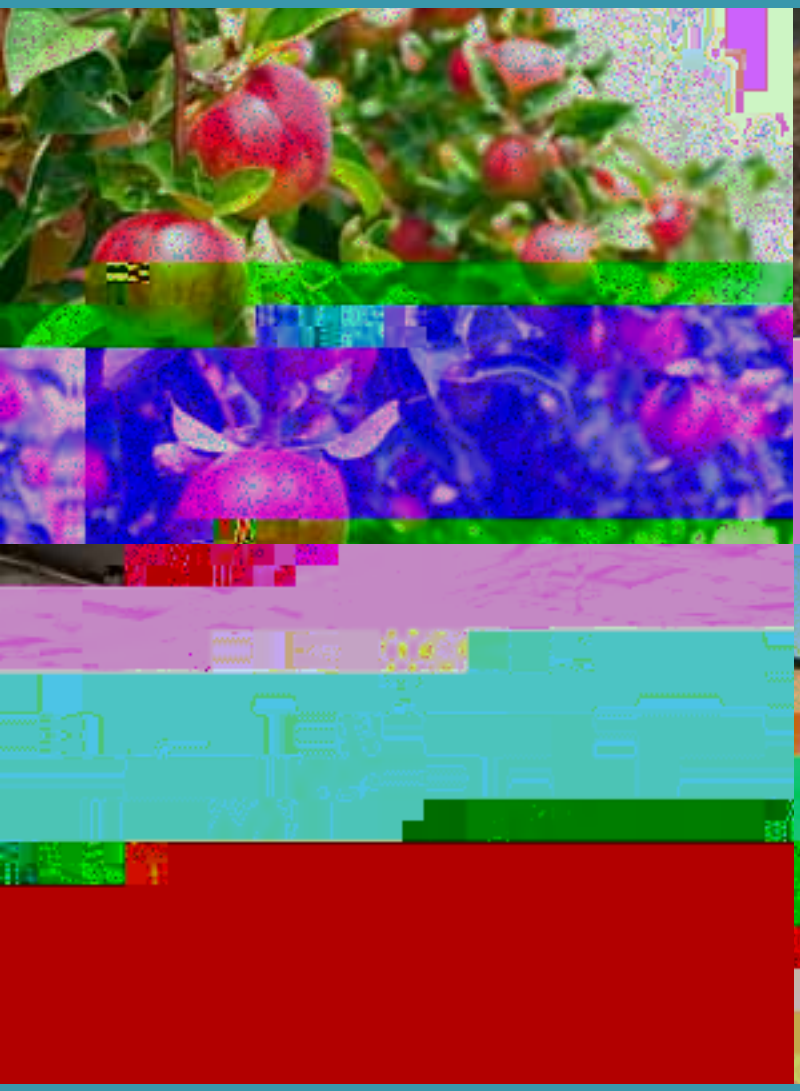
Innovation Requirements for Primar Food Production in the UK to 2030



Prepared b the Joint Commissioning Group[1]

(Principal Editor Chris Pollock, Aberystwyth University)

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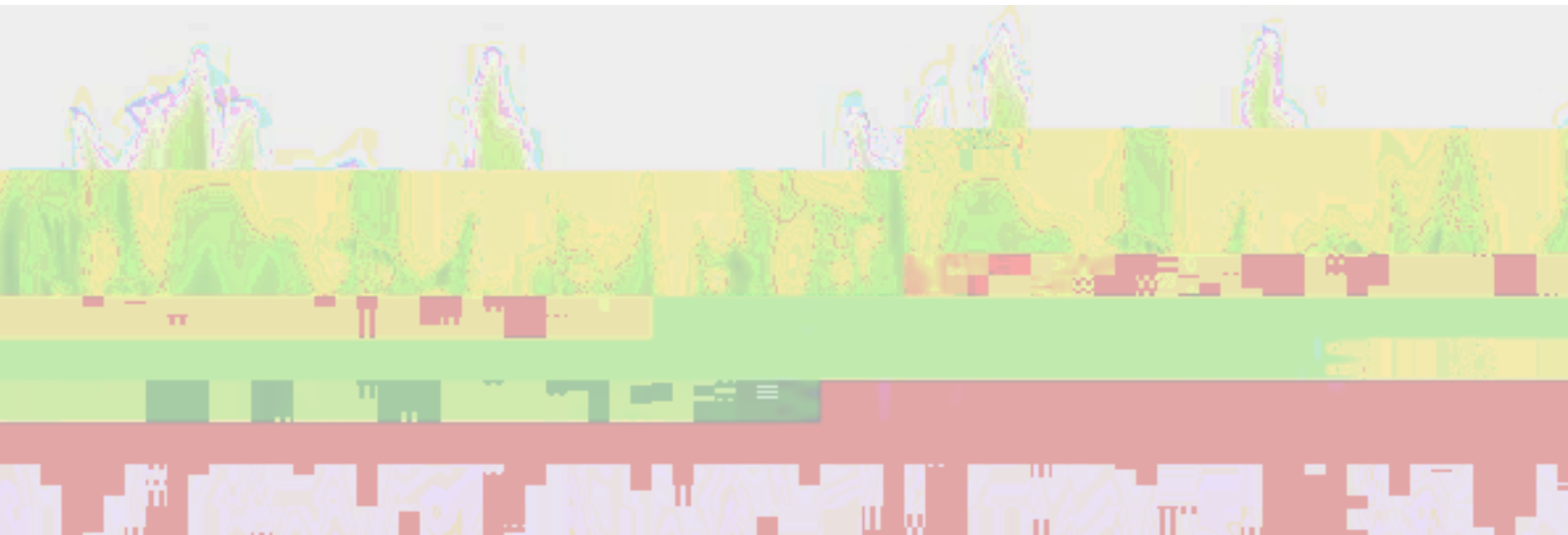

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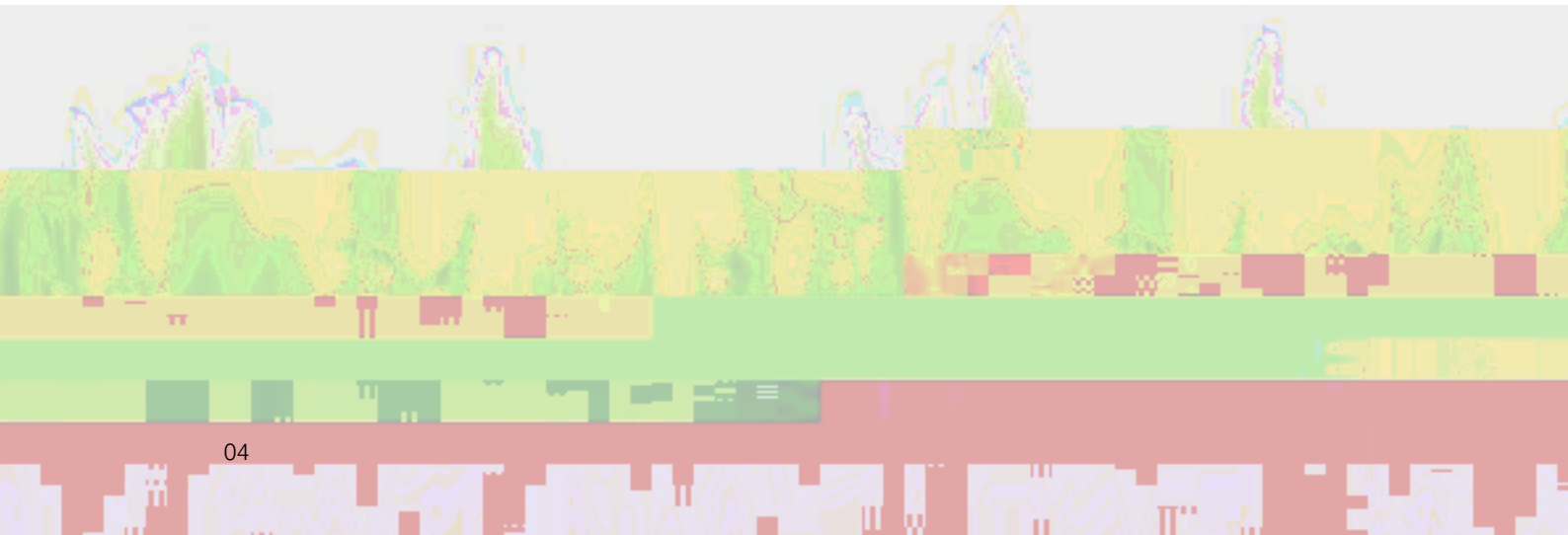

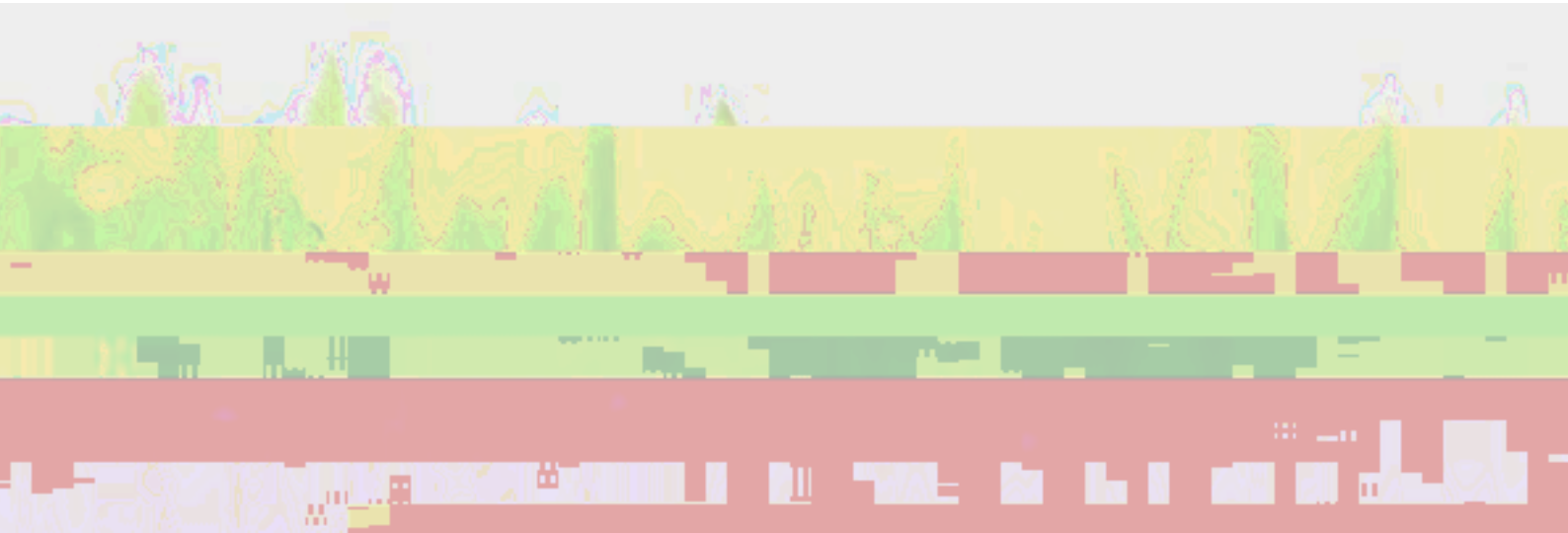

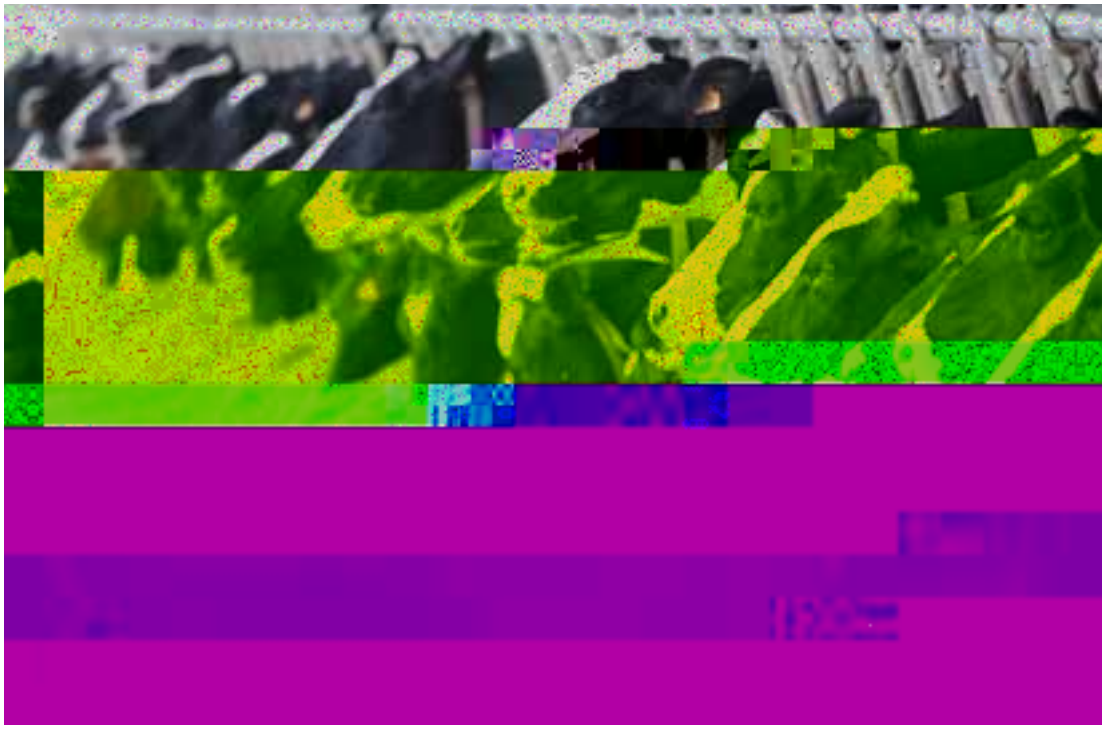

2 Apply modern genetic and breeding approaches to improve the quality, sustainability, resilience and yield-led profitability of crops and farm animals.

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3 Use systems-based approaches to better understand and manage interactions between soil, water and crop/ animal processes.

-

6 Develop evidence-based approaches to valuing ecosystem service delivery by land users, and incorporate these approaches into effective decision-support systems at the enterprise or grouped enterprise level.

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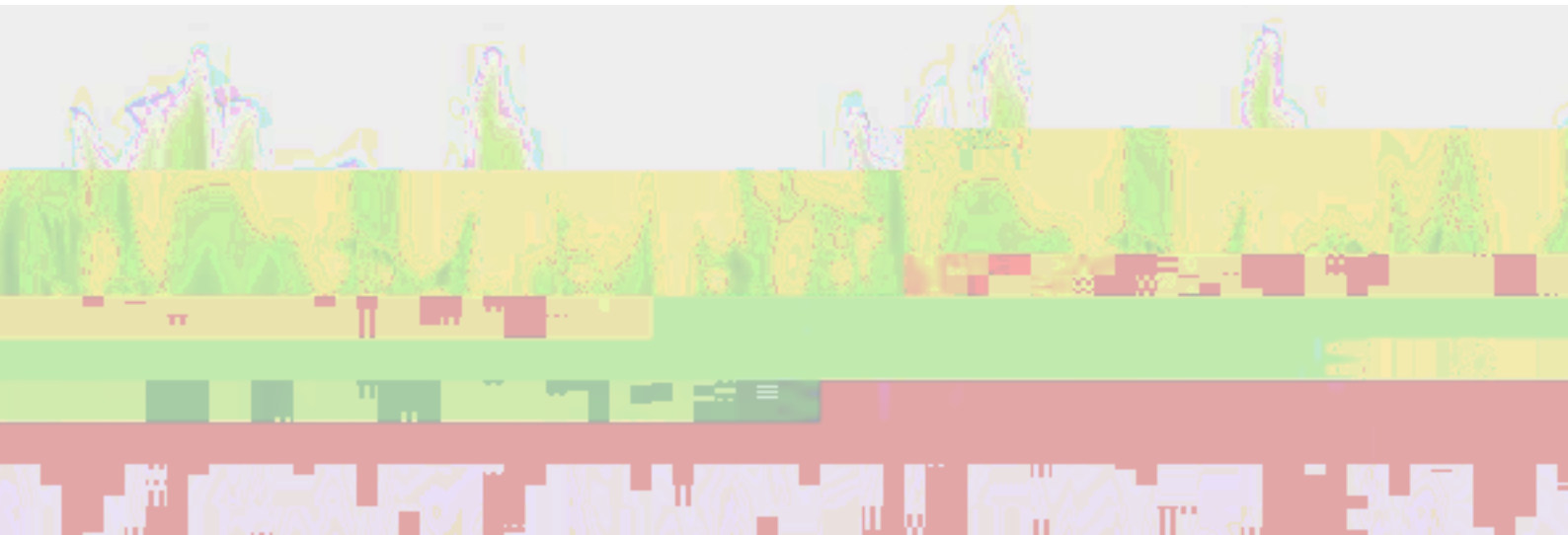
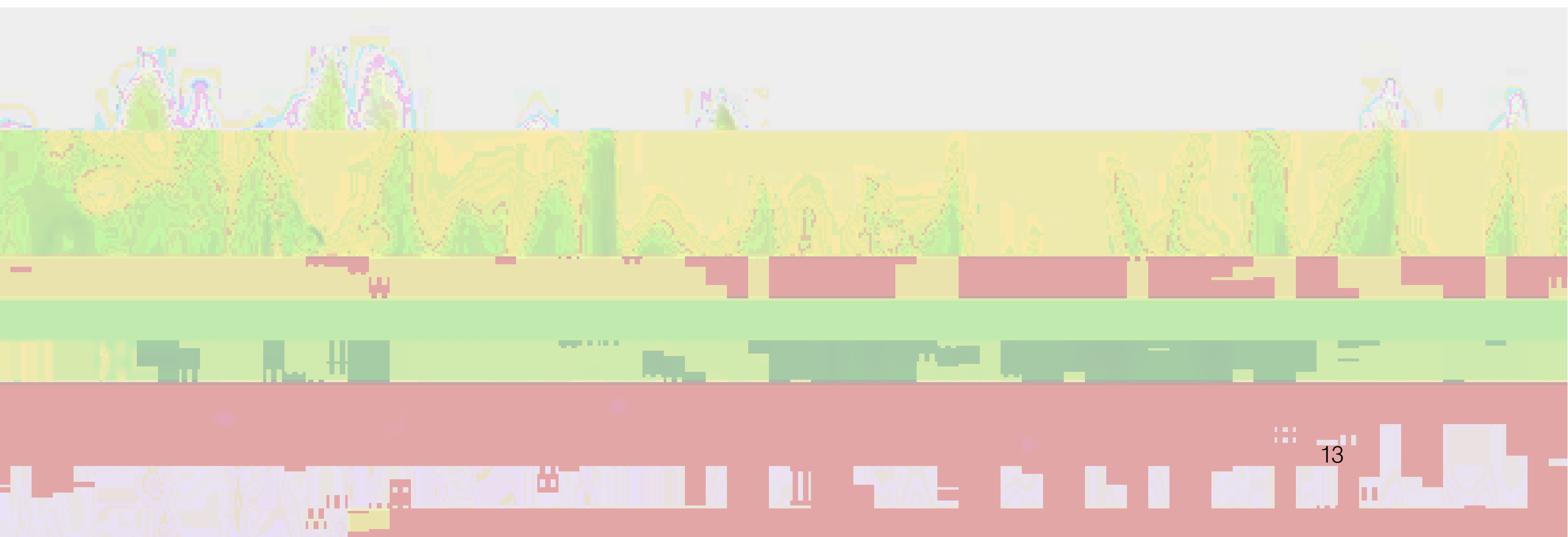
7 **Extend the training, professional development and communication channels of researchers, practitioners and advisors to promote delivery of the targets above.**





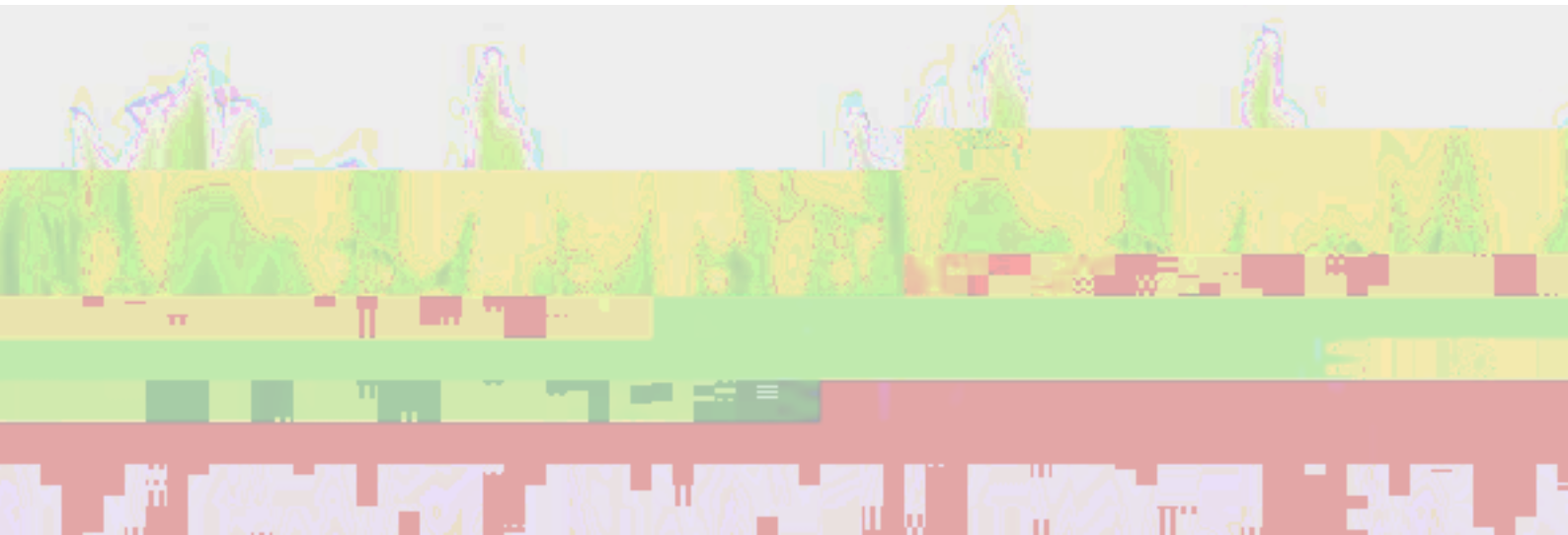


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Table 1. Factors likely to constrain the ability of the global food chain to meet demands by mid-century (Royal Society, 2009)

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2 IAA D (2008). A A %20 %20 %20C G %20 %20D %20 %20(E).

3 B J (2011). F f F I 1(2), 2-6.

4 R (2009). R 1608: R B . 72 B : 978-0-85403-784-1.

[illegible]

Table 2. Key priorities for action for policy-makers[5]

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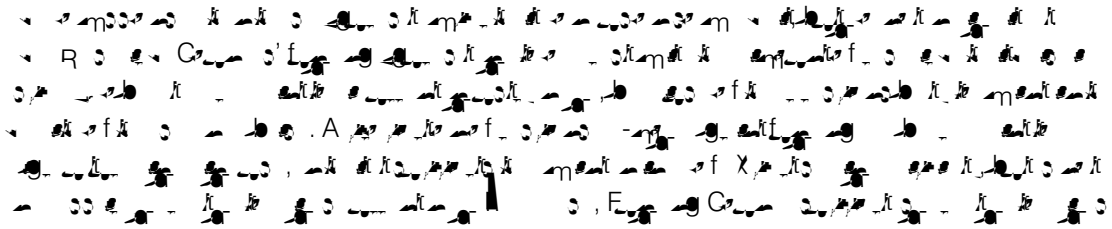


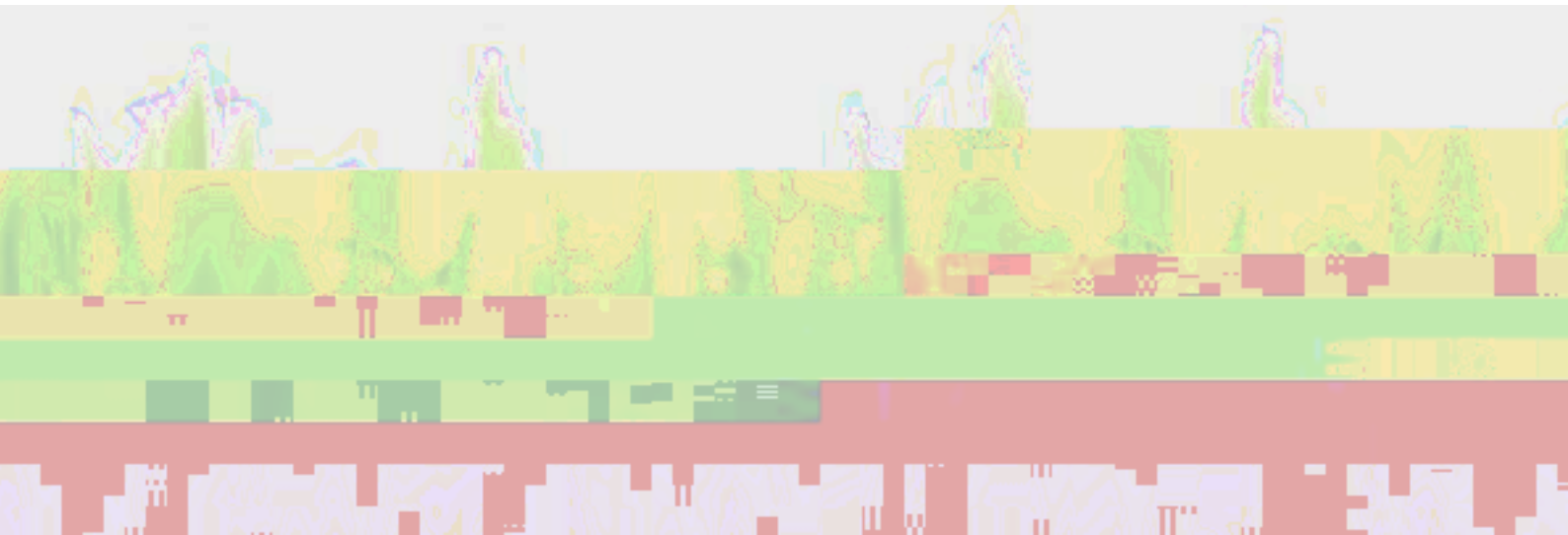
II. Information and Evidence

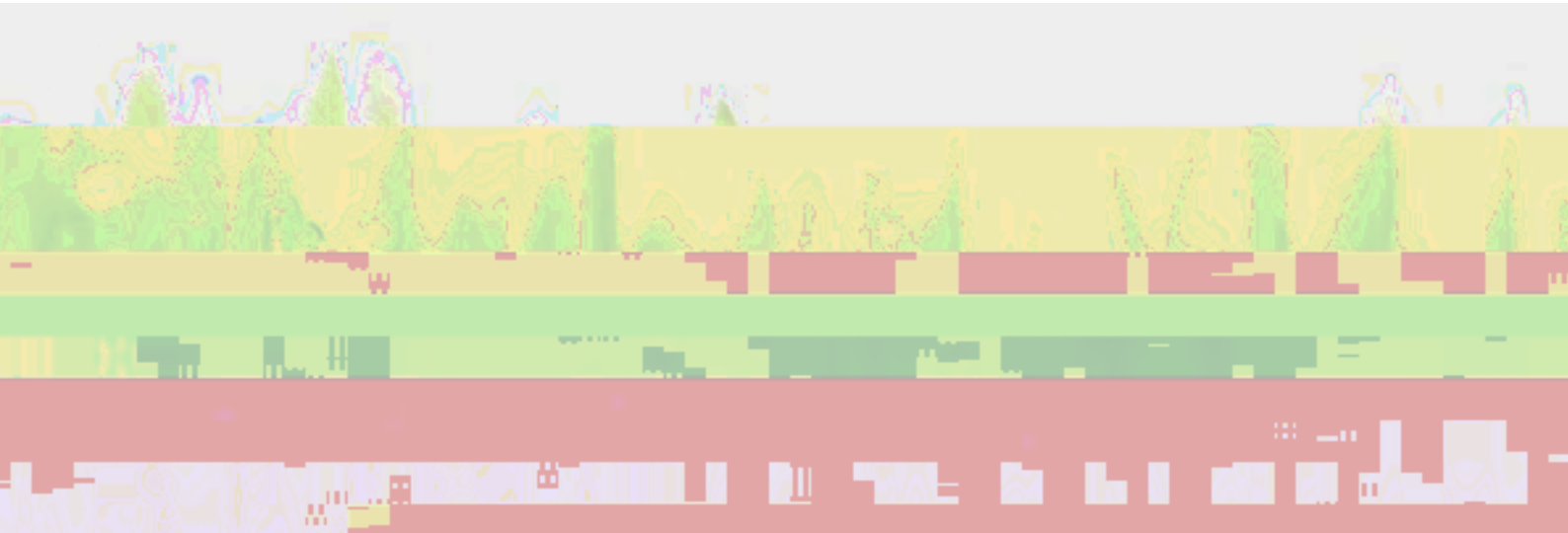
A

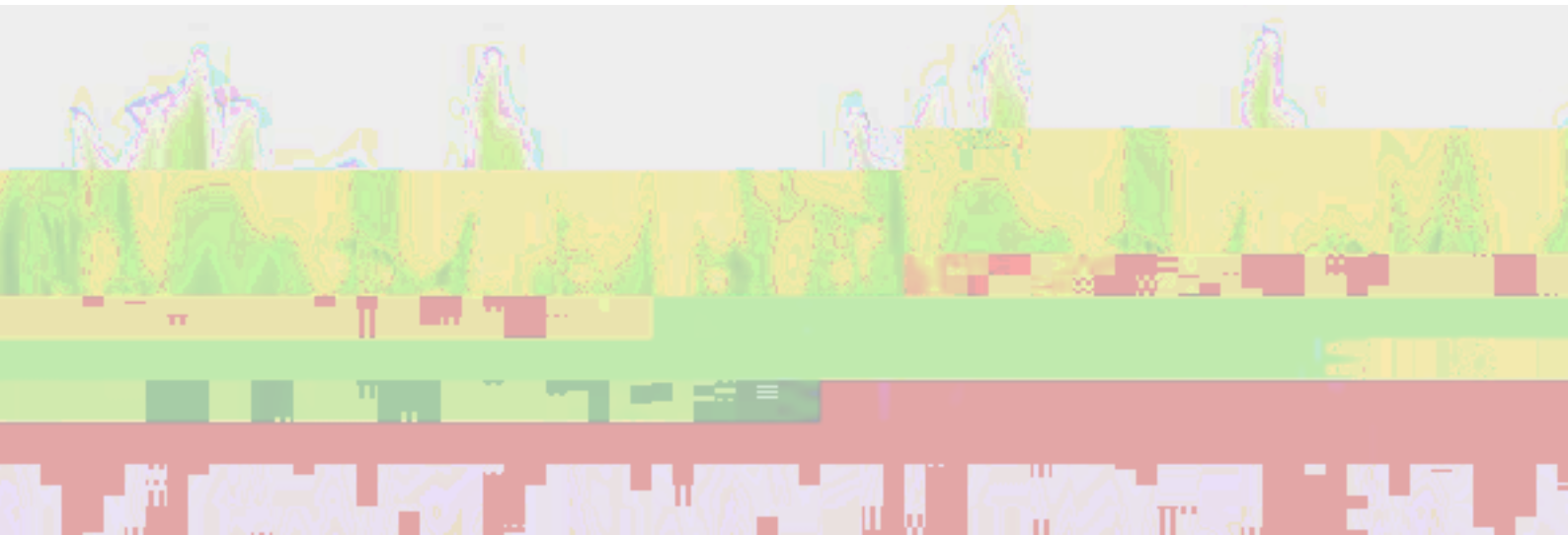
In this section we provide a summary of the information and evidence that we have considered in 2010 in relation to Agriculture and Food (AgriFood) and Research and Development R&D.

We have considered information from: RAGE, BBSRC, Defra, AHDB and other sources of information (Cambridge Econometrics, Oxford Economics, Business Monitor, Agriculture and Horticulture Development Board). Each piece of information has been considered in relation to its relevance to the Agri-Food sector.

We have considered information from Research Councils (BBSRC), Government Research Establishments (GRE), Higher Education Institutions (HEI) and Private Research Organisations (PRO).







2 Apply modern genetic and breeding approaches to improve the quality, sustainability, resilience and yield-led profitability of crops and farm animals.

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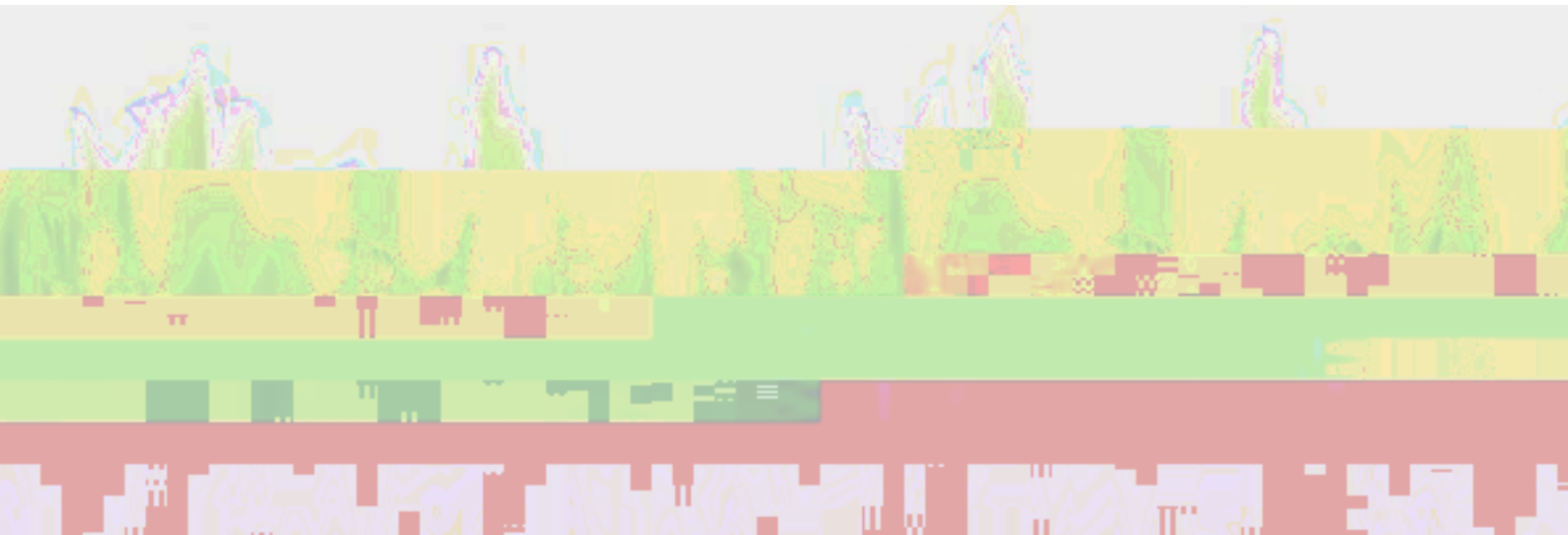
No-spray crops.



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Protein supply,

5 Develop integrated approaches to the management of animal disease within farming systems.

- [illegible]

Improving animal health – everybody wins. [illegible]
f_ 9 0 0 0 93.54 9 ( ) 6(f) 20 (r)(_)93.54 .3.54

6 Develop evidence-based approaches to valuing ecosystem service delivery by land users, and incorporate these approaches into effective decision-support systems at the enterprise or grouped enterprise level.

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7 Extend the training, professional development and communication channels of researchers, practitioners and advisors, to promote delivery of the targets above.

Up-skilling the industry.

8 Improve the use of social and economic science to promote the development, uptake and use of sustainable, resilient and profitable agricultural practice that can deliver affordable, safe and high-quality products.

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- I [illegible]
- B [illegible] R&D [illegible]

H [illegible]

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- R [illegible]

[illegible]

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Campden BRI publications

'Scientific and technical needs of the food and drink industry – 2012-14'

House of Lords

European Union Sub-Committee D 'Innovation in EU Agriculture' – 2011 (19 R f 2010-12)

HM Government

The Natural Choice – securing the value of nature. UK National Ecosystem Assessment

Commercial Farmers Group (CFG)

Priorities for Agricultural and Horticultural R&D (2009)

Environmental Sustainability KTN

'Environmentally Sustainable Agri-Food Production' (2012)

Defra Green Food Project Report

Hybu Cig Cymru (HCC) Welsh Meat Roadmap

Institute of Agricultural Engineers (IAgrE)

Society for General Microbiology

British Beet Research Organisation (BBRO)

A 3.

II

Improved EID technology & portable systems of livestock record keeping
****
Livestock benefits on arable farms
******
Balancing production and environment (ecosystem
***
Vaccine development (blue tongue, TB, Schmallenburg etc)
****
Biosecurity & disease eradication
******
Breeding for disease resistance
****
Rumen metagenomics
****
Additives to improve FCE/ gut health
*****
Improving effectiveness of AI
*****

Dairy Sector Workshop – Key Challenges & Priorities for Research

*******	Early embryonic death genetic, nutritional, health status	****	Lameness/ pain detection	****	Genotype links to treatment regime - stratified management	*****	Neo-natal & pre-ruminat management	******	Immune system function/ suppression
*****	Cow stress - measurement	*	New DD treatments formalin/ copper sulphate	***	In-line detection automated	****	Liver damage & fatty liver	******	Johnes
****	Submission rate vs conception rate (declining CR - why?)		KE adoption of current best practice	***	Multi-modal & interptetation	***	Calf & heifer rearing	*****	Better diagnostics
**	Once-a-day milking		Digital dermatitis - pathology, resistance & vaccination	**	Alternatives to antibiotics	**	FCE	***	Anti-microbial resistance
**	Endemic & sub-clinical disease		Why do some cows not get lame	**	Diagnostics - real-time & stratified therapy	**	Rumen modifiers	**	Social & behavioural requirement of cows - modelling building design
*	Physiological drivers of (in)fertility		Health economics	**	Biological control - cow, teat, environment	**	Synthetic amino acids	*	Persistent & multiple vaccines
*	Nutritional drivers of fertility & negative energy balance		Cow behaviour	*	Cow comfort & environmental				

Potatoes & Field Scale Vegetable Workshop – Key Challenges & Priorities for Research

Crop Husbandry		Genetics		Environment & Social		Farming Systems		Engineering & IT	
**********	Availability of crop protection products	*****	Availability of marker-assisted breeding	****	Matching ecology with production	******	Rotational soil & nutrient management	**	Post-harvest detection of internal defects
*****	Crop maturity control (brassicas)	*****	Introducing N-fixation in other crops	**	Managing effective biodiversity/ beneficials	**	Rotational solutions to persistent issues	***	Robotics
****	Weed control	****	Potato blight	**	Sources of major nutrients	**	Alternative weed control barriers	**	Advanced storage & grading systems
****	Bruising	****	Drought resistance	**	Energy use/ climate change	*	New crops for the UK	**	IT to diagnose problems - remote sensing
***	Nutrients	***	Storage - sprout control	*	Efficient use of water		Crops to aid weed/ pest control	**	Mechanical harvesting of veg
***	New diseases/ invasive species	***	Yield	*	Meeting consumer requirements	*	Urban farming		Precision weeders
***	Light to propagate veg plants	***	Pest & disease resistance/ tolerance	*	Low GI potatoes		Legacy left by cereal farmer	*	Reducing management hours - MIS
***	Spear rot in brassicas	**	Nutritional quality (diet/ health)	*	Introducing predators into the field		Benefits of mixed farming systems		Better automated vision grading
**	Virus prevention	**	Improvements to enable mechanical harvesting	*	Non-water control of common scab		Risks to mixed farming	*	Educating next generation
**	Post-emergence herbicides	**	Shelf life		Targeting spray applications		Value of compost etc	*	Soil nutrient/ N analysis
**	Soil management	**	Gene identification in a broad range of plants	*	Waste utilisation for energy		Anaerobic digestion		Indicator plants to understand growth
*	Aphid control	*	Soil biology	*	Landscape level management of water		Vertical farming		Storage v transport
*	Water/ irrigation management	*	Resilience over range of environmental conditions		Pest horizon scanning		Companion/ perma-cropping		Plants & growing systems to make robots work
*	Alternative (non-peat) substrates for transplants	*	Adaptation to higher temps (climate change)		Social acceptability of new science		Short-term issues rented land		CTF for vegetable production
*	Crop dessication	*	Smart plants		Phosphate utilisation		Green manures		Sensors for selective harvesting
	Crop uniformity		What initiates what in plants (including weeds)		Energy use for protected production				Automated phenotypic data collection
	Crop establishment		Resistance to club root		Regulatory pressure for pollution control				Contaminant removal/ reduction
	Potato nematode control		Nutrient stress resistance		Keeping inputs/ run-off in the field				Atmosphere control by crops
	N-optimisation		Flavour		Novel uses of by-products				Unknown unknowns
	Constraints of RB209		Public acceptability of new varieties		Precision landscape planting				ID of pathogens (food poisoning)
	Snails in peas		Quicker integration of traits into commercial varieties		Headland management for biodiversity				
	Bio-fungicides		Bolting control		Efficacy of organic weed control in different conditions				
	Skin blemishes		Improving N-fixation in legumes						
	Sugar levels potato storage		Oxidisation post-harvest						
	Potato blight		Crop programming in a changing climate						
	Weed control - non chemical								
	Season extension								
	Downy mildew								
	Fusarium								
	Xanthomonas in brassicas/ leeks								

**********	Closing the yield gap - understanding why	********	N-fixing cereals	******	Overiding need for science/ evidence base regulation	*****	Improved economics of pulses	*******	Variable rate fert & manure application
*****	Improved blackgrass control	****	GM traits for consumer benefits	******	Reducing N-use	****	Direct drilling in a maritime climate	****	In-crop testing of nitrogen/ protein content
****	Micro-nutrients & trace element nutrition	***	Genetic disease resistance	*****	Need for tramsparent & independent consistent research messaging	****	Benchmarking to integrate technical decisions wth economics & sustainability	***	Smart GPS pesticide application
***	Soil-borne diseases and rotational effects (take all & club root)	***	Pest-repellent traits (slugs, pigeons, aphids etc)	****	Loss of chemistry	***	Science skill base & career retention	**	Soil nutrient mapping
***	Mycotoxin management	**	Drought tolerance & abiotic stress resistance	****	Efficacy of sterile strips to prevent weed ingress	***	New (to UK) crops for climate change adaptation	**	Remote sensing (pests, disease, nutrients)
**	Disease management and implications for development of resistance	**	Protein genetics	***	Soil biology & soil structure	**	Resource use efficiency	**	Low/ zero-tillage systems
	Integrated weed control programmes	**	Improved rooting structure	***	Reducing water requirement - soil moisture holding capacitu	**	Better info on rotations	*	Sensors for farmer measurement of crop stands
	Inefficiency of nutrient use in OSR (root structure)	**	Maximising energy production (maize)	***	Landscape scale planning	**	New break crops for UK	*	Monitoring crop quality in stor

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Q2. What generic areas of research will have the most positive impact on the sustainable intensification of agriculture in the next 20 years?

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Q3. What key challenges/ research needs were not highlighted/ identified by sector workshops?

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Q4. Given that current systems of agricultural production in the UK are driven largely by historical factors, what changes/ alternative farming systems should be investigated or researched to deliver sustainable productivity growth and provision of environmental goods in the future?

New paradigms in precision agriculture

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Valuing ecosystem services and developing land use systems to optimise delivery where appropriate

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Endemic and emerging disease management and eradication in livestock

Q5. What other factors (positive and negative) will have a significant effect on agricultural production between now and 2030, and what role does R&D play in ensuring those impacts are optimised/ mitigated against?

Positive factors:

1. Consolidation/ collaboration of agricultural R&D with other strategic imperatives

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2. Climate change opportunity

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3. Rising demand for food

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5. Carbon accounting

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1. The Australian model for applied agricultural research: rural development corporations

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2. The Consortium for Plant Biotechnology Research, St Simons Island, Georgia, USA.

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3. Canadian Agri-Science Clusters

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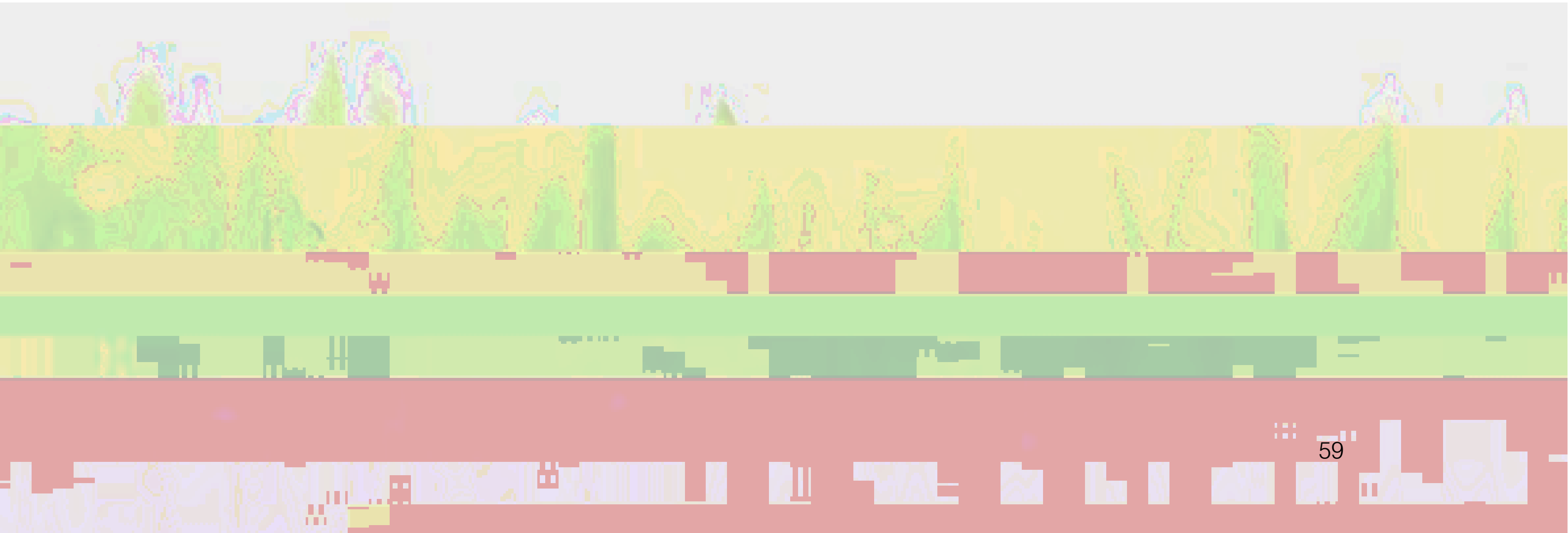

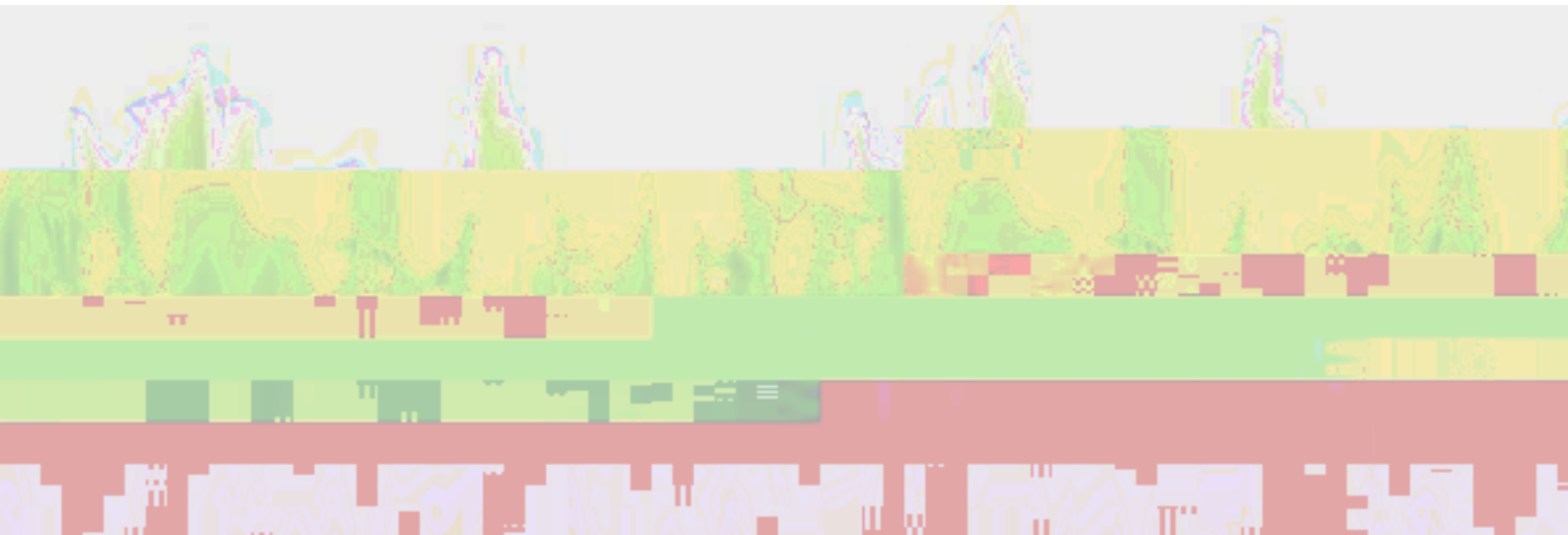

AHDB – Ian Crute

NFU – Andrea Graham

AIC – Paul Rooke

RASE – David Gardner

NFU Scotland – Nigel Miller

Technology Strategy Board – Calum Murray