FOOD & FARMING FUTURES

AHDB

Innovative and Disruptive Technologies for Agri-food Supply Chains

Innovation Acceleration

Angela Karp & Achim Dobermann

Rothamsted Research

Content

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- Specific challenges of disruptive innovation in agriculture
- Lean-Startup, as way of managing the innovation process
- Lean @ Rothamsted Research

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Innovation – Do we agree what it is?

"I thought I was on to something but I can't figure out how to move it."

Not just a bright idea!

But also its conversion into something that has value

Invention

The process of creating something no-one else has before.

Innovation

The process that translates knowledge into economic growth and social well being.

Current agri-tech innovation trends

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Mobile/Cloud computing	Smart phones, wearables
Location-base monitoring	Satellites and remote sensing, geo-information, drones, proximal sensing
Big Data and IoT	Big data algorithms; Linked open data
Robotics	Automation of activities
Artificial Intelligence	M2M; autonomous devices and vehicles
CRISPR/Cas9	Precision breeding; simultaneous changing of many traits

- Farm Robotics, Mechanisation & Equipment
- Farm Management Software
- Supply Chain Logistics and Traceability
- Novel Farming Systems (vertical and urban)
- Novel Crops & Rotations
- Innovative Food (cultured meat, insects)
- Restaurant Market places
- Online Restaurants & Meal Kits
- In-Store retail & Restaurant Tech
- eGrocery

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Disruptive Innovation– are we ready for it?

Advance what we know (incremental innovation)

Think completely differently (disruptive innovation)

Risk, uncertainty and failure

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Who invented the automobile??

AUTOMOBILE FIRSTS			
Inventor	**Date**	**Type/Description**	**Country**
Nicolas-Joseph Cugnot (1725-1804)	1769	STEAM / Built the first self propelled road vehicle (military tractor) for the French army: three wheeled, 2.5 mph.	France
Robert Anderson	1832-1839	ELECTRIC / Electric carriage.	Scotland
Karl Friedrich Benz (1844-1929)	1885/86	GASOLINE / First true automobile. Gasoline automobile powered by an internal combustion engine: three wheeled, four cycle, engine and chassis form a single unit.	Germany Patent DRP No. 37435
Gottlieb Wilhelm Daimler (1834-1900) and Wilhelm Maybach (1846-1929)	1886	GASOLINE / First four wheeled, four-stroke engine- known as the "Cannstatt-Daimler."	Germany
George Baldwin Selden (1846-1922)	1876/95	GASOLINE / Combined internal combustion engine with a carriage: patent no: 549,160 (1895). Never manufactured -- Selden collected royalties.	United States
Charles Edgar Duryea (1862-1938) and his brother Frank (1870-1967)	1893	GASOLINE / First successful gas powered car: 4hp, two-stroke motor. The Duryea brothers set up first American car manufacturing company.	United States

Karl Benz; - his car was practical, used a gasoline-powered internal combustion engine and worked much like modern cars do today.

Henry Ford;- neither invented the car or assembly line – he combined (and perfected) assembly-line manufacturing of goods with building cars.

Ideas that fail are part of the journey

How do we support, reward and incentivize the risk takers?

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Agriculture is inherently uncertain and diverse

Areas of Uncertainty:

- Production (weather etc)
- Price
- Technology
- Policy
- “Notion of rational behaviour”

Diversity:

- Farming business
- Ownership
- Value Chains
- Operational

- ❖ Longer-term investment for testing innovations
- ❖ More funding for translation of ideas
- ❖ More engagement and collaborations with farming community

Innovations in practise as well as products

Embodied: products, tools, technologies

Non-embodied: improved practice

- Financial models that do not rely on *in perpetua* donor funds, whilst not driving up user cost and deterring solutions from becoming widely adopted
- Opportunity for government support leading to quick wins?

Technology push vs need and societal acceptance

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- Food vs Fuel
- Farming vs Biodiversity
- Organic vs Intensive
- GM vs Conventional

Increased acreages of GM crops across the world, since 1996, record the fastest adoption ever of any major agricultural innovation…. (except where it can't be grown commercially)

- ❖ We need to engage and share ideas early
- ❖ Make decisions on evidence (not opinion)
- ❖ Ensure large corporates are also part of disruptive innovation

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Complex Research & Innovation Landscape

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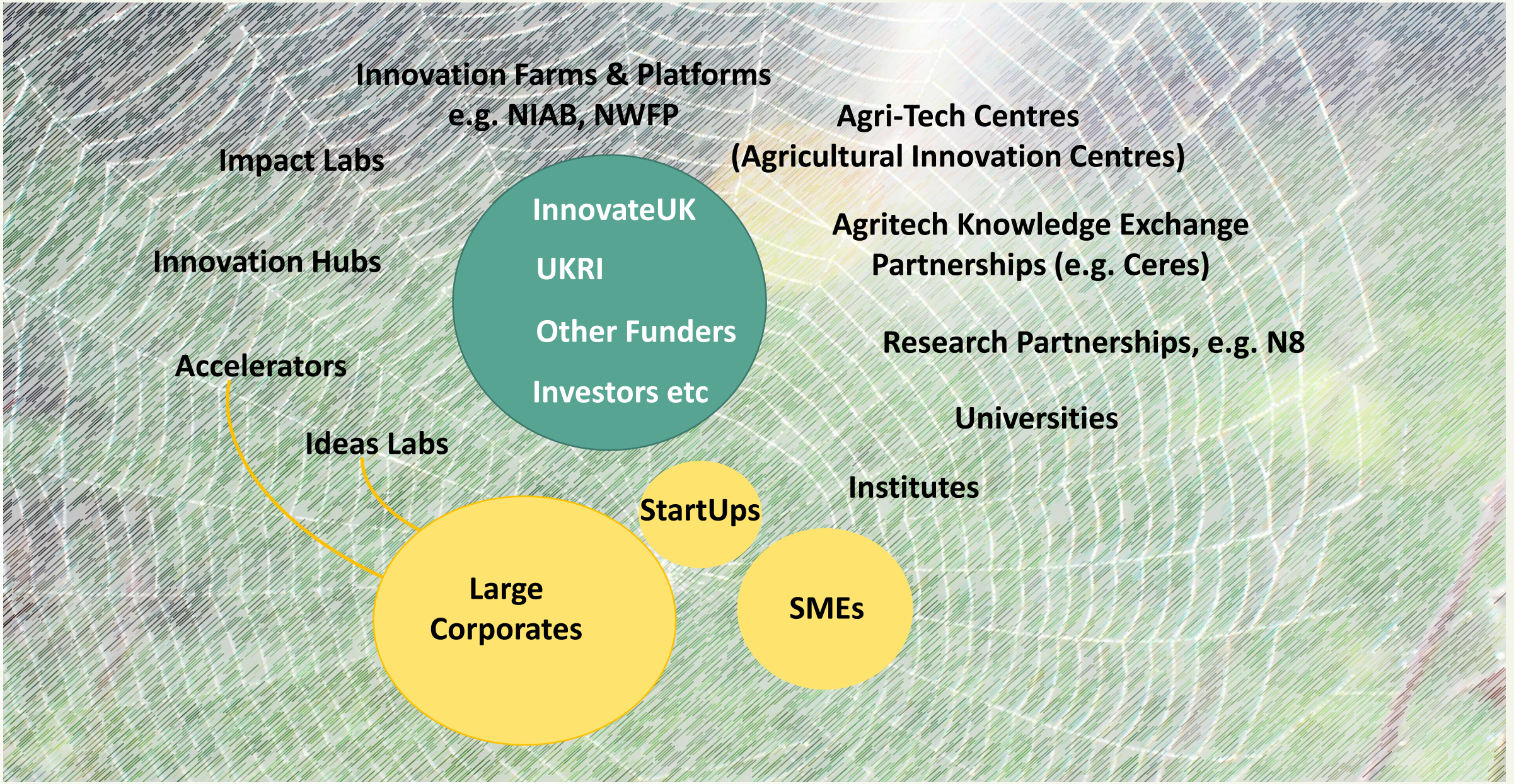

Clear and speedy routes to success

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Unfairly competed

Fail

Run off with

Blocked as a threat

Excellent teamwork and collaborations

Path to strike clear

Success

- Peer-to-peer learning and mentoring to navigate the fragmented Agri-Tech landscape
- Reward systems for entrepreneurs who take risks
- Inspire by celebrating our Innovators (e.g. InnovateUK showcases: BBSRC Innovator of the Year; REAP)

Work together to help score goals for UK plc

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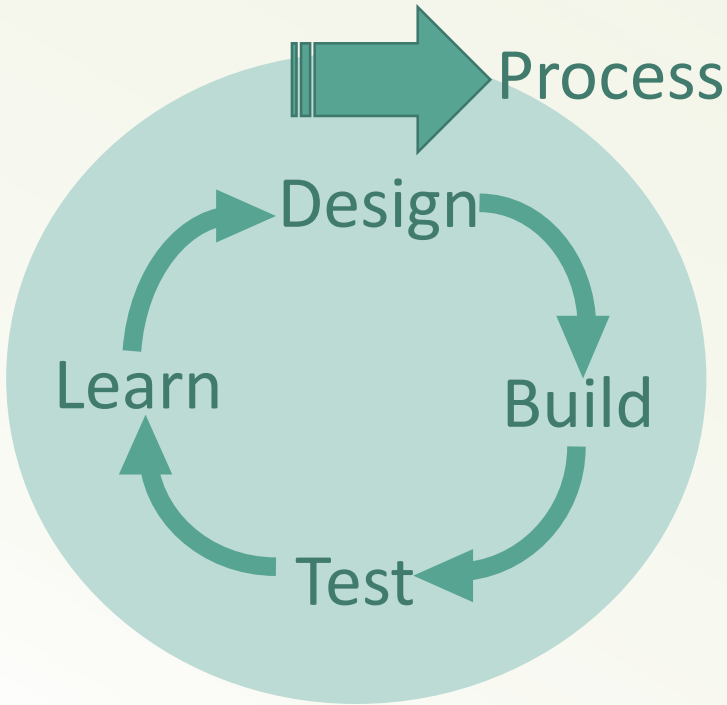
Lean StartUp Thinking

A useful set of tools for managing innovation when there is high risk and high uncertainty



- Build a prototype to test (not a business model)
- Test your riskiest assumptions quickly
- Use actionable metrics (that inform on your assumptions)
- Learn and build, then test again
- Fail quickly what isn't working; pivot; rebuild

Pivots

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Zoom-in:	Single feature becomes the whole product
Zoom-out:	Single feature insufficient to support a whole product
Customer Segment:	Product hypothesis confirmed but not for the customers planned
Customer Need:	Knowledge of customers revealed something else they want
Business Architecture:	Switch from low margin, high volume to high margin low volume (or vice versa)
Technology:	New technology won't provide what's needed or at costs that will work
Value capture:	Change in value proposition
Engine of growth :	Change in growth strategy to seek faster to more profitable growth
Channel:	Change in how product is delivered to customers (e.g. sold in stores or on-line)

The LeanStartUp; Eric Ries

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Testing and Validation

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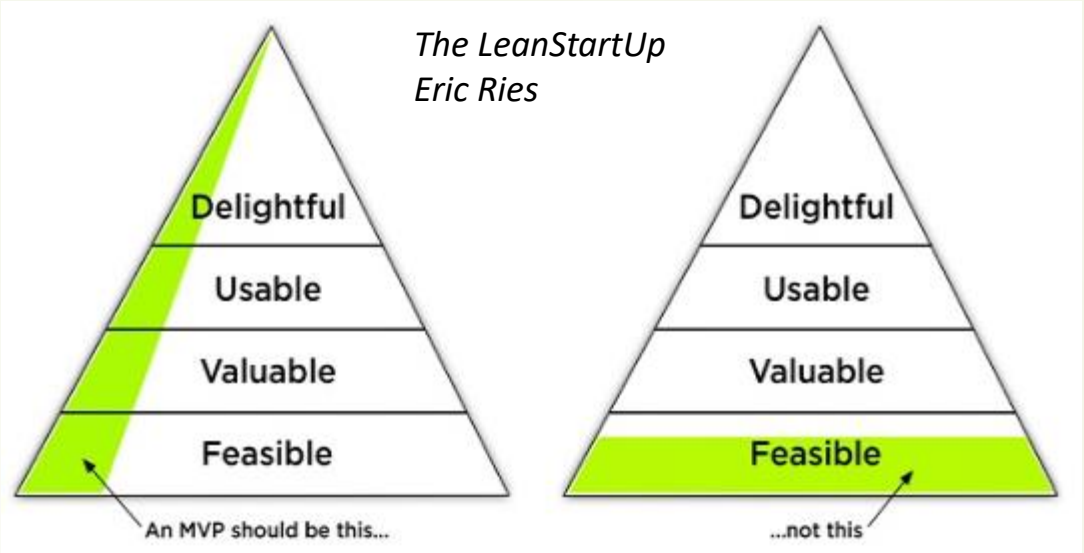
Ensure your test collects data on your riskiest assumptions about:

- Desirability
- Usefulness
- Viability
- Feasibility

Are the features introduced/changed the real reason for any uptake/growth?

Minimum Viable Product (MVP)

Version of what you are trying to produce that test the riskiest assumptions to collect the maximum amount of validated learning from users/customers with the least effort.



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Farm Crap App

Chris Hodgson, Rothamsted North Wyke

Free app enables farmers to better manage manures and nutrients, reducing wastage and improving the farm business.

Developed with Duchy College, FoAM Kernow and Elixil, it works in-field without wireless connection on Android and Apple devices; it can be downloaded via iTunes or Google Play.

An improved Pro version received 2,700 downloads since May 2017 for the iOS version alone.

AgRIA – Agricultural Research & Innovation acceleration

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3 Operational Models: all using Lean methodologies

SHORT LEAPS

Many "start fast, fail early" projects

- General topic areas (e.g. Soils, AI, Big Data)
- High risk ideas addressing any need across the sector
- Up to 100K funding for early prototype testing; Mentored

LONG LEAPS

Few, large high-risk projects

- Specific need (e.g. how to make a cart that doesn't need a horse)
- Big challenge –funding offered over secured time period
- Failure rate high; projects starting/finishing will change
- Metered funding

NEW ENTREPRENEURS

3-4 yr innovation studentships

- Specific topic areas (e.g. Soils, AI, Big Data)
- Studentships mentored by entrepreneurs

- ❖ Dynamic, adopts lean (start fast - fail early/pivot) concepts
- ❖ Rapid early testing (getting new ideas off the ground)
- ❖ Co-creation and high engagement and participation

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Building a learning-support culture

Hackathon with UCL

sponsored by EPSRC, CABI and GODAN

Knowledge Exchange Grant
Impact Accelerator Awards
University collaborations

- Technology Innovation projects (TIPs)
- Off-The-Starting Block Innovation projects I and II
- Entrepreneurism Mentor

Entrepreneur Mentorship

Aislinn Pearson; Innovation Fellow

- Feasibility of fibre optic technology for in-field monitoring of soil
- Product development in AfSiS (→new company)

SHORT LEAPS

Many "start fast, fail early" projects

#60minworms prototype testing with Farmers

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11th March- 30th April
820 ha surveyed
>9000 earthworms assessed by farmers

Jackie Stroud (Rothamsted) on-farm trial
Assessment with Tim Ashton

- Majority of fields show good distribution
- Only 5% high abundance so far
- Differences in abundance of different earthworm types

SHORT LEAPS
Many "start fast, fail early" projects

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Soil AgRIA studentships

Cranfield University

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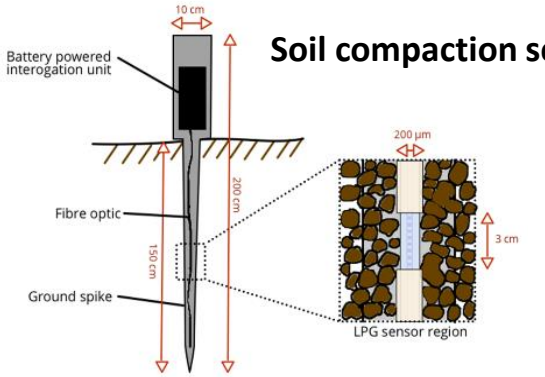


Soil compaction sensor

Satellite-based soil and crop productivity

Novel ways to measure, map and manage soils

Optimum location and use of soils sensors

Novel SOC measurement and indexing tool

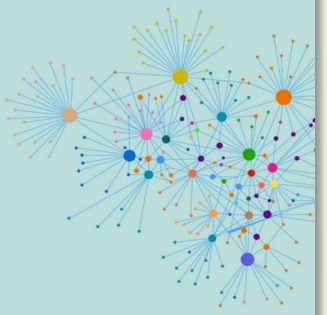
NEW ENTREPRENEURS

3-4 yr innovation studentships

Development of in-field diagnostic tools to measure available nitrogen accurately to mitigate losses to the environment

Nitrate/Ammonium specific paper-strips can easily measure Nitrogen content in a soil

An integrated network of sensors has the ability to successfully determine several soil factors - moisture, pH, temperature, nitrogen content



Connecting all the data with a powerful model in order to predict nitrogen release in different soils

IMPROVED FERTILISER RECOMENDATIONS FOR FARMERS

ERDF-funded AgRIA Initiative

EUROPEAN UNION
European Regional Development Fund

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Partnership

University of Hertfordshire

Cranfield University

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UCL

Oaklands College

Four Themes

- Soils, Water and the Environment
- Big Data and the Internet of Things
- High Value Products form Plants & Soils
- Sustainable Green Products

Opportunity

£2.7M

25 SHORT LEAPS over 3 years

high risk,-start fast, fail early projects

Academic-SME collaborations

First call for projects ~ July 2018

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FarmINN

Supporting innovative on-farm research projects which aim to provide real-world, scientifically proven solutions to challenges faced by UK farmers. Enabling farmers to rigorously test new ideas whilst de-risking the process of trying innovative practices.

Do you have an innovative idea you want to test out on-farm?

Visit the website to download application forms **www.rothamsted.ac.uk/knowledge-exchange** or email **farminn@rothamsted.ac.uk**

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AHDB CEREALS & OILSEEDS

Coordinated with Innovative Farmers (e.g. cross-referrals possible)

FarmINN

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Farmers are supported to test their ideas rigorously on-farm with researchers using lean approaches

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AGRICULTURE & HORTICULTURE DEVELOPMENT BOARD

Farmer Innovation

Rothamsted experts connect with farmer

Co -design project

Advisory panel

Lean testing

Share Results

SHORT LEAPS
Many "start fast, fail early" projects

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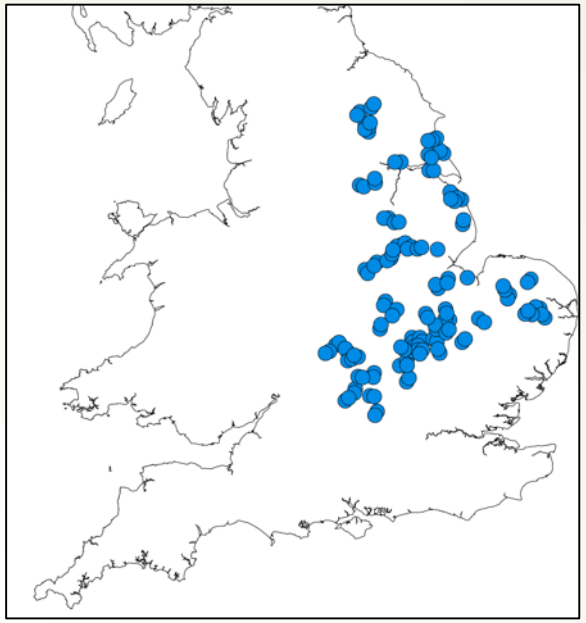
The Black-Grass Resistance Initiative

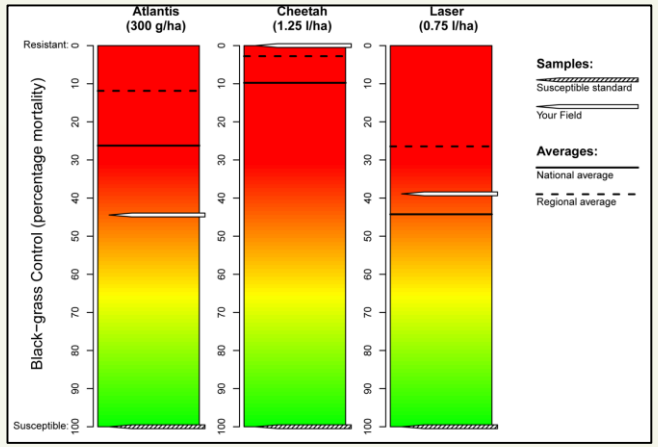
Farm network



71 Farms

Black-grass monitoring
- Abundance
- Resistance
- Management

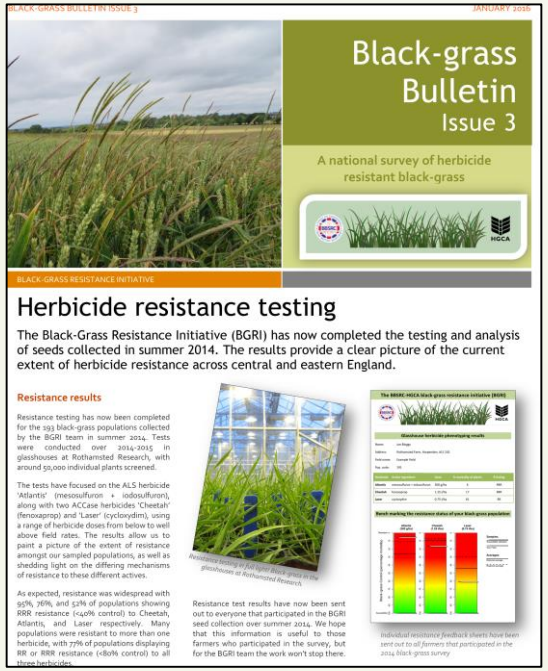
Benchmarking resistance (Field & Farm Level)



Evidence–based Black-grass Management

Engaging end-users

Newsletters



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Clean Agricultural Growth: The Farmers View

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- Survey sent to 12 diverse farmers;- essential success factors in your system? Knowledge Gaps?
- Workshop (4th April):- farmers worked in mixed groups, identified common factors and needs.

Keys to Success

1. No/reduced till
2. Grass leys
3. Continuous soil cover
4. Diverse cropping/farming system (smart rotations)
5. Diversity in space and time (e.g. mob grazing)
6. Reduced N dependency
7. Reduced AgChem dependency/prophylatic use
8. Being informed
9. Adaptable mindset

Future Research needs

1. Evidence for practises that improve soil health
2. More crops for our rotations
3. Moving to nutrient value not yield
4. Reducing C footprint & N dependency
5. Reversing size trend of farm machinery
6. Solutions that are farm-size independent
7. Introducing organic principles to reduce inputs
8. Data capture that informs decisions
9. Better understanding of trade-offs

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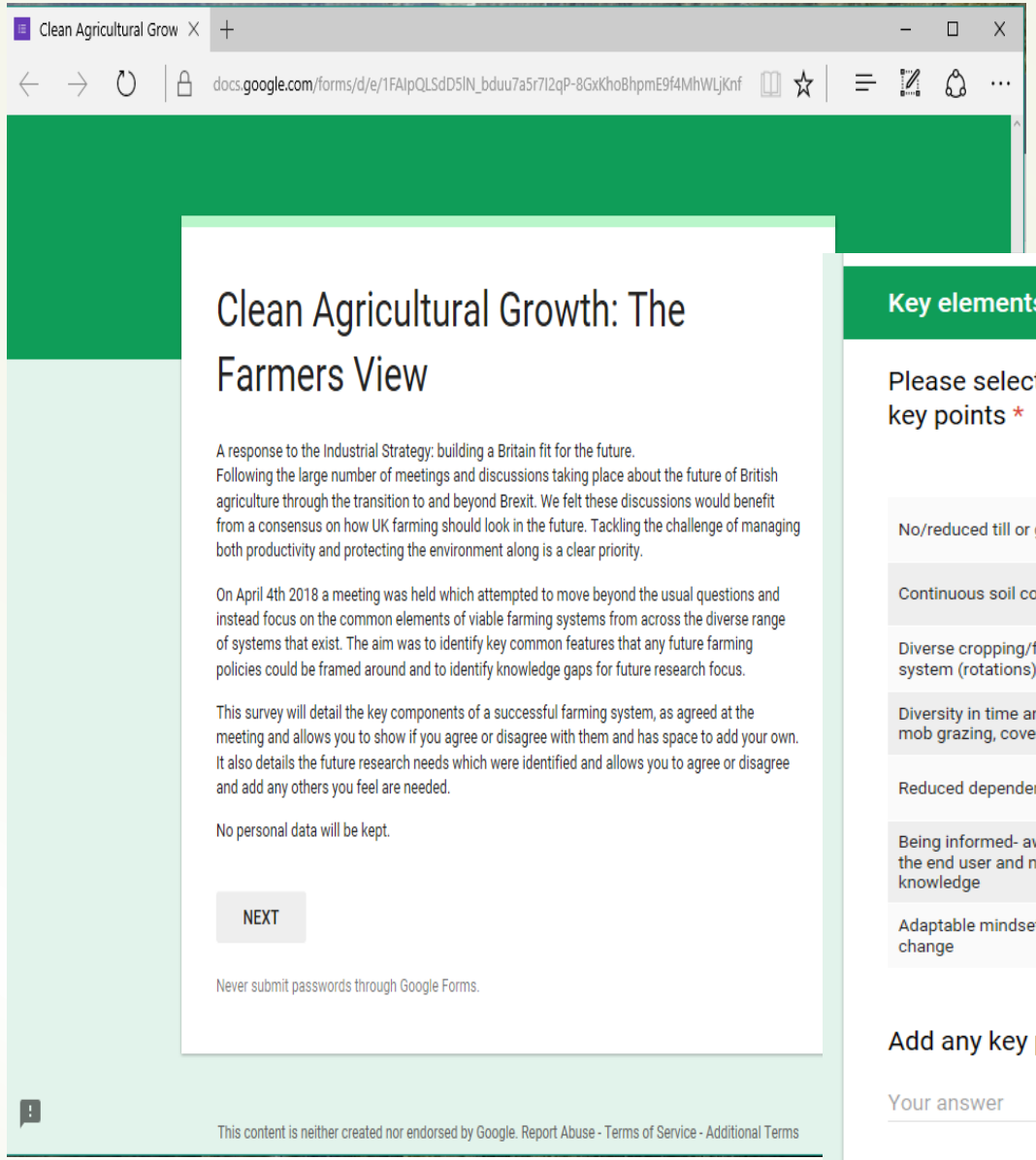

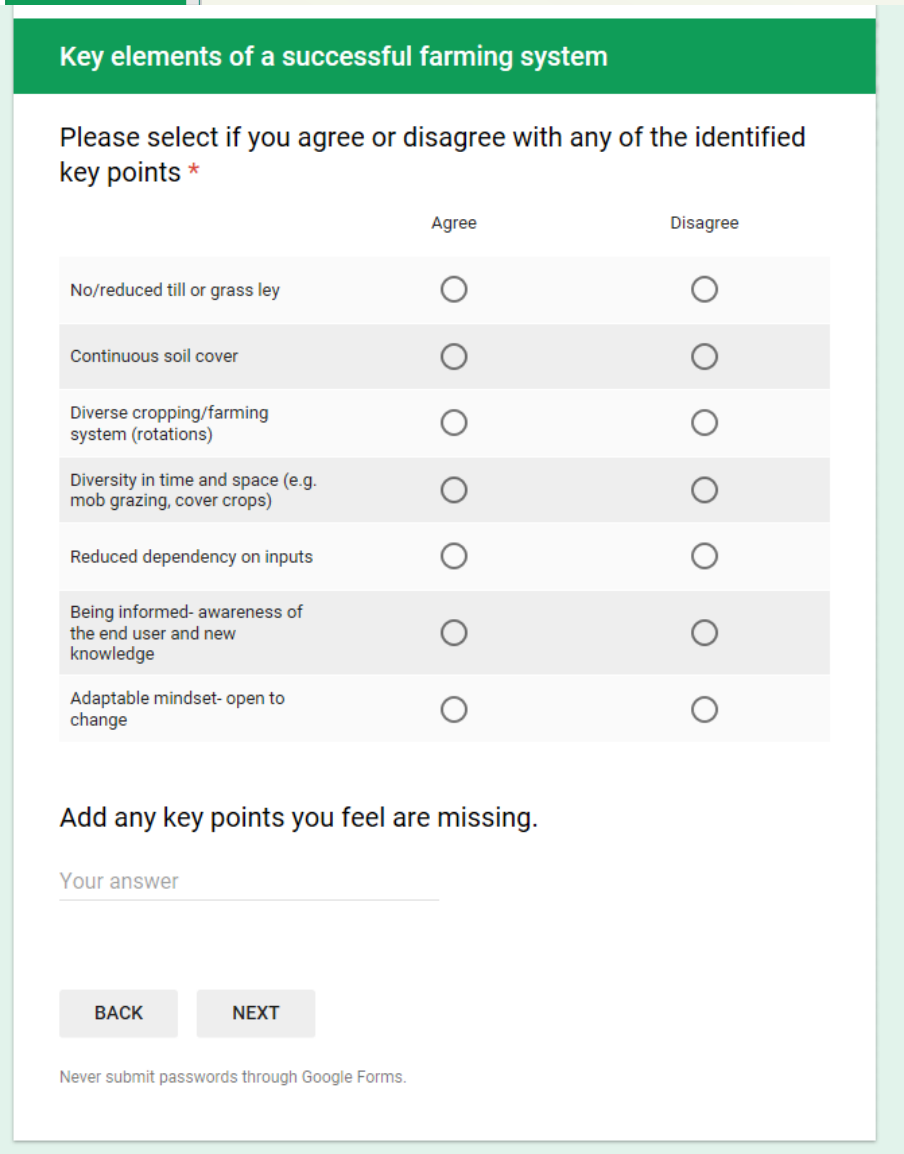

Now: Engaging with more farmers via social media – https://goo.gl/spHb6Z

Engaging widely: The Ripple Effect

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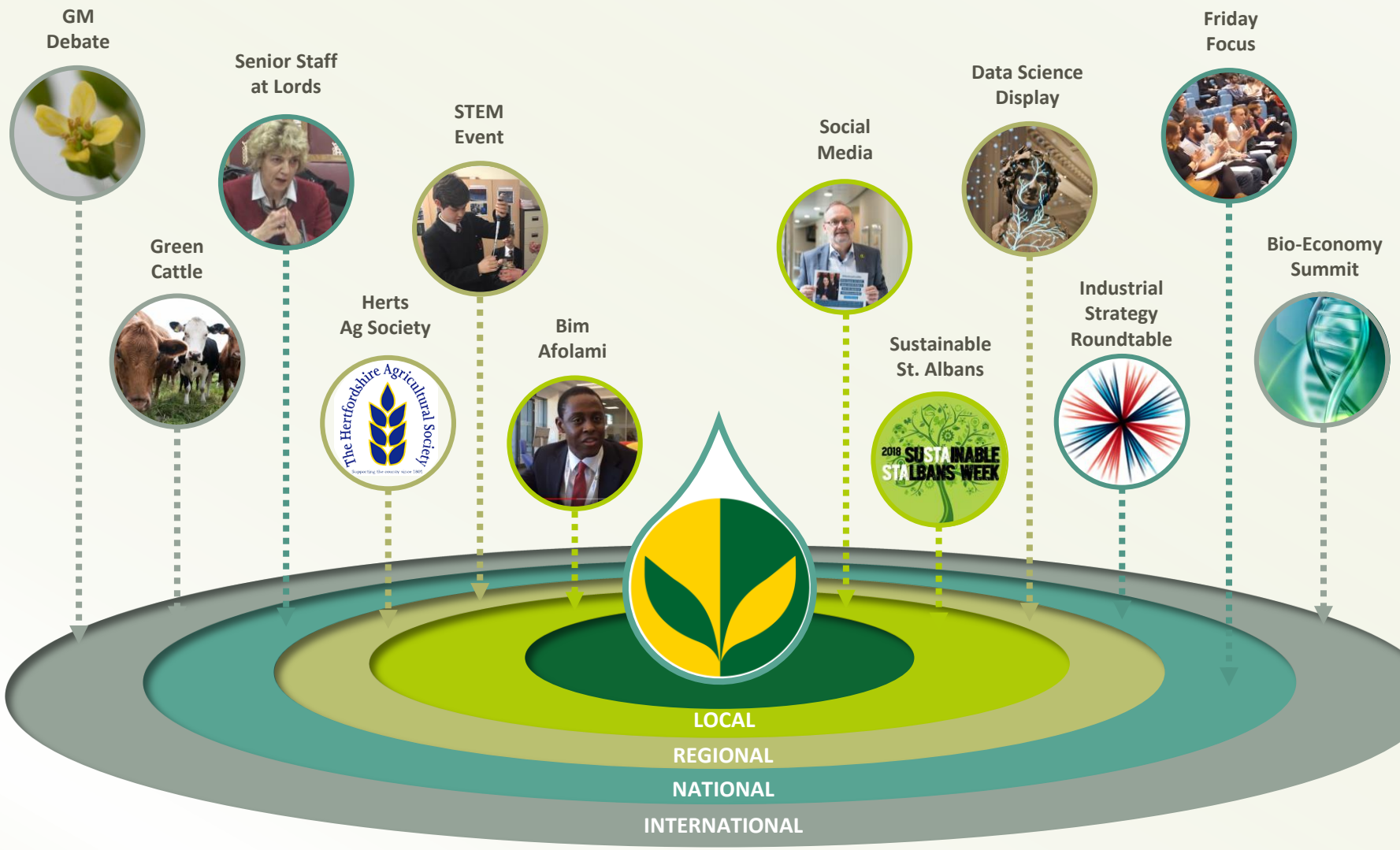

Future disruption via lean innovation

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Smart Adoption

Farmer-empowered decision-making

Healthy (optimised) Farm Dashboards

- Fertiliser use
- AgChem use

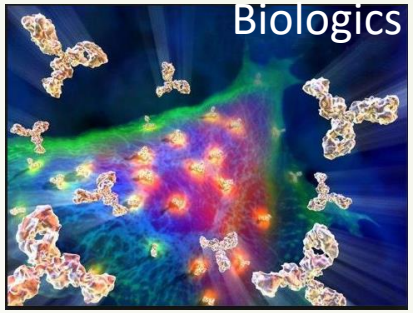
AI: sustainable fork to plate (certified) value chains

Next Generation Crop/Animal Protection

Peer to Peer learning

Farmers directly access information and advice for their farms

Intelligent iAgents Process automation; Cognitive insight



Intelligent Combinations of Novel Genetics, Synthetic Biology and Breeding

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Take home messages

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- Good ideas alone will not deliver new products or practices that transform industries; we need to manage the innovation process.
- Disruptive innovation requires different mindsets and approaches.
- Agriculture has to deal with large uncertainties – we need to collaborate with farmers in translation of ideas.
- We need innovations in practice (non-embodied innovations) and not just new products.
- Adoption cannot be pushed; we need to think smartly about how to engage early and understand real needs through innovative communication channels.
- Lean StartUp methodologies have much to offer within this context

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Come and celebrate great ideas with us

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