Relevance of Long-Term Experiments to Business & Policy

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The Future of Long-Term Experiments in Agricultural Science - 21 May 2018
Relevance of Long-Term Experiments to Business & Policy

- Relevance of Long-Term Experiments to Business & Policy
- Different ways in which LTEs are relevant
- Examples
- Today – multiple objectives
- Challenges and opportunities in dealing with multiple objectives
- What might be missing from the LTE approach
## (LT) Experiments & Science

<table>
<thead>
<tr>
<th>Concept</th>
<th>Description</th>
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<tr>
<td>Hypothesis</td>
<td>Test – Experiment – <strong>Effect</strong> - Science</td>
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<tr>
<td>Why?</td>
<td>Mechanism – how? - <strong>Cause</strong> – <strong>Theory</strong></td>
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<td>Systems</td>
<td>Interactions – <strong>Trade-offs</strong> – Synergies – Conflicts</td>
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<td>How certain?</td>
<td><strong>Variation</strong> – How Confident? - <strong>Agronomy</strong></td>
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## Societal Value

<table>
<thead>
<tr>
<th>Area</th>
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<tr>
<td>Evidence</td>
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<tr>
<td>Strategy</td>
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<td>Acceptability</td>
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<td>Risk Management</td>
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Hypothesis: Plants get their nitrogen from the soil

Air (Carbon dioxide)  Nitrogen

Air or Soil?

Jean Baptiste van Helmont measured the change in weight of soil used to grow a willow tree and concluded that the weight gain came from the water.

Justus van Liebig realised that plants got their C from the air but concluded erroneously that most plants would get their N from the atmosphere too.

John Lawes & Henry Gilbert showed that minerals came from the soil.

Water
Myzus persicae at Rothamsted 1965 - 2017
(2017 is shown in red)

First suction trap record

July
June
May
April

Jan - Feb mean screen temperature °C

r² = 0.7378
P < 0.001

Mean temp. 1965 - 2017
Plus 1°C

Theory: Climate Change

RRes Insect Survey, James Bell
Thresholds & Policy: Heavy metals from sewage sludge in soil

Soil microbial biomass (mg/kg soil)

10^9 cells/g soil

10^4 cells/g soil

Control or FYM plots  Sludge treated plots

Giller et al SBB 1998
Systems & Agronomy: What interventions matter & how do we know?

Graph showing trends in crop yield and fertilizer application. The graph includes data points for various crop yields and nitrogen applications, with legends indicating different crop varieties and fertilizer types. The x-axis represents the years from 1840 to 2020, and the y-axis represents grain yield at 85% dry matter.

Key interventions include Fungicides, Herbicides, Liming, Fallowing, Continuous Wheat PKs 164 kg N FYM, and Unmanured, continuous wheat.
Delivery of Multiple Services

Broadbalk: both yield and [NO3] better today than 100 years ago

2000-meas
Series 2
1880-meas
1880-fit

Better
Yield t/ha

Park Grass LT Hay meadow

Better

limed
unlimed
initial years

Better

pH

No. Species

yield

http://www.era.rothamsted.ac.uk/
North Wyke Farm Platform – Multiple Objectives

3 Independent farmlets – 7 fields each

Test of Management

Drainage, nutrients, emissions

Productivity & economic output

Ongoing

Orr et al., EJSS 2016
Combining fields expands horizons

Combinations of Fields

- Combined
- High Clay
- Low Clay
- Threshold

Nitrate Concentration mg N/l

Income, £
Multiple Objectives, Space, Changes in Time & Networks
I promise to pay the bearer on demand the sum of Twenty Pounds.
Participatory Research for LTEs

- Demonstrate a practice
- Underlying hypothesis – which may change over time depending on findings
- Adaptive ‘treatments’
- Focus on outcomes, trends or changes rather than effects
- People and what they do are central
- Not necessarily the only aim of the experiment
- Novel, or different, statistics may be needed. We’re still doing Science!
# Long-Term Experiments, Participation and Trust

## (LT) Experiments & Science

- **Hypothesis** – Test – Experiment – **Effect** – Science

- **Why?** – Mechanism – how? - **Cause** – Theory

- **Systems** – Interactions – **Trade-offs** – Synergies – Conflicts


## Societal Value

- **Evidence**

- **Strategy**

- **Acceptability**

- **Policy**

## Role in Building Trust

- Prove

- Agree

- Persuade - Adapt

- Demonstrate - Network

- Build Trust - Leadership

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(Rothamsted Research 175)
Conclusions – Relevance of LTEs to Business & Policy

• Deliver multiple objectives or services
  ➢ Build a wealthier society

• Combining management of fields in a landscape helps overcome constraints
  ➢ Retain more options
  ➢ May be only realistic ways to maintain farming under constraints
  ➢ Requires cooperation and trust between cooperating partners
  ➢ May not be easy or comfortable

• Adaptive, participatory research needed as well as rigorous tests of hypotheses
  ➢ Leadership, GLTEN Global Long-Term Experimental Network
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