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Agri-Tech Industrial Strategy: Evaluation Scoping Study and Baseline

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Prepared by:

First Floor
43 Chalton Street
London
NW1 1JD

www.sqw.co.uk

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Executive Summary

The **UK Strategy for Agriculture Technologies** (The 'Strategy') was published in 2013 and has a clear and ambitious vision: "*We want the UK to become a world leader in agricultural technology, innovation and sustainability; exploit opportunities to develop and adopt new and existing technologies, products and services to increase productivity; and contribute to global food security and international development*".

This evaluation scoping study and baseline had two main objectives:

- Estimate the current size of the Agri-Tech sector and make projections for the sector based on its current structure and global trends up to the 2030. The purpose of the projections is to provide an informed view of how the sector might develop without the Strategy

- Make recommendations for how the Strategy should be monitored and evaluated.

The size of sector

The central estimate is that Agri-Tech directly accounts for £14.3bn in value-added and 542,000 jobs in the UK. The central estimate results from a transparent, readily-replicable method based on published statistics. The approach first maps the Agri-Tech sector to detailed activities identified in the Standard Industrial Classifications. Consideration is then given to the proportion of each detailed activity actually engaged in 'Agri-tech' rather than supporting other activities, and on the basis of this estimates are derived for the size of each contributing activity from published statistics. The assumptions for the scale of engagement of particular activities in Agri-Tech are informed by the findings from a bespoke company survey.

The sector is dominated by the farming sub-sector, and within that core agriculture production. Core agriculture production accounts for £9.7bn in value-added and around 474,000 jobs. The next largest sub-sectors are engineering and precision farming (a substantial element of which is wholesale activity related to agricultural machinery, equipment and supplies) and animals, with each contributing just over £1bn in value-added and almost 21,000 jobs.

These estimates are uncertain, although the uncertainty is focused around particular activities, which together comprise only around 17% of the estimate for Agri-Tech as a whole. Plausible high/low estimates for these aspects give a range for Agri-Tech value-added of between £13¾bn and £14¾bn with employment of between 532,000 and 552,000.

Indicative estimates for the size of the Agri-Tech sector over the last five years show that it has followed the trends of core agriculture, given the relative dominance of these activities. Value-added increased in 2009 (in contrast to the performance of the wider economy), before falling back in 2010 and rising strongly in 2011. Since then value-added has seen little growth. The performance of Agri-Tech excluding the core agriculture activities has been more in line with that of the wider economy; output fell sharply in 2009 before

recovering in 2010 and growing to 2012. Employment levels are roughly where they were in 2008.

Projections for the Agri-Tech sector

The central projection is intended as a neutral baseline scenario, to illustrate the indicative outcome for the sector, taking account of underlying trends in UK and global agriculture. It provides a 'business as usual' projection against which future outturns can be assessed and compared. It does not represent an attempt to model the Strategy for the sector.

The framework in which the projections were developed modelled the prospects for each sub-sector separately, using a common structure. There was consistency across sub-sectors, with outcomes for one Agri-Tech sub-sector impacting on the prospects for another sub-sector where appropriate. For example, the outcome for core agriculture production (part of the Farming sub-sector) is expected to impact on levels of investment made by the sub-sector. This in turn will be the level of domestic demand faced by those making investment goods (e.g. Engineering & precision farming sub-sector).

Key assumptions driving the projections included those for future global demand for agriculture products and core UK agriculture production (core agriculture accounts for 85-90% of farming Gross Value Added (GVA) and 60-65% of Agri-tech GVA). The view on future global demand for agriculture products drew on that published by OECD/FAO. Future growth in core UK agriculture production was taken from that projected by the FAPRI-UK model (0.5% pa). Global agriculture investment is assumed to grow at 1% pa. This is slower than global agriculture output growth which implies weakening investment intensity. This is interpreted to mean that Agri-Tech is not leading to a change in global investment trends, but potentially changing the composition of that investment.

Overall, the value-added of Agri-Tech is projected to grow modestly by an average of ¾% pa over 2013-2030, raising value-added from £14¼bn in 2013 up to £16¼bn in 2030 in volume terms. Employment in Agri-Tech as a whole is projected to fall to 2030, by about 5% due to falling employment in core agriculture.

The fastest growing sub-sectors within Agri-Tech in output terms are expected to be in the high-tech areas such as ICT and engineering and precision farming which will benefit from the move for core agriculture to adopt developing techniques. The Farming sub-sector is projected to record the slowest growth among the sub-sectors (½% pa in terms of value-added).

Overall employment in Agri-Tech is projected to decline through to 2030. The primary factor behind this is the projected fall in employment in the Farming subsector, and core agriculture in particular. Productivity growth in agriculture is expected to pick up from the low rates seen in recent years, to around 1¼% pa in the long term. Given the trends in output, the outcome is 37,000 fewer jobs in core agriculture than in 2014. With core agriculture accounting for around 85% of all employment in Agri-Tech, the outcome for agriculture dominates the sector. Nevertheless, the employment prospects elsewhere in Agri-Tech are more favourable; employment in most other subsector is projected to rise in the medium and longer term.

Sensitivity analysis

Six alternative sets of results have been generated using high/low growth scenarios for assumed growth in UK agriculture output, global agriculture output and global agriculture investment. The alternative assumptions for UK agriculture output will primarily impact domestic demand for agriculture but will also impact UK agriculture investment because the investment intensity ratio of UK agriculture is unchanged in the alternative scenarios. The alternative assumptions for global agriculture demand are expected to impact on global demand for UK agriculture commodities as well as the export demand for other parts of Agri-Tech to support production overseas. However, the scenario assumes overall global agriculture investment is unchanged from the central projection. The impact of changes in global agriculture investment on demand for UK agriculture investment goods is considered in the global agriculture investment scenarios.

The alternative investment scenarios have comparatively little impact on the outcome for the Agri-Tech sector as a whole However, the ICT, Infrastructure and Engineering & precision farming sub-sectors all experience changes of +/- 1-2% in both GVA and employment. The alternative assumptions for global agriculture output impact on Agri-Tech GVA by +-7-8% by 2030. This effect is mainly felt in the Farming sub-sector although the Plants and Environment & physical sub-sectors see the strongest proportional change. The scenarios involving alternative assumptions for growth in UK agriculture output have a similar size of impact on the overall sector by 2030.

Metrics for monitoring

Metrics have been developed for the different components of the Agri-Tech Strategy:

- Catalyst
- Centres
- International Development
- Internationalisation, i.e. exports and inward investment
- Overall coordination and influencing activities.

Logic models were developed for each of these components and from the specification of benefits within the logic models, a full long list of metrics was identified (Annex E of the main report) to be used in the assessment of Strategy performance. In order to inform the Leadership Council a shorter more focussed set of metrics was required. The priority metrics are set out in Figure 5-1 of the main report.

The prioritised list was determined through consideration of three key issues:

- ensuring a spread across the themes of the Strategy
- achieving a ‘balanced’ approach that captures a mix of more immediate effects (to guide on-going delivery) and longer-term effects (to demonstrate achievement of objectives)

- reflecting what is likely to be most feasible to measure and potentially attribute to the Strategy bearing in mind the likely focus of resource on monitoring and evaluation (and associated primary research).

In terms of responsibilities for taking forward these metrics, we recommend the following:

- Innovate UK should incorporate key metrics for outputs and intermediate outcomes (where possible) into its monitoring systems for the **Catalyst** where these data are not already collected. This should build on Innovate UK's existing monitoring systems and include appropriate breakdowns for Catalyst projects that contribute to **International Development** objectives.

- Output and intermediate outcome metrics should be incorporated into the monitoring systems for the **Centres**. Where feasible and appropriate to the way in which individual Centres operate, these should be consistent across the Centres.

- UKTI should be asked to report formally on the key metrics relating to **Internationalisation**.

- The Leadership Council, Defra and BIS should put in place processes for monitoring the direct outputs and, where possible, the intermediate outcomes of the actions relating to **Influencing and Leadership**.

- The tracking of conditions (which feed into final outcomes) has already begun with the separate baseline work that we have undertaken as part of this study, and a process for future tracking should be put in place by BIS and Defra, including where appropriate adding questions to existing surveys (e.g. Agriculture in the UK). These metrics cut across the five themes that have been used to inform our thinking. It is worth noting that some of the metrics are 'attitudinal' indicators, e.g. "profile of the Agri-Tech sector" and "measure of networking".

Evaluation framework

There are five components to the recommended evaluation framework and these are summarised in Table 1, with detailed descriptions of approaches contained within the main report.

Table 1: Summary of recommendations

Component	Approach	Timings
Catalyst and International Development	Theory-based approach: • Beneficiary survey/tracking • Survey of unsuccessful applicants to help assess project and output additionality • Consultations/survey with research partners • Case studies, covering a range of projects to capture those with foci on international development, agricultural productivity and	Need to acknowledge differing start points and timescales of projects Proposed: • Initial evaluation in 2016 • Interim evaluation in 2017/18 • Final evaluation in c.

Component	Approach	Timings
	environmental benefits	2020
Centres	Theory-based approach: • Case study based for different Centres funded, including consultations/tracking with businesses, research partners, businesses indirectly affected • Consider feasibility of establishing a comparator group • Light touch consultation/tracking of unsuccessful applicants for Centres to see what was done instead • Process evaluation on governance, moving to self-sustaining models, joint working between Centres	Need to allow c. 5 years to allow for outcomes to be flowing through, so could do: • Process evaluation within 1 year of establishment • Interim impact 2-3 years • 2nd Impact 5 years (and possibly subsequently)
International-isation	Theory-based approach: • Survey of benefiting companies • Survey of non-exporters and enquirers • Case studies of inward investors	Shorter-term potential, perhaps 2016
Influence and Coordination of the Strategy	Theory-based approach • Establish base line of R&D funding and cooperation between relevant organisations • Range of surveys/consultations to assess influence of Strategy on policy makers, funders and others • Delphi surveys of expert opinion • Media monitoring	Need to allow time for influencing and outcomes to flow through, so: • continuous tracking of some indicators • Five yearly evaluations
Overall Strategy	Modelling of sector performance (baseline and pseudo-counterfactual) compared to outturns as part of overall assessment of Strategy, which should also incorporate findings from above triangulated with evidence from projections Modelling would: • Have baseline projections on output, employment, with associated external and internal drivers around global growth, UK market share and investment intensity • Update baselines based on revised external drivers, and new evidence on relationships between inputs and outputs • Compare outturns to revised baseline projections based on other evidence indicating how the Strategy had led to changes in market share and investment intensity.	Need to allow effects to work through, so propose an initial assessment in 2020, with subsequent ones, depending on requirements of policy in: • 2025 • 2030

Source: SQW

Evaluation priorities

The priorities for evaluation will ultimately depend on factors outside the scope of the current project, including the fact that only a few programmes have been identified and choices will need to be made as the Strategy develops. Nevertheless, there are some general principles which should inform prioritisation:

- The scale of public investment, with higher levels of investment meaning that a particular intervention should be a higher priority for evaluation.

- The extent to which the programme is itself innovative, in order to draw lessons from the programme under consideration as well as to decide whether continuation is justified – the more innovative an intervention the higher the priority.

- 'Evaluability' – the extent to which robust evaluations are possible and whether it will be possible to demonstrate impacts, with greater evaluability indicating a higher priority.

Of the programmes which have so far been defined, this suggests a high priority for the Catalyst and Centres. Public investment in the Catalyst is of the same order as the Centres (although slightly lower) and both are much higher than for the internationalisation activities. The Catalyst evaluation will be complex, but of the three components considered we believe this one is most likely to generate robust impact assessments. The Centres evaluation will be more complex, but they are the most innovative of the interventions foreseen at present.

1. Introduction

This is the final report of *the Agri-Tech Industrial Strategy: Evaluation Scoping Study and Baseline*. The **UK Strategy for Agriculture Technologies** (The 'Strategy') was published in July 2013. Its vision is clear and ambitious: "*We want the UK to become a world leader in agricultural technology, innovation and sustainability; exploit opportunities to develop and adopt new and existing technologies, products and services to increase productivity; and contribute to global food security and international development*". To this end, it sets out a blue print for a long term partnership across the "triple helix" of government, research and industry. Some fourteen different actions are identified. In the round, these are concerned with improving translational research; providing better leadership; building a stronger skills base; aligning research priorities more effectively; and enhancing export performance.

The evaluation scoping study and baseline assessment had two main objectives:

- To provide an estimate of the current size of the Agri-Tech sector ('the snapshot') and projections ("baseline projections") for the sector based on its current structure and global trends up to the 2030. The purpose of the projections is to provide an informed view of how the sector might develop if the Strategy was not in place

- To make recommendations for how the Strategy should be monitored and evaluated.

It was undertaken by a consortium of organisations:

- SQW led the consortium and was responsible for developing the evaluation methodologies.

- Cambridge Econometrics estimated the current size of the sector and modelled the baseline projections.

- BMG Research undertook a large scale survey of businesses to support the sector modelling.

- Collison and Associates, a specialist rural and agricultural consultancy, advised the consortium on developments in the sector.

The final report was delivered in July 2015.

1.1. Approach

1.1.1. Modelling the sector

The first challenge for the study was defining the Agri-Tech sector in terms of Standard Industrial Classification (SIC) codes in order to access relevant data for modelling purposes. The Leadership Council had provided a narrative definition of the sector which is reproduced in Figure 1-1.

Figure 1-1: Leadership Council's definition of the sector

The **farming industry**, including diversified activities such as on-farm waste and biomass (grass, energy crops, specialist crops) for non-food uses

Plant subsectors (crops including cereals, oilseeds, pulses, forage, potato, sugar beet, vegetables, salads, mushrooms and fruit) including:

- Plant genetic improvement: genetics, genomics, biotechnology, breeding/ propagation, genetic conservation
- Plant health: plant production (physiology, agronomy, crop management and nutrition such as fertilizer/ agri-chemicals) and plant protection (identification, diagnostics, epidemiology, management / control including biological controls / vaccines / therapeutics of pest disease and weeds)
- Crop storage and silage (including post-harvest storage and on-farm waste and biomass for non-food uses)

Animal subsectors (livestock: dairy, beef, sheep, pigs, poultry (egg and meat) and aquaculture for fish: salmon, trout, shellfish) including:

- Animal genetic improvement: genetics/ genomics; breeding/reproductive technologies; genetic conservation
- Animal nutrition, including ingredients for animal feed; grazing systems and pasture diversity
- Animal health and welfare (endemic diseases, exotic diseases, behaviour): identification, diagnostics, epidemiology, management / control, vaccines, therapeutics, surveillance; building and environmental design to reduce stress and promote welfare

ICT systems and decision support: to support production planning, scheduling; input use efficiency (e.g. irrigation scheduling)

Environmental and physical subsectors including:

- Soil/ substrate management: soil physics, biology and chemistry, soil amendments (e.g. biosolids, AD digestates, water retention gels etc.); controlled traffic farming; reduced ground pressure; soil sampling; soilless growing media (glasshouse crops)
- Environmental interactions (air, water, biodiversity – plant and animal; ie. technology / decision support tools to improve animal welfare & environmental outcomes including reducing air and water pollution, greenhouse gas emissions including quantity and quality of air and water)
- Harvest and early-stage processing including harvest technologies, post-harvest cleaning, post-harvest storage (chemicals and storage conditions), on-farm waste (AD and other waste treatment plants) and biomass for non-food uses.

Engineering and precision farming, including machinery (cultivation, crop and grass health (drilling, spraying, fertiliser application), tractors, harvesters, pickers, post harvest transport and cleaning), robotics including GPS applications and autonomous devices, sensor technology (hand held, fixed and remote including animal welfare and monitoring)

Infrastructure: buildings (including glasshouses, livestock production buildings), heating and cooling systems, storage of crop and animal products in ambient, controlled atmosphere, cold stores and freezing plants, irrigation/ water management storage and distribution systems, dirty water systems, lighting (intensive livestock and glasshouse crops); 'vertical' and enclosed farming systems

Advisory services.

We mapped the Leadership Council's definition onto 2007 SIC 5 digit codes. This 'top-down' mapping included some SIC codes which are entirely within the Agri-Tech sector, but also many where some businesses could be considered part of the Agri-Tech sector but others are not. This identified 39 separate level five SIC codes.

To provide a further perspective on the sector, we also undertook a 'bottom-up' review of SIC codes for firms which are expected to be in the sector, using two approaches:

- 100 firms drawn from a range of lists of trade associations and attendees at trade fairs/events identified by the study team

- 100 firms drawn from a longer list that PA Consulting had identified through a mapping exercise of Agri-Tech firms; we selected 10 firms at random from each of the 10 sub-sectors covered by the PA work.

Around 80 separate Level 5 SIC codes for these 200 firms were then compared to the 'top-down' definition. This led to a further seven SIC codes being added to the sector definition. These SIC codes formed the basis of sector modelling. The approach and findings are set out in Chapters 2 and 3. It drew on Office of National Statistics (ONS) data, including Input-Output tables, and Cambridge Econometrics' model of the UK economy. The estimates were refined by drawing on the results of a telephone survey of 2,000 businesses in the 46 SIC codes which gathered information on the proportion of their business within the Agri-Tech sector.

1.1.2. Monitoring and evaluation framework

This part of the project began by developing logic models for the Strategy and its distinct components. From these logic models metrics were developed for monitoring and tracking. The validity of these initial models was tested through discussions with key stakeholders which are involved in implementation of the Strategy and the project steering group. After refining the models and metrics, evaluation plans were developed.

1.2. Format of the report

This report is in two parts. Part I presents the results of the modelling of sector size and baseline projections and part 2 reports on metrics and the evaluation framework. Supporting information is presented in Annexes.

Part I: Modelling the sector

2. The Size of the Agri-Tech sector

2.1. Introduction

As discussed earlier in this report, Agri-Tech is not an industry or activity that is identified in existing industry classifications. Indeed, there is no widely-accepted definition of what comprises Agri-Tech other than it encompasses a variety of activities that are identified in existing classifications. Given this, there is no definitive estimate for the size of the sector. Nevertheless, it is important for developing appropriate policies for the sector that some boundaries are put on the size of the sector and its components. The estimates presented below are constructed from published statistics.

2.2. Method of approach

The method adopted is transparent and based in published statistics. As such it is readily replicable and can produce updated estimates as additional data (e.g. for subsequent years) become available. Nevertheless, despite being transparent and replicable, the method still relies on a series of assumptions.

Estimates are made for the following indicators:

- Turnover
- Value-added
- Employment
- Gross investment
- Employment costs
- Exports
- Imports

In broad terms, the estimates are constructed by:

- identifying which activities (identified in the Standard Industrial Classifications) are within the scope of Agri-Tech
- determining what proportion of each of these activities is Agri-Tech
- making estimates for the size of each contributing activity.

2.2.1. Mapping activities to the Agri-Tech sector

The mapping of the Agri-Tech sector to activities identified in Standard Industrial Classifications (SIC) is described earlier. The outcome is a list of unique activities identified at the level of 5-digit SIC that are within scope, and a mapping between them and the various Agri-Tech sub-sectors. There is not a unique mapping from activities to subsectors: one activity identified in terms of SIC can be identified within more than one Agri-Tech sub-sector. What is important is that there is no overlap in the scope of the various Agri-Tech subsectors.

2.2.2. Identifying the share of an activity that is 'Agri-Tech'

The definition of Agri-Tech being used includes SIC activities identified at the 5-digit level. Not all of the 5-digit activity needs to be related to Agri-Tech; this may be the case for Manufacture of prepared feeds for farm animals (SIC 10910) or Manufacture of fertilisers and nitrogen compounds (SIC 20150), but is clearly not be the case for Other professional, scientific and technical activities (SIC 74909).

Assumptions for the share of each detailed activity that is related to Agri-Tech are made drawing on evidence from:

- UK Input-Output tables
- a survey of firms.

The UK Input-Output tables demonstrate the structure of goods and services used by each sector of the economy (sectors identified in the I-O tables are typically defined at the broader 2-digit SIC). Values can be calculated from the tables for; proportion of intermediate production of a good/services that goes to agriculture and the proportion of output of a good/services that goes as intermediate demand to agriculture which could be taken as proxies for the proportion of an activity related to Agri-Tech[1]. As these I-O-based ratios are constructed for broader industry groupings that are used to define Agri-Tech judgement is applied to confirm relevance for the detailed activities[2].

The survey of firms carried out for this study asked firms within particular sectors the extent to which their activities are related to Agri-Tech, thereby providing an additional source on this particular question. The survey results for several activities were notably higher than the I-O based estimates, particularly professional service and R&D activities. This is not altogether surprising, as the survey was structured in particular to give a closer focus on the activities in these more broadly-based activities that are related to Agri-Tech. For example, the I-O data identify the Scientific research and development sector (SIC

[1] For those detailed activities where there is little final demand other than exports, then the first of these ratios can be seen to be a more appropriate guide to the proportion of activity that is serving Agri-tech. However, if the activity has a large market among consumers, then this ratio will overestimate the importance of Agri-tech and the second ratio may be more appropriate.

[2] For example, the detailed activity of manufacture of pesticides and other agrochemical products (SIC 20200) is part of the wider I-O sector Dyestuffs, agro-chemicals. 22% of intermediate demand for the I-O sector goes to agriculture, whereas the whole of the 5-digit activity manufacturer of pesticides etc is assumed to come within the definition of Agri-tech that has been adopted.

72), of which only Research and experimental development on natural sciences and engineering (SIC 7210, comprising) is identified to relate in any way to Agri-Tech. The survey covered only those companies within the relevant activity. A second factor that could contribute to the different estimates for these activities from the two sources, is that the coefficient constructed from the I-O data (based on importance of the intermediate demand going to agriculture) is a less than ideal approximation for activities where much demand comes from other funding sources, such as public research funds.

Table B-1 in Annex B reports the separate proxy estimates for the proportion of activities seen to be within Agri-Tech, together with the assumption taken forward in the calculations below.

2.2.3. Estimates by detailed activity

The basic approach to constructing the estimates for the component activities is set out below. It is illustrated through two worked examples in Annex A. The scope of the Agri-Tech sector has been defined in terms of 5-digit industry classifications. The Annual Business Survey (ABS) is the principle source of economic information on sectors. It provides data on a range of indicators, including turnover, value-added, and investment but only provides data down to 4-digit level of activity. The Business Register and Employment Survey (BRES) does provide estimates of employees at the level of 5-digit SIC. Estimates of the ABS indicators at the level of 5-digit SIC are constructed under the simplifying assumption that the relative size of each detailed (5-digit) activity is that given by its relative share of employees reported in BRES.

The ABS does not provide estimates for exports or imports. The COMEXT database provides comprehensive data on exports and imports of physical goods on various classifications, with the CPA[3]_2008 classification consistent with SIC (at a 4-digit level). Estimates of exports and imports for the 5-digit SIC activities are made in an analogous way to that described for the ABS data, with estimates of total exports/imports for each 5-digit activity being constructed by allocating the 4-digit SIC data from COMEXT according to the relative size of output (estimated from the ABS data earlier). Estimates for the scale of trade for service activities are constructed in a similar way using the database of trade values maintained by Cambridge Econometrics (CE)[4].

Estimates for the size of the Agri-Tech sector as a whole are then constructed by applying the assumptions for share of any one activity being in Agri-Tech to these estimates of activity[5].

2.2.3.1. Making estimates for 'volumes'

The ABS and COMEXT reports financial indicators in current prices. Comparison of changes over time are more commonly made using volume measures, adjusting for price inflation. Volume estimates for have been made by deflating the current price estimates

[3] Classification of Products by Activity

[4] CE maintains a detailed time series database of economic data that is used to populate its detailed model of the UK economy, MDM-E3. These data are maintained at the level of 86 industries, which are typically defined at the level of 2-digit SIC. This database is consistent with the data published by ONS.

[5] The share of detailed activities that are assumed to form part of the Agri-Tech sector do not vary over time

for each 5-digit activity using output price deflators for the broader sector industry within which each 5-digit activity is located[6]. Employment costs in each industry are deflated using the general price level of consumer spending.

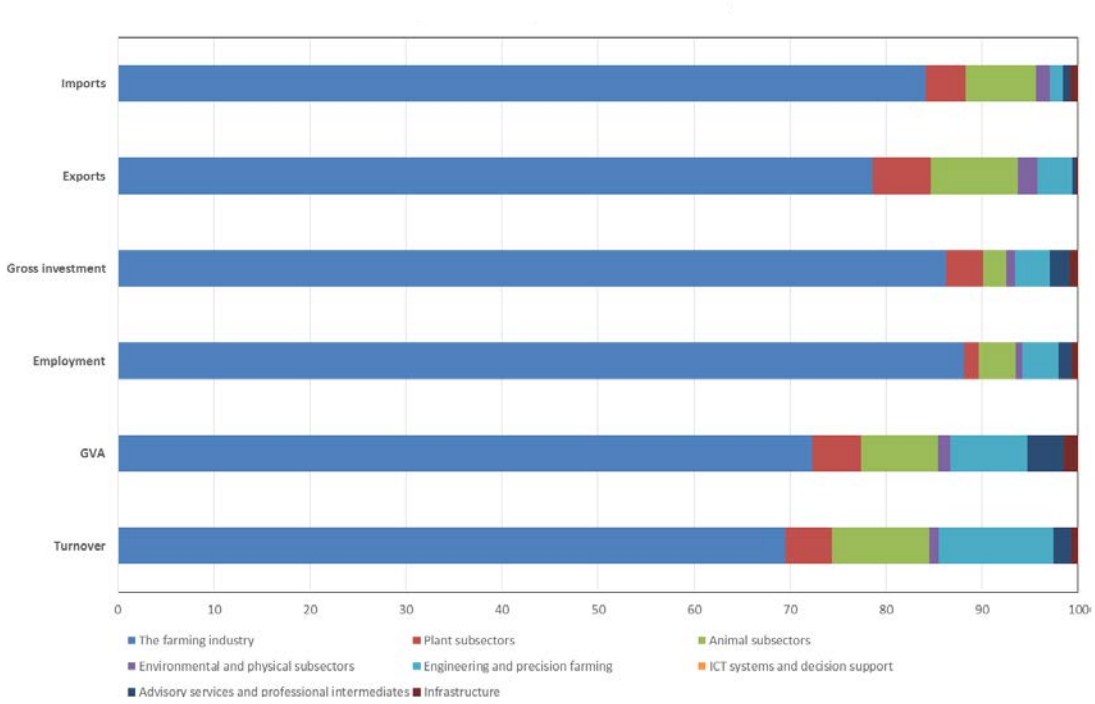
2.2.3.2. Estimates for sub-sectors

The estimates for the size of the various subsectors are made by combining the estimates for the relevant detailed activities (given by the original mapping between SIC and Agri-Tech subsectors). Where a particular activity is identified as being within the scope of more than one subsector, its contribution to the Agri-Tech sector is apportioned to each sub-sector equally.

2.3. Estimates for the size of the Agri-Tech sector

Table 2-1 and Figure 2-1 show the estimates for the Agri-Tech sector and its component parts for 2013. Overall, the Agri-Tech sector accounted for some £14.3bn gross value-added (GVA) and 542,000 jobs. The sector is dominated by the farming sub-sector and within that core agriculture production.

Figure 2-1: Composition of the Agri-Tech sector in 2013



[6] The price deflators are taken from the database of UK economic data maintained by CE, which disaggregates the UK economy into 86 separate industries.

Table 2-1: Estimates for the size of the Agri-Tech Sector, 2013

	Turnover (£bn)	GVA (£bn)	Employment (000s)	Gross investment (£bn)	Exports (£bn)	Imports (£bn)
Agri-Tech total	56.8	14.3	542.4	3.0	13.6	32.5
Sub-sectors						
The farming industry	39.5	10.3	477.9	2.6	10.7	27.3
Plant	2.7	0.7	8.4	0.1	0.8	1.3
Animal	5.8	1.1	20.9	0.1	1.2	2.4
Environmental and physical	0.5	0.2	3.6	0.0	0.3	0.5
Engineering and precision farming	6.8	1.1	20.4	0.1	0.5	0.4
ICT systems and decision support	0.0	0.0	0.0	0.0	0.0	0.0
Advisory services and professional intermediates	1.0	0.5	7.7	0.1	0.0	0.3
Infrastructure	0.4	0.2	3.5	0.0	0.0	0.3

The next largest subsectors are *engineering and precision farming* (a substantial element of which is wholesale activity related to agricultural machinery, equipment and supplies) and *animals* each contributing just over £1bn in value-added and almost 21,000 jobs.

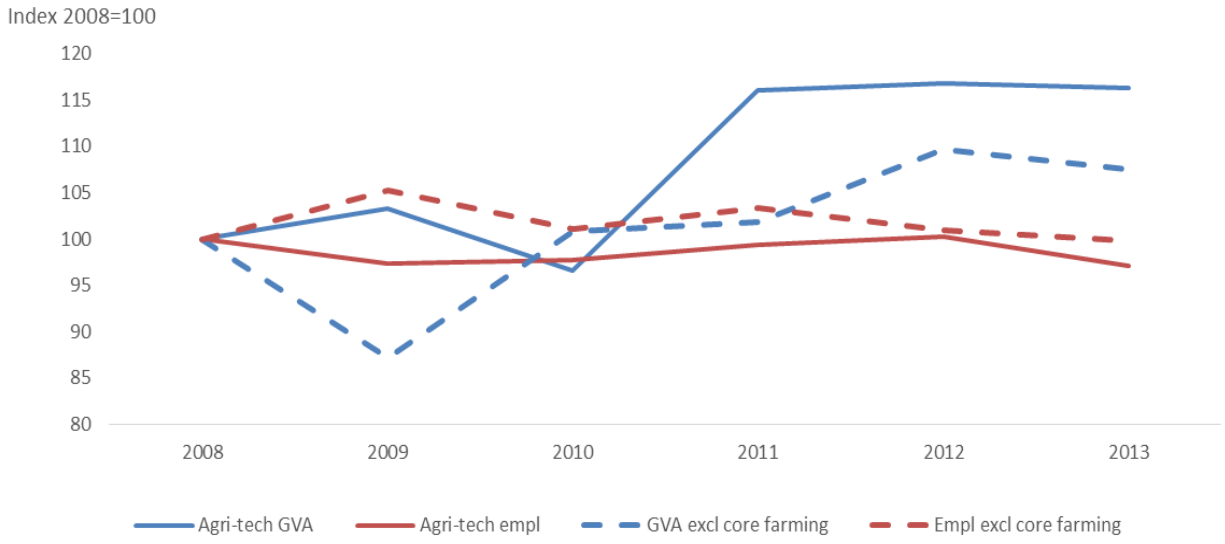
Viewing the Agri-Tech sector in terms of its component activities on a SIC basis (Table 2-2) reinforces the dominance of traditional agriculture production within its scope. It also reinforces the contribution manufacturing activities make, and brings into focus the relative number of jobs provided by related wholesale activities (35,000).

Table 2-2: Size of the Agri-Tech sector by Broad Industry

	GVA (£bn)	Employment (000s)
Agri-Tech total	14.3	542.4
Selected SIC Sections		
Agriculture, forestry and fishing	9.7	474.1
Manufacturing	1.8	17.9
Construction	0.1	1.3
Wholesale/retail trade	2.2	35.1
Professional, scientific and technical services	0.3	9.6
Other	0.2	4.4

Figure 2-2 illustrates the estimates for the Agri-Tech sector over time. The trend for the sector as a whole generally follows that for traditional agriculture, given the relative dominance of the activity within the sector. Value-added (volume measure) is estimated to have increased in 2009 (in contrast to the performance of the wider economy), before falling back in 2010 and rising strongly in 2011. Since then, value-added has seen little change. Employment levels have been relatively stable over the period. The performance of Agri-Tech excluding the core farming activities (shown by the dotted line) has been more in line with that of the wider economy; output fell sharply in 2009 before recovering in 2010 and growing to 2012. Employment levels are roughly where they were in 2008.

Figure 2-2: Estimates for the size of the Agri-Tech sector



2.3.1. Uncertainty surrounding the estimates

The main sources of uncertainty in the estimates provided above are in the estimates for the share of SIC-defined activities assumed to be within Agri-Tech[7]. The uncertainty is likely to be greater around the more broadly defined activities which support many different activities across the economy, such as Technical testing and analysis (SIC 7120) or Other professional, scientific and technical activities n.e.c. (SIC 7490). The effect of this uncertainty on the estimate of the Agri-Tech sector overall is compounded by the fact that these sectors can themselves be relatively large in size, and so a relatively small change in what proportion of, say, Other professional, scientific and technical activities falls within 'Agri-Tech' could have a notable on the estimate for the whole of the Agri-Tech sector.

However, there is a large portion of the Agri-Tech sector about which there is no uncertainty: Agri-Tech has been defined with core agriculture (SIC 01, 03) and other

[7] This assumes no error in the mapping of SIC activities to the Agri-tech sector or in the estimates for detailed sectors from national statistical sources.

activities including manufacture of fertilisers and nitrogen compounds, Manufacture of agricultural tractors and Wholesale of agricultural machinery, equipment and supplies being entirely within Agri-Tech. The activities defined to be wholly within Agri-Tech contribute £11.9bn value-added (83% of Agri-Tech total) and 503,000 jobs (93% of Agri-Tech total). Therefore, even if the true contribution the other activities within Agri-Tech is underestimated by 50%, then the estimate of value-added for Agri-Tech as a whole is underestimated by less than 10% (and employment by about half that rate).

The project survey provided some evidence for uncertainty around particular activities based on the number of firms approached and the number of them that reported to be involved in Agri-Tech-related activities. This is reported in Table B-1 in Annex B. For example, 29 companies within the Animal feed manufactures sector (SIC 1091) were approached for the survey. Of these 72.4% (21) said they were engaged in activities relating to Agri-Tech[8]. Sampling error mean that the 'true' level of engagement lies within +-16.3pp of this central estimate; that is somewhere between 56% and 89% of the sector is engaged in some Agri-Tech-related activity.

Table 2-3 reports 'upper' and 'lower' estimates for the size of the Agri-Tech sector. To arrive at these results, the scaling factors implied by the survey results have been applied to the central estimates for each component activity. So, the contribution for Animal feed manufactures sector in the upper estimate is scaled up by a factor of 1.23 (calculated from the figures mentioned above: 89%/72.4%) and that in the lower estimate is scaled by a factor of 0.77 (56%/72.4%). The activities that are deemed to be wholly within Agri-Tech (such as core farming and Manufacture of agricultural tractors) are common across the three estimates.

There are a number of activities mapped to Agri-Tech that are not covered in the survey. In the upper/lower estimates presented below, the contribution of these activities (which account for about 2.5% of Agri-Tech value-added) have been scaled by factors calculated from the averages across the non-core agriculture sectors surveyed (0.77 and 1.24).

[8] This does not mean that all their activities are Agri-tech related.

Table 2-3: Indication of uncertainty of engagement in Agri-Tech from the company survey

SIC		Agreed to interview	Screen out	Eligible %	Sample error (pp)	Minimum eligible	Maximum eligible
1091	Animal feed manufacture	29	8	72.40%	16.3	56.10%	88.70%
2015	Fertiliser manufacture	59	32	45.80%	12.7	33.10%	58.50%
2020	Pesticide manufacture	49	38	22.40%	11.7	10.70%	34.10%
2110	Basic pharmaceutical manufacture	160	157	1.90%	2.1	0.00%	4.00%
2120	Manufacture of pharmaceutical preparations	27	24	11.10%	11.8	0.00%	22.90%
2830	Tractor and farm vehicle manufacture	140	36	74.30%	7.2	67.10%	81.50%
3600	Water collection/treatment	168	156	7.10%	3.9	3.20%	11.00%
3821	Non-hazardous waste disposal	124	115	7.30%	4.6	2.70%	11.90%
4611	Agricultural wholesalers	306	55	82.00%	4.3	77.70%	86.30%
6130	Satellite communications	9	9	0.00%	0	0.00%	0.00%
7211	Biotechnology research	27	25	7.40%	9.9	0.00%	17.30%
7219	Other natural science research	223	199	10.80%	4.1	6.70%	14.90%
7490	Environmental consultancy	79	71	10.10%	6.6	3.50%	16.70%
7500	Veterinary surgeons	558	449	19.50%	3.3	16.20%	22.80%
	Total for above	1958	1374	29.80%	6.9[9]	36.70%	22.90%

[9] Average of the individual sector sample errors.

As Table 2-4 shows, the alternative estimates for the extent to which particular activities are within the Agri-Tech sector suggest the sector's value-added could be between £13¾bn and £14¾bn with employment of between 532,000 and 552,000.

The activities with the greatest 'uncertainty' around them are the activities around Biotechnology research, Manufacture of pharmaceuticals, Other professional scientific and technical activities and Other natural science research, and Animal feed manufacture. This is generally associated with largest absolute impacts on its contribution. Within Agri-Tech, the greatest variation is with the estimates for the animal subsector. This is primarily due to the alternative estimates for Animal feed manufacture, an activity which is only identified within the Animal subsector. The subsector does also include research and professional service activities, which see large differences in their contribution between the estimates, but their impact is dispersed between various sub-sectors.

Table 2-4: Alternative estimates for size of Agri-Tech sector

	Gross Value-Added (£bn)			Employment (000s)		
	Central estimate	High	Low	Central estimate	High	Low
Agri-Tech total	14.25	14.71	13.76	542.41	552.41	532.75
Of which ….						
The farming industry	10.31	10.38	10.23	477.88	479.44	476.35
Plant subsectors	0.73	0.79	0.67	8.4	10.21	6.6
Animal subsectors	1.14	1.33	0.9	20.9	25.22	16.89
Environmental and physical subsectors	0.19	0.23	0.16	3.63	4.31	2.94
Engineering and precision farming	1.14	1.16	1.11	20.39	20.86	19.92
ICT systems and decision support	0	0	0	0.02	0.03	0.02
Advisory services and professional intermediates	0.55	0.57	0.52	7.68	8.25	7.1
Infrastructure	0.21	0.25	0.17	3.51	4.1	2.93

Table 2-5: Differences from central estimate for size of Agri-Tech sector

	Gross Value-Added (£bn)		Employment (000s)	
	High	Low	High	Low
Agri-Tech total	0.5	-1	10	-19.7
Of which ….	0	0	0	0
The farming industry	0.1	-0.2	1.6	-3.1
Plant subsectors	0.1	-0.1	1.8	-3.6
Animal subsectors	0.2	-0.4	4.3	-8.3
Environmental and physical subsectors	0	-0.1	0.7	-1.4
Engineering and precision farming	0	0	0.5	-0.9
ICT systems and decision support	0	0	0	0
Advisory services and professional intermediates	0	0	0.6	-1.1
Infrastructure	0	-0.1	0.6	-1.2

3. Baseline projections for the Agri-Tech sector

3.1. Introduction

Following on from the estimates for the current scale of the Agri-Tech sector, this Chapter examines the future prospects for the sector across a variety of key economic variables under a series of alternative assumptions.

The central baseline projection is intended as a neutral baseline scenario, to illustrate the indicative outcome, taking account of underlying trends in UK and global agriculture, to provide a '*business as usual*' projection against which future out turns can be assessed and compared. The baseline projection is not an attempt to model the outcome of the Strategy for the sector. The impact of key assumptions on the baseline projection is tested through sensitivity analysis.

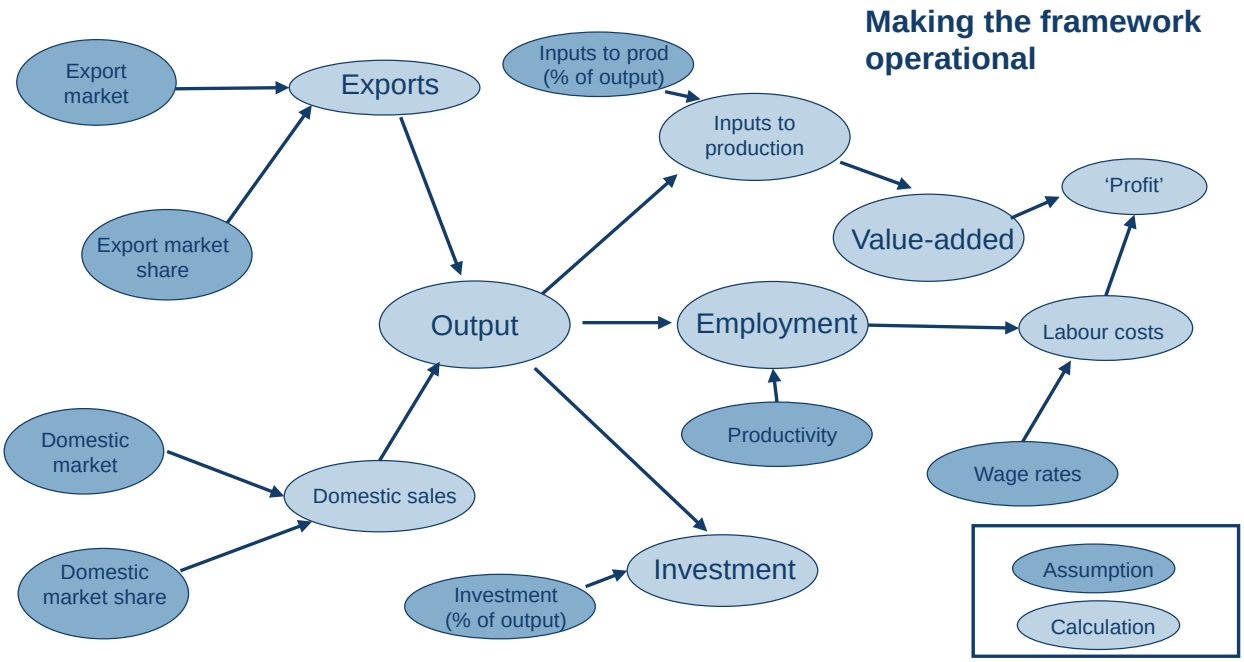
The set of assumptions behind the baseline projections can be easily modified over time as new information becomes available - yielding a more up-to-date baseline estimate of the Agri-Tech sector. The baseline can be compared against customisable alternative assumptions capturing say, the expected pick-up in growth from a proposed Agri-Tech policy.

3.2. Model framework

Each of the Agri-Tech sub-sectors are modelled using a common structure, as depicted in Figure 3-1. The key macroeconomic variables, output, employment, value-added etc. are calculated from assumptions relating to, for example export markets, domestic demand, export demand, domestic demand, investment intensity, wages and productivity.

The model is demand-driven i.e. export and domestic demand are the most important assumptions because they allow for the calculation of output which then has a further knock-on impact to the calculations of other indicators.

Figure 3-1: Model structure



Mapping the Agri-Tech sub-sectors highlights their interconnectedness: outcomes for one Agri-Tech sub-sector will impact on the prospects for another sub-sector. For example, the outcome for core agriculture production (part of the Farming subsector) will impact on levels of investment made by the other sub-sectors. This in turn will be the level of domestic demand faced by those making investment goods (e.g. Engineering & precision farming subsector).

The Farming sub-sector accounts for the large majority of the Agri-Tech sector and in turn the Farming sub-sector is dominated by core agriculture. Therefore, assumptions made for core agriculture will have the dominant impact on the outlook for Agri-Tech as a whole. The specific nature of the assumptions will be explored in a later section, but an important point is that good quality data sources are required to inform the assumptions for core agriculture.

Table C-1 in Annex C shows how the Agri-Tech sub-sectors relate to each other and identifies the key drivers of demand. The key assumptions driving the baseline projections are those for growth in export markets, in domestic agriculture output and world and UK demand for agriculture investment.

3.3. Key assumptions

The following sources of information are drawn on to produce the baseline projections:

- Forecasts for prospects for global demand for key agricultural commodities published by Organisation for Economic Cooperation and development (OECD), Food and Agricultural Organisation (FAO)[10]

- Defra projections for UK output of key agricultural commodities from the Food and Agricultural Policy Research Institute (FAPRI) model[11]

- FAO projections for global agricultural investment[12]

- Long term forecasts of UK sectors published by Cambridge Econometrics[13]

- Results from sector survey conducted as part of this study

- Expert opinion from the project team and its advisors and discussions with Defra and BIS.

3.3.1. Global context

The assumptions for future global demand for agriculture products are those published by OECD/FAO[14]. Global demand is projected to experience the strongest growth in countries in Asia and for commodities such as meat and fish. However, demand for UK agricultural goods is much more concentrated in the EU for commodities such as dairy products. The means that underlying demand for UK agricultural exports is projected to grow slightly slower than the 1¾% pa growth in global output.

Global agriculture investment growth is based on FAO projections for the agricultural capital stock. The view of the project team and advisors is that this growth, of ½% pa, underestimates the prospects for growth in developing countries in particular. A growth rate of 1% pa is assumed. This is weaker than the projected growth for global agriculture output which implies falling investment intensity. This is broadly in line with the historical trends. We interpret this as Agri-Tech not leading to a change in global investment trends, but potentially changing the composition of that investment.

3.3.2. UK agriculture

It was requested that the projection for core agriculture production be that projected by the FAPRI-UK model. The FAPRI-UK model is maintained by the Agri-Food and Biosciences Institute (AFBI) in Belfast and funded by Defra and the devolved administrations. The model is used to generate independent projections of production, domestic use, net exports and prices for key agricultural commodities up to 2021. The commodities available in FAPRI do not cover the entirety of agricultural production. Therefore, to test the suitability of the FAPRI projections, we compared the long run underlying growth of all commodities available in FAPRI against the historical trend in agriculture output data

[10] OECD/FAO *Agricultural Outlook* (2014)
[11] Defra *FAPRI - UK 2012 Baseline Projections* (December 2012)
[12] FAO *World Agriculture towards 2030/2050* (2012)
[13] Cambridge Econometrics *UK Industrial Forecast* (March 2015)
[14] OECD/FAO *Agricultural Outlook* (2014)

(defined in terms of SIC 01). They were found to be broadly similar. FAPRI projections suggest average growth of ½% pa in UK agriculture output which is slightly slower than the historical trend.

Core agriculture production accounts for almost half of the entire Agri-Tech sector output (and a much higher proportion of total employment), therefore the assumptions made have considerable influence on the projection for the sector as a whole

The future trend in investment by UK agriculture is based on CEs long term economic forecast for the core agriculture sector. This forecast has a gradual strengthening in investment intensity of output by agriculture (contrasting with falling investment intensity globally). This is because the UK is seen as one of the leading countries in the high-tech Agri-Tech sub-sectors (i.e. outside of Farming) and the continued necessity for UK agriculture to implement more high-tech farming practices to improve efficiency in light of challenges such as limited land supply.

The future trend in productivity in UK agriculture is also based on CE's long term economic forecast for the core agriculture sector. The long term historical trend in agriculture has been one of declining employment and rising productivity. However, the underlying rate of productivity growth has fallen over time and has been particularly weak (near zero) through the past decade. Productivity growth is projected to remain weak in the short term but to strengthen thereafter, to average around 1% pa in the long term.

3.3.3. Other assumptions

Other key assumptions influencing the results include those for the following:

- Growth in productivity (determining employment from output), Investment as a share of output (to determine investment from output) and average wages (to calculate labour costs from employment):

    - The starting point is to assume that growth in the variable for the Agri-Tech sector is that given by the appropriate aggregation of CEs' long term forecasts for UK industries[15]. The sectoral detail in CE's forecasts does not provide sufficient disaggregation to construct the Agri-Tech sub-sectors precisely; it is assumed that the projected trends in the CE forecasts apply to the more detailed activities within each CE sector. So, for example, the 'Advisory' sub-sector comprises some elements of the broader management consultancy and professional services sectors modelled by CE. The trend of the sub-sector will be an aggregation of the CE trends weighted by the detailed composition of the sub-sector.

    - The survey results are used to further refine the assumptions where necessary. It should be kept in mind that the SIC codes covered by the

[15] CE publishes long term forecasts for the UK twice a year for each of 86 industry sectors. The forecasts are developed in MDM-E3, the Multisectoral Dynamic Model of the UK economy. The detailed behavioural equations within the model are estimated by formal econometric methods on timeseries data. The forecasts used to underpin this analysis are those published in June 2014.

respondents may represent only a small proportion of an Agri-Tech sub-sector; hence, caution is exercised when amending assumptions for Agri-Tech sub-sectors. The respondents are asked about expectations regarding growth trends of the key macroeconomic indicators over the next five years and in the long term. Responses are quite broad (e.g. expecting the trend in wage growth to fall back or stay the same of pick up). This means that the general consensus among the respondents is compared to the trend shown in the CE long term forecast data.

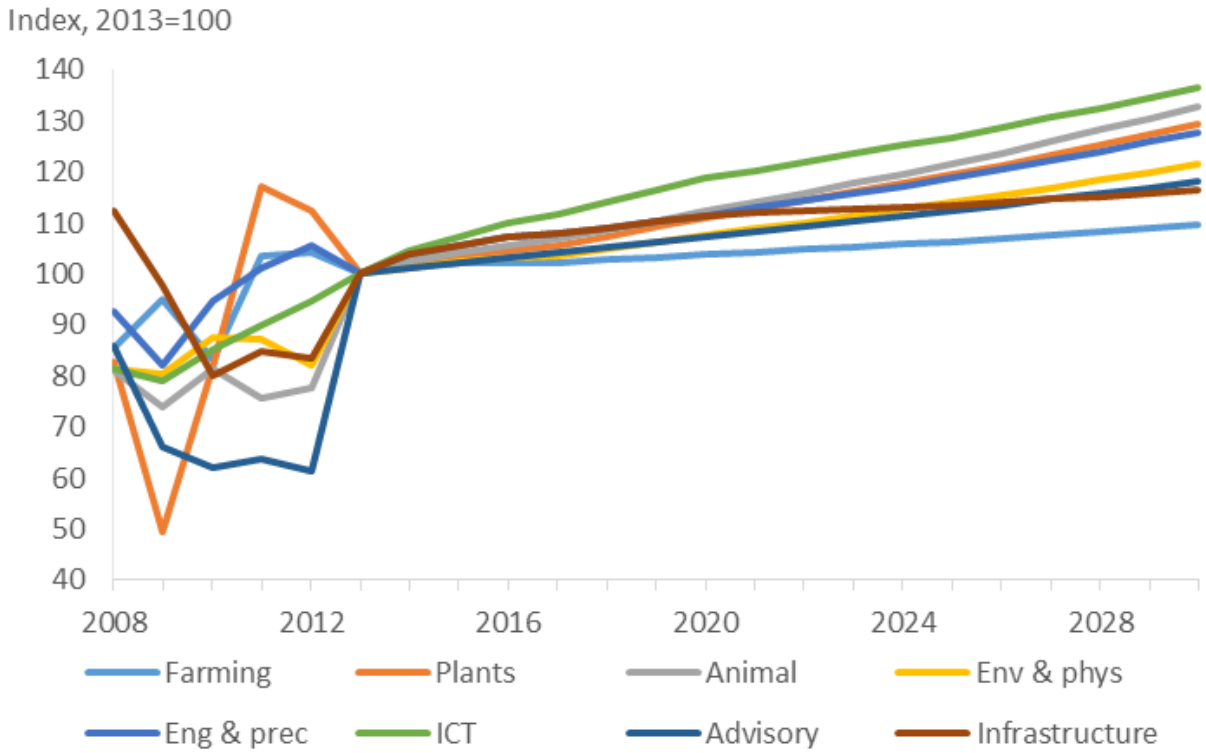
- Change in inputs to production (determining the change in value-added associated with each unit of output):
  - The baseline projections assume no change[16].

3.4. Results

3.4.1. Overview

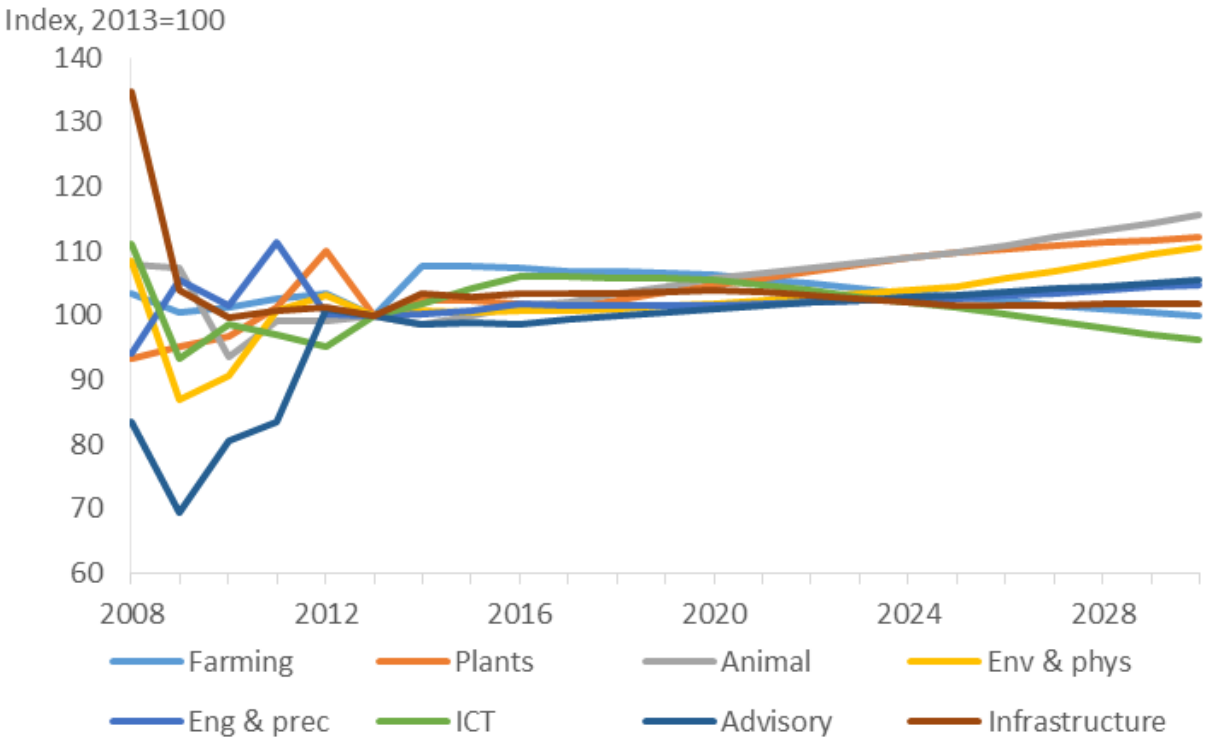
Figure 3-2 and Figure 3-3 show the growth in GVA and employment in the baseline projections.

Figure 3-2: Trends in value-added by subsector



[16] Data do show a historical improvement in TFP in agriculture (see Agriculture in the UK 2013, Defra). Were the trend to continue, then this would lead to higher GVA for the Farming subsector for a given level of output, but this would be counterbalanced by a reduction in the GVA for those Agri-tech sub-sectors that provide the inputs to production, as fewer inputs would be required to produce the output.

Figure 3-3: Employment trends by subsector



With respect to GVA, the fastest growing sub-sectors are in the high-tech areas such as ICT as agriculture improves efficiency. The Farming subsector is projected to record the slowest growth rate (½% pa). As Farming is the largest subsector, this relatively weak growth is a major determinant on the outcome for the Agri-Tech sector as a whole.

Figure 3-3 shows that any growth in employment in a subsector will be modest for all of the sub-sectors. The ICT and Farming subsector actually experiences a slight fall over the projection period as efficiency gains gradually improve productivity over time. While the ICT subsector makes the smallest contribution of any sub-sector to Agri-Tech, Farming is the dominant subsector and its performance drives the outcome for Agri-Tech as a whole.

GVA for the broad Agri-Tech sector is projected to grow modestly by an average of ¾% pa over 2013-2030. This is an increase in constant price GVA from £14¼bn in 2013 up to £16¼bn in 2030. Growth is slightly stronger in the long term (1% pa over 2025-2030) but generally remains stable (see tables in Annex D for more details).

Overall, employment in Agri-Tech in 2030 is projected to be some 5-5¼% lower than in 2014. The primary contributing factor to this is the projected fall in employment in the Farming subsector, and core agriculture in particular. By 2030 the projections are for 37,000 fewer jobs in core agriculture than there were in 2014. This outcome is sensitive to the assumptions for productivity growth[17]. Employment in most other subsectors is

[17] If the very weak productivity growth seen recently were to persist then employment in core agriculture could remain stable over the medium term.

projected to rise in the medium and longer term, with strongest growth in the environmental and physical subsector.

Within Agri-Tech the underlying prospects for GVA growth are strongest in the ICT, Engineering & precision farming, Plant and Animal sub-sectors as all are projected to record average growth of 1½-1¾% pa over 2013-2030. For all of these sectors this is slower than historical GVA growth implied by disaggregated ABS data over 2008-2013. However, this result should be treated with caution due to the short time series available from ABS and the volatility of the data over this period.

The Animal sub-sector is driven by strong export demand that gradually strengthens over 2013-2030. This is driven by strong projected demand from meat production. The prospects for the Plant sub-sector are less driven by export growth because of weaker global demand for plant products (and hence that part of agricultural production and the supporting activities that serve it, and which define the Plant sub-sector). However, there is robust domestic demand for the subsector, with firms involved in the manufacture of fertilisers and pesticides reporting strong growth prospects in the survey data.

Growth in the ICT and Engineering & precision farming is driven by robust domestic demand from UK farmers in the medium term-to-long term as farmers invest in using more high-tech farming techniques. Even though ICT and Engineering & precision farming have relatively strong GVA growth prospects, the robust underlying trend in productivity for both sectors limits employment prospects (¼% pa for Engineering & precision farming and -¼% pa for ICT).

In contrast the underlying prospects for GVA growth is weakest in the Farming, Advisory and Infrastructure sub-sectors (½-1% pa over 2013-30).

The relatively weak prospects for GVA growth in Farming is driven by modest growth in domestic demand of ¾% pa over 2013-2030 (in line with population growth) and a slow increase in imports as a share of output. The Infrastructure sub-sector has close ties to the Farming sub-sector. Growth in investment by Farming weakens in the medium-to-long term, which ultimately drives weakening demand for Infrastructure goods and services. This also drives the result for the Infrastructure and Advisory sub-sectors because the goods and services provided are typically not traded globally. The bulk of the Infrastructure is accounted for by construction activity and agents in the Advisory sub-sector typically work with local farmers.

There are small changes in the composition of Agri-Tech between 2013 and 2030. The share of GVA accounted for by Farming falls slightly from 73% to 70%. This is counterbalanced by an increase in share for all of the other Agri-Tech sub-sectors, highlighting the growing importance of the remainder of Agri-Tech that the UK is seen as one of the global leaders in. Most notably, the Plant sub-sector increases its share from 5¼% to 6%, the Animal sub-sector increases its share from just under 8% to 9% and Engineering & precision farming increases its share from 7¾% to 8½%. Interestingly, all of the sub-sectors see little or no change with respect to the contribution to Agri-Tech employment.

Annex D shows detailed tables of the GVA and employment projections for the Agri-Tech sub-sectors.

3.5. Sensitivity analysis

This section presents a sensitivity analysis of the model results. Key assumptions driving the central projection include UK agriculture output (based on FAPRI projections), global agriculture output (based on OECD/FAO projections) and global agriculture investment (based on FAO projections). Six alternative sets of results have been generated using high/low growth scenarios for each of these three key assumption.

The low/high projections for UK agriculture output are determined by the 10th percentile and 90th percentile estimates of UK output of key agricultural commodities from the FAPRI projections[18]. The high/low scenario assumptions for UK output are for growth that is on average +0.9 pp pa and -0.7 pp pa in relation to baseline UK agriculture output growth (0.9% average growth pa).

The alternative scenarios for global agricultural demand and global agriculture investment will be +/- 1pp pa in relation to their respective baseline average growth rates (1¾% pa for output and 1% pa for investment).

The alternative assumptions for UK agriculture output will primarily impact domestic demand for agriculture but will also impact UK agriculture investment because the investment intensity ratio of UK agriculture is unchanged in the alternative scenarios.

The alternative assumptions for global agriculture demand will impact global demand for UK agriculture commodities (and then the associated inputs to their production) as well as the export demand for other parts of Agri-Tech to support production overseas. However, the scenario assumes overall global agriculture investment is unchanged from the central projection. The impact of changes in global agriculture investment on demand for UK agriculture investment goods is considered in the global agriculture investment scenarios (scenarios where global agriculture output is the same as in the baseline).

Figure 3-4 shows the percentage difference between the baseline projections and each of the alternative scenarios. It is immediately clear that the investment scenarios have very little impact on the broad Agri-Tech sector (employment and GVA are within ¼% of the baseline for both high and low scenarios; equivalent to +/- £30m from the baseline for GVA and +/- 500 jobs from baseline employment). This is primarily because a change in global agriculture investment will change the demand for UK Agri-Tech investment goods, but not the demand for core UK agriculture (which accounts for the bulk of the Farming sub-sector). However, the ICT, Infrastructure and Engineering & precision farming sub-sectors all experience changes of +/- 1-2% in both GVA and employment.

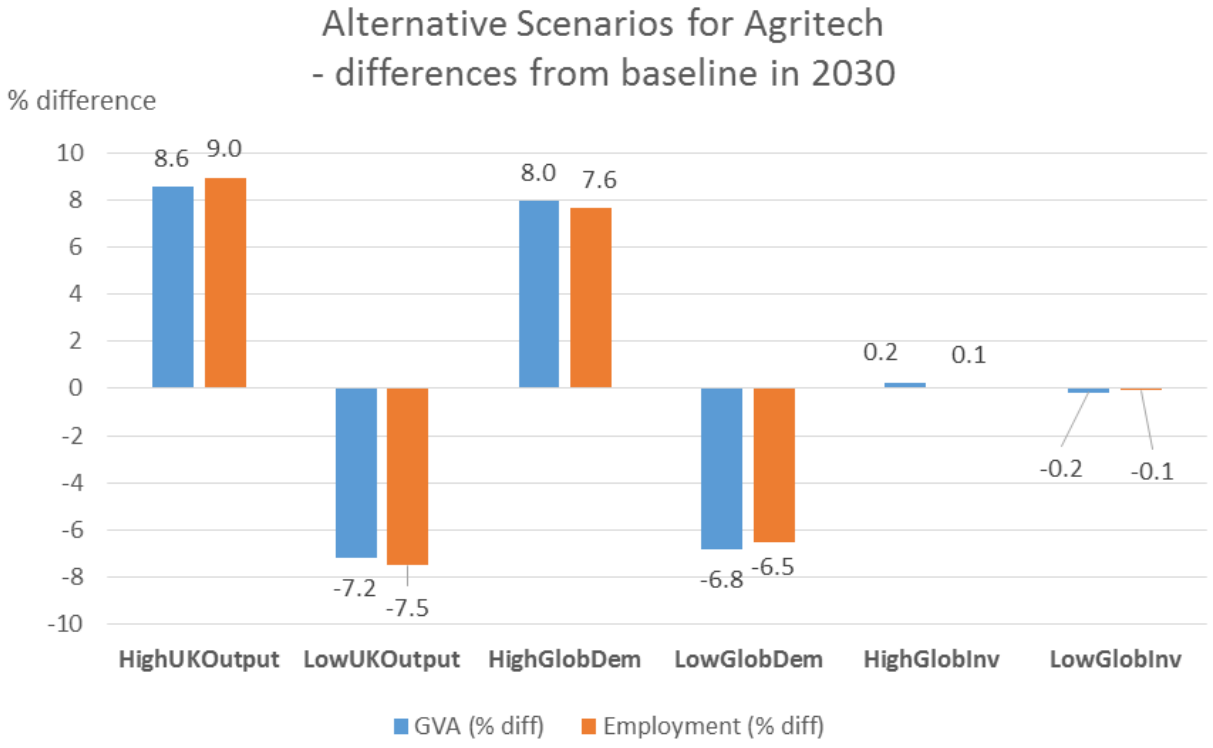
The scenario for high global output growth results in Agri-Tech GVA being 8% higher (+ £1¼bn) and employment being 7½% higher (+ 42,000 jobs) in 2030, compared to the baseline. In contrast, the low growth scenario generated GVA which is 6¾% lower (-

[18] The central projections for the Agri-tech sector used the 2012-based FAPRI projections. Different percentile estimates were not available for this FAPRI projection. Instead the later 2013-based FAPRI projections were used to derive high/low scenario percentage point differences from the central projection, and this differences were applied to the central assumption for the Agri-tech baseline to arrive at the alternative assumptions.

£1.1bn) and employment which is 6½% lower (- 36,000 jobs) than the baseline. This is driven by Farming which sees and absolute change of around +/- £¾bn in GVA and +/- 30-35,000 jobs in employment (equivalent to around +7½% in the high growth scenario and around -6½% in the low growth scenario). The Plants and Environment & physical sub-sectors see the strongest proportional change in both GVA and employment (+/- 9-13%).

In the scenarios with alternative assumptions for UK agriculture output GVA and employment is around + 8½% and - 7¼% compared to the baseline in 2030. The Farming subsector is impacted by around +/- £1bn in GVA and around +/- 35,000-45,000 jobs in 2030 (equivalent to around +9% in the high growth scenario and around -7½% in the low growth scenario). However, the strongest proportional change occurs in the Advisory sector which sees GVA and employment 12% higher than the baseline in the high growth scenario, but 10% lower than the baseline in the low growth scenario.

Figure 3-4 Sensitivity analysis



Part II: Metrics and evaluation

4. Introduction

4.1. Background

There were two overarching and related objectives for this strand of the study, namely to:

- develop a set of metrics for monitoring the progress of the Agri-Tech Strategy, including through reviewing the appropriateness of the existing outcomes and metrics
- develop a methodology for the evaluation of the Strategy.

The Agri-Tech Strategy itself is wide-ranging. Its overarching vision combines high level aims on R&D and the commercialisation of ideas/technologies to generate economic returns as well as productivity benefits to agriculture, and on food security, sustainability and international development:

> *"We want the UK to become a world leader in agricultural technology, innovation and sustainability; exploit opportunities to develop and adopt new and existing technologies, products and services to increase productivity; and contribute to global food security and international development"*

The actions within the Strategy are therefore also wide-ranging, including applied R&D funding to help ideas move from the laboratory to the market (Catalyst fund), upgrading infrastructure to encourage greater collaboration between industry and the research base in key areas (the Centres for Agricultural Innovation or 'Centres'), support for exports and inward investment, and a series of influencing and enabling actions such as on-farm demonstrations, encouraging greater investment in skills and training and the formation of a Leadership Council to drive the Strategy forward. This wide-ranging Strategy, both in terms of the end objectives (economic, societal and environmental) and types of actions, provides the backdrop to the task to develop an approach monitoring and evaluation.

4.1.1. The Strategy's components

In order to identify appropriate metrics and plans for evaluation, the Strategy has been broken down into its key components. Five components were identified:

- Catalyst
- Centres
- International Development
- Internationalisation, i.e. exports and inward investment
- Overall coordination and influencing activities.

It is worth noting that two of these components, the Catalyst and Centres, have the only significant additional spending commitments from the Strategy's key partners (i.e. BIS, Defra and DFID). The Catalyst has £70m of public investment committed (£30m from BIS, £30m from the Biotechnology and Biological Sciences Research Council (BBSRC) and £10m from DFID) and the Centres have a commitment of £90m of public funding. In providing an assessment of the value gained from these public investments, evaluation of these two components is likely to be key and has guided, to some extent, the evaluation scoping. However, the influencing actions of the Leadership Council and the wider actions of others could have a catalytic effect in delivering on the economic and broader objectives of the Strategy. Whilst some of these influencing actions may be nebulous, and so difficult to measure, their role also needs to be explored for the purpose of evaluation.

In order to guide the establishment of metrics and the scoping of evaluation options, logic models were developed for each of the five components of the Strategy. These set out the steps from the rationale and objectives associated with each component, the inputs and activities, and the anticipated outputs and intermediate and final outcomes. In addition, logic models included the underpinning theory of change and a set of core research questions for each of the components, in order to guide evaluation issues and questions. From these logic chains, initial metrics were also set out for each of the logical steps.

4.2. Structure of Part II

The report is structured as follows:

- Chapter 5 sets out the recommendations on the metrics, which should be used to the guide the monitoring, evaluation and tracking of the progress of the Strategy.

- Chapter 6 summarises the recommended options for evaluation of the Strategy, reflecting on the key issues and challenges in evaluating industrial strategy interventions and the priorities for assessing the impact of the Strategy.

- Chapters 7 to 11 set out the detail of the recommended options for evaluation, covering the different components of the Strategy, namely: Catalyst, which includes a dimension on international development (Chapter 7); Centres (Chapter 8); internationalisation actions (Chapter 9); and the influencing and coordination role of the Strategy (Chapter 10). Chapter 11 provides the recommendations for evaluating the overall impact of the Strategy, bringing together findings from the individual components alongside a top-down assessment of sector progress.

- A series of Annexes accompany the main recommendations, covering detailed lists of metrics (Annex E and the thinking that has informed the evaluation options, including options that have been discarded (Annexes F-G).

5. Metrics

5.1. Introduction

This Chapter sets out the proposed metrics for measuring the overall progress of the Agri-Tech Strategy. The Chapter includes a 'priority' list, which we suggest should be reported to the Leadership Council for their review, and a longer full list to aid the monitoring and evaluation of specific activities (found in Annex E). We would emphasise that we are not suggesting that only metrics on the priority list should be collected. Indeed the long list comprises indicators that will need to form part of the detailed monitoring and evaluation of individual parts of the Strategy (covered in subsequent Chapters of this report).

The metrics are set under the different components of the Agri-Tech Strategy:

- Catalyst
- Centres
- International Development
- Internationalisation, i.e. exports and inward investment
- Overall coordination and influencing activities.

In order to identify the metrics (and also to inform evaluation scoping) logic models were developed for each of these components. These 'logic models' set out why the actions are being progressed, their objectives, the inputs used to deliver them and the anticipated benefits (in terms of outputs and intermediate and final outcomes). From the specification of benefits within the logic models, a full long list of metrics was identified. The final version of this long list is presented in Annex E. Comprehensive assessment of the performance of the Strategy will require individual strands of monitoring and evaluation across the different themes to capture evidence on these aspects.

In order to inform the Leadership Council a shorter more focussed set of metrics was required. The priority metrics, as set out in Figure 5-1, were identified through a process of iteration with the study Steering Group and agreed with the Leadership Council. The prioritised list is based on three key issues:

- ensuring a spread across the themes of the Strategy
- achieving a 'balanced' approach that captures a mix of more immediate effects (to guide on-going delivery) and longer-term effects (to demonstrate achievement of objectives)
- reflecting what is likely to be most feasible to measure and potentially attribute to the Strategy bearing in mind the likely focus of resource on monitoring and evaluation (and associated primary research).

5.2. The proposed metrics

There are three types of metrics:

- **Monitoring** indicators: these are metrics that can be observed and counted through putting in place systems to monitor the activities delivered by the Strategy. Given that they can be observed and counted, they reflect the immediate and direct results from delivering actions, and so can be measured and reflected upon more quickly than other indicators. These include **outputs**[19] in particular. They can also include some **intermediate outcomes**[20] if systems are put in place to measure these going forward (e.g. going back to businesses supported to see if they have taken products/services to market), though fuller assessment of outcomes requires evaluation to take account of the counterfactual.

- **Evaluation** indicators: these metrics are measured through evaluative research, such as surveys of businesses engaged, and require analysis to estimate the extent to which they are *additional* because of the Strategy and its actions. These are key metrics because they better reflect the **outcomes (both intermediate and final**[21]**)** of the Strategy, but take more elapsed time to measure, require an investment of resources and involve estimates of attribution to the Strategy.

- **Tracking** indicators: these are metrics that can be measured through secondary data sources and reflect changes in the conditions that the Strategy is trying to bring about (and so relate to **final outcomes**). These are cost effective indicators as they draw on (or add to) existing data sources, and they also provide a strategic view on how conditions are improving (or deteriorating), which may prompt new action. However, changes in these cannot directly be attributed to the Strategy itself without further evaluative research, because they could reflect other factors. For example, it is possible to track productivity as a condition indicator, though the final outcome, 'impact on productivity', requires estimating the effect of the Strategy (or individual actions within the Strategy) on productivity and potentially relating this to overall changes in the sector's productivity. If, for example, a cluster of Centre or Catalyst projects were aimed at increasing productivity, or improved environmental performance, then an evaluation might seek to assess the direct impacts of these projects on productivity or the environment independently of tracking these changes in the sector as a whole.

As stated in the introduction to this Chapter, a long list for comprehensive monitoring and evaluation metrics can be found in Annex E. The need for the long list reflects the various routes to impact of a diverse set of actions that are included within the Strategy, and required to deliver the vision.

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[19] *Outputs* are the direct results of activities implemented under the strategy, for example, additional R&D as a result of Catalyst or Centre actions.

[20] *Intermediate outcomes* result from the adoption of outputs, for example, new products incorporating the R&D results

[21] *Final outcomes* are the impacts on high-level Strategy objectives for example, increase GVA, employment etc. in the agri-tech sector.

5.3. Implementing the measurement of these metrics

In developing the metrics, a key question was raised about who will be responsible for gathering the data for measurement. There are a number of recommendations that we make with respect to this:

- Innovate UK should incorporate key metrics for outputs and intermediate outcomes (where possible) into its monitoring systems for the **Catalyst** where these data are not already collected. This should build on Innovate UK's existing monitoring systems and include appropriate breakdowns for Catalyst projects that contribute to **International Development** objectives.

- Output and intermediate outcome metrics should be incorporated into the monitoring systems for the **Centres**. Where feasible and appropriate to the way in which individual Centres operate, these should be consistent across the Centres.

- UKTI should be asked to report formally on the key metrics relating to **Internationalisation**.

- The Leadership Council, Defra and BIS should put in place processes for monitoring the direct outputs and, where possible, the intermediate outcomes of the actions relating to **Influencing and Leadership**.

- The tracking of conditions (which feed into final outcomes) has already begun with the separate baseline work that we have undertaken as part of this study, and a process for future tracking should be put in place by BIS and Defra, including where appropriate adding questions to existing surveys (e.g. Agriculture in the UK). These metrics **cut across the five themes** that have been used to inform our thinking. It is worth noting that some of the metrics are 'attitudinal' indicators, e.g. "profile of the Agri-Tech sector" and "measure of networking". In the tables in Annex E, we set out the links between indicators and themes/components of the Strategy, proposed sources for the metrics (including whether formal monitoring arrangements will need to be put in place, and the role for evaluation) and suggested responsibilities for measurement.

Figure 5-1: Priority metrics (and associated themes)

Outputs	Intermediate **Outcomes**	Final **Outcomes**
• No. of collaborations between industry & research base (Catalyst; Centres)	• No. of new products/services successfully taken to market - in UK, and in developing countries (Catalyst, Centres, International Development)	• GVA effects through businesses engaged (Catalyst, Centres, Internationalisation)
• No. & value of paid-for contract research projects, split by public and private spend (Centres)	• No. of patents filed (Catalyst, Centres)	• Overall size of sector in the UK in terms of employment & no, of firms (Catalyst, Centres, Internationalisation, Influencing & Leadership)
• R&D spend by private sector, & value of R&D into projects with international development focus (Catalyst, International Development)	• No. of agriculture businesses taking up new products/services in the UK and developing countries (Catalyst, Centres, International Development)	• Impact on exports (Catalyst, Centres, Internationalisation)
• No. of (i) businesses and (ii) individuals assisted with skills development (Centres)	• £ turnover generated for UK agri-tech firms, including % exports and % exports to developing countries (Catalyst, Centres, International Development, Internationalisation)	• Impact on inward investment (Catalyst, Centres, Internationalisation)
• No. of businesses assisted to export (Internationalisation)	• Employment created in UK agri-tech firms (Catalyst, Centres, International Development, Internationalisation)	• Additional value of inward investment influenced through Leadership/effect of the Strategy (Influencing & Leadership)
• No. of inward investment projects (Internationalisation)	• Profile of agri-tech sector to UK businesses and internationally (Influencing & Leadership, Internationalisation)	• Impact on productivity - Total Factor Productivity, Labour Productivity, yields (Catalyst, Centres, Internationalisation)
• Value of inward investment projects (Internationalisation)	• Measure of networking within agri-tech sector (Influencing & Leadership)	• Impact on environmental indicators - energy use, GHG emmissions, nitrogen inputs (both total amounts associated with the sector and per unit of output). Nutrient balance(Centres, Catalyst, Internationalisation)
• Media value generated for the agri-tech sector by key government and agency partners and the Leadership Council (Influencing & Leadership)	• £ funding influenced for: (i) skills investment, (ii) innovation funding, (iii) RDPE spend, (iv) on-farm demonstration activity (Influencing & Leadership)	• Contribution to international development outcomes (International Development)
• No. of businesses engaged through communications (Influencing & Leadership)	• Influence of HE with respect to agri-tech courses/course provision (Influencing & Leadership)	• Changes in attitudes towards quality/ productivity (Influencing & Leadership)
		• Investment in capital in agricultural businesses (Influencing & Leadership)
		• Employer investment in skills (Influencing & Leadership)
		• No./% of graduate level jobs in agri-tech sector (Influencing & Leadership)
		• Wages in agri-tech sector (Influencing & Leadership)

6. Evaluation options considered

6.1. Process of appraising evaluation options

For each component strand of the Agri-Tech Strategy we have appraised various evaluation options, considering the following issues in particular:

- Options have been assessed for empirical impact evaluation including what these options may involve, their limitations (such as selection bias issues) and how these could be addressed. Drawing on the Magenta Book we have defined "empirical impact evaluation" methods as those that provide a quantitative measure of the impact of an intervention by isolating the effect of a policy from other factors affecting the outcome through use of statistical and/or econometric analysis. This normally involves establishing a counterfactual through a formal comparison or control group.

- Other options for evaluating the impact of the different strands have been considered, including the potential limitations/weaknesses (such as bias) and how these could be addressed. These options have included theory-based and survey-based approaches. Whilst these might include empirical methods, they are distinct from "empirical impact evaluation" because attribution is judged based on the evidence rather than through a formal counterfactual that incorporates statistical and/or econometric methods.

- Other evaluation options have also been examined, such as approaches to estimate outcomes, assess processes of delivery, and understand lessons from implementation and the evidence on what works for whom and why.

In Annexes E-G the evaluation options considered for each part of Strategy are set out. The main viable options were tested with the client group, with the feedback informing the recommended options.

6.2. Evaluating industrial strategy

The Agri-Tech Strategy bears a number of characteristics of 'complicated' (multiple components) and 'complex' (emergent) interventions. For example, in itself there are a range of components, including some selective measures (such as R&D support) as well as more cross-cutting measures such as to support skills investment across the sector and/or to influence the perceptions of the UK as a place to invest in Agri-Tech. In addition, partnership development is key to the delivery of the Strategy, with a need to brigade action – in this sense, some components will be emergent over time, and may be subject to change as organisational imperatives change. Within individual components of the Strategy, there are characteristics of interventions that are complicated. For instance, with respect to R&D support and research-industry partnerships, the outcomes themselves are only expected in the long-term and may be subject to confounding factors. This degree of

complicatedness is not unusual for an industrial strategy intervention, and is acknowledged in recent OECD work on evaluating industrial policy (Warwick and Nolan, 2014[22]). Nonetheless, these characteristics are critical in informing evaluation approaches. As noted in the Magenta Book (HM Treasury, 2011[23]), the degree of complexity of an intervention affects the type of evaluation approach that is feasible, and in particular limit the extent to which empirical impact evaluation is possible.

In addition to this, other characteristics of the policy and policy design are likely to limit empirical impact evaluation, notably:

- components targeting beneficiaries are small in their scale, which affects the extent to which sufficient sample sizes are possible for statistical analysis – the required sample sizes vary depending on factors such as the standard deviation of the outcome variables, their distribution and the intended statistical power (an illustration is provided in Chapter 7 with reference to the Catalyst)

- these components are also deliberately selective in their design – for example the Catalyst only funds what are judged to be the best projects, and the Centres are subject to a competitive application process

- those projects funded are also likely to be heterogeneous in their nature, and so the scale, timing and nature of the outcomes are likely to vary.

Therefore, whilst empirical impact evaluation approaches have been considered as part of the assessment of evaluation options, the nature of the Strategy and its components have required a range of other options to be considered as well, either as alternatives or as complementary approaches. These alternative options should not be considered to be any less valid than empirical impact evaluation. Indeed, Warwick and Nolan (2014) note that in evaluating national industrial strategy a mixed methods approach is often required. As an example of this, for an evaluation of the Swedish Competence Centres Programme, which funded R&D for consortia of companies working with several departments of host universities, Stern *et al.* (2013)[24] adopted a mixed methods approach. The evaluation used: a literature review of studies of other programmes; interviews with Centre managers and university representatives; interviews with companies; the use of statistical databases on companies; and a survey of PhD graduates from the programme. This combination of methods found evidence of a range of direct effects (such as the development of new products, resulting in increased revenues for companies, and the development of knowledge networks), indirect effects (such as opening up access to a greater pool of labour for companies) and spillover effects (such as through PhD holders moving on to work elsewhere in industry, taking their skills with them).

[22] Warwick, K. and Nolan, A. (2014) "Evaluation of Industrial Policy: Methodological Issues and Policy Lessons", *OECD Science, Technology and Industry Papers*, No. 16, OECD Publishing
[23] HM Treasury (2011) *The Magenta Book Guidance on Evaluation*, HM Treasury: London
[24] Stern, P., Arnold, E., Carlberg, M., Fridholm, T., Rosemberg, C. and Terrell, M. (2013) *Long term industrial impacts of the Swedish Competence Centres*, Vinnova Analysis 2013:11, Stockholm

These issues do not mean that impact evaluation cannot be undertaken. The evaluation literature points to a growing armoury of alternative approaches to impact evaluation. For instance, White and Phillips (2012)[25] bring together a series of approaches to impact evaluation that are the most appropriate options under a number of circumstances, including those similar to the case of the Agri-Tech Strategy (and its components), such as:

- there is a small *n*, i.e. small groups of treated participants
- heterogeneity in the treatment group, the wider context of the intervention, or the treatment itself
- where comparison groups cannot be designed in for ethical or political reasons (i.e. where there is in-built selection to the policy design)
- where interventions are "complex", involving multiple agencies or simultaneous causal strands or where outcomes are emergent.

The approaches proposed by White and Phillips (2012) bring together different methodologies developed by a range of evaluators. They can be broadly categorised as 'theory-based approaches', as they have in common a requirement to establish the underlying theory of change for an intervention, and the collection of evidence to establish the case for whether or not the theory has occurred in practice (at least in part) due to the intervention in question. The approaches include techniques such as realist evaluation, contribution analysis, process tracing and most significant change analysis. These approaches, and other similar evaluation options, have been considered in assessing the best way to evaluate the Agri-Tech Strategy. In many cases the evaluation recommendations and the detailed methods, as set out in subsequent Chapters, suggest using theory-based approaches, drawing in particular on contribution analysis (to assess, based on the evidence, the extent to which outcomes are attributable to the intervention as per the postulated theories of change versus other contributory factors). These assessments should draw on a range of evidence such as surveys of beneficiaries and non-beneficiaries and case studies. We have also considered the potential role of process evaluation, and in making recommendations have kept in mind two key principles, namely evaluability and proportionality.

6.3. Summary of options

In Table 6-1 we set out the recommended options for evaluation for the different components of the Strategy, providing brief details of the suggested approaches and timings. Further detail on these options is set out in the subsequent Chapters of this report. Chapters 7 to 10 cover the different components of the Strategy (Catalyst and International Development, Agri-Tech Centres, Internationalisation, and Influence and Coordination of the Strategy), and Chapter 11 sets out the detail on evaluation at the level of the Strategy overall.

[25] White, H. and Phillips, D. (2012) "Addressing attribution of cause and effect in small n impact evaluations: towards an integrated framework", *International Initiative for Impact Evaluation Working Paper 15*, 3ie

In Annexes E-G we set out the longer lists of options that were considered for evaluating the different components of the Strategy.

Table 6-1: Summary of recommendations

Component	Approach	Timings
Catalyst and International Development	Theory-based approach: • Beneficiary survey/tracking • Survey of unsuccessful applicants to help assess project and output additionality • Consultations/survey with research partners • Case studies, covering a range of projects to capture those with foci on international development, agricultural productivity and environmental benefits	Need to acknowledge differing start points and timescales of projects Proposed: • Initial evaluation in 2016 • Interim evaluation in 2017/18 • Final evaluation in c. 2020
Centres	Theory-based approach: • Case study based for different Centres funded, including consultations/tracking with businesses, research partners, businesses indirectly affected • Consider feasibility of establishing a comparator group • Light touch consultation/tracking of unsuccessful applicants for Centres to see what was done instead • Process evaluation on governance, moving to self-sustaining models, joint working between Centres	Need to allow c. 5 years to allow for outcomes to be flowing through, so could do: • Process evaluation within 1 year of establishment • Interim impact 2-3 years • 2nd Impact 5 years (and possibly subsequently)
Internationalisation	Theory-based approach: • Survey of benefiting companies • Survey of non-exporters and enquirers • Case studies of inward investors	Shorter-term potential, perhaps 2016
Influence and Coordination of the Strategy	Theory-based approach • Establish base line of R&D funding and cooperation between relevant organisations • Range of surveys/consultations to assess influence of Strategy on policy makers, funders and others • Delphi surveys of expert opinion • Media monitoring	Need to allow time for influencing and outcomes to flow through, so: • continuous tracking of some indicators • Five yearly evaluations
Overall Strategy	Modelling of sector performance (baseline and pseudo-counterfactual) compared to outturns as part of overall assessment of Strategy, which should also incorporate findings from above triangulated with evidence from projections Modelling would: • Have baseline projections on output,	Need to allow effects to work through, so propose an initial assessment in 2020, with subsequent ones, depending on requirements of policy in: • 2025 • 2030?

Component	Approach	Timings
	employment, with associated external and internal drivers around global growth, UK market share and investment intensity • Update baselines based on revised external drivers, and new evidence on relationships between inputs and outputs • Compare outturns to revised baseline projections based on other evidence indicating how the Strategy had led to changes in market share and investment intensity.	

7. Recommendation 1: evaluation of the Catalyst scheme

7.1. Background to the Catalyst

The Catalyst is a proof of concept fund with around £70m of public expenditure, intended to leverage at least £30m of industry match. The fund is managed by Innovate UK, which runs other Catalyst schemes (e.g. the Biocatalyst) and other R&D grant schemes (e.g. Smart and Collaborative R&D). Public sector sources of funding involve BIS (£30m), BBSRC (£30m) and DFID (£10m). With DFID's involvement there is an emphasis on projects that have a focus on international development objectives, and this is set out in the fund's literature for would-be applicants and its marketing. There are three types of project, which reflect the differing stages of R&D projects that are supported:

- early stage projects to test the commercial potential of scientific ideas and the feasibility of new technologies (taking ideas up to Technology Readiness Level (TRL) 4)

- industrial research awards to develop innovative solutions through technology development, lab-based prototyping, product development planning, trials and market testing (taking ideas up to TRL 7)

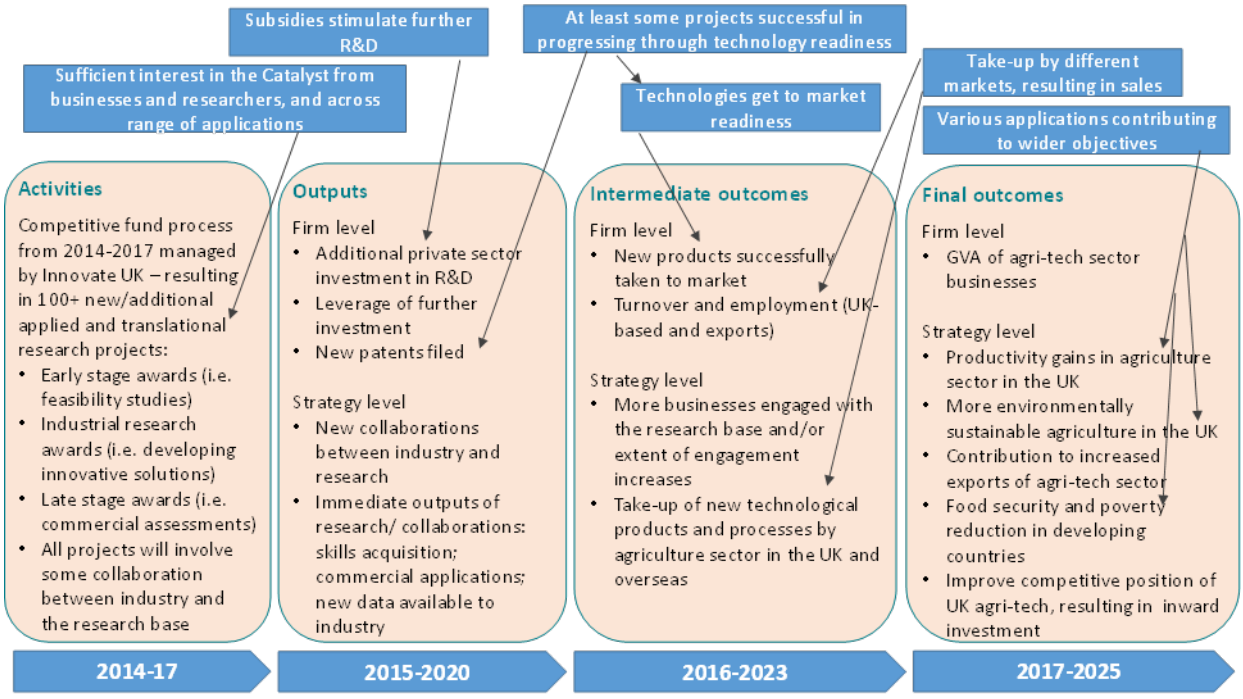
- late stage awards, which include commercial assessments for technologies that are closer to commercialisation (taking ideas up to TRL 9).

Projects have to be collaborative, involving companies and research partners, and with some having multiple partners. The fund will disperse monies between 2014 and 2017 on a competitive basis. The timescales of projects themselves can vary between 12 months and three years, and so whilst some of the first projects funded could finish in 2015, some of the last projects funded could run until 2020. It was initially expected that there would be over 100 projects, and so with collaboration taken into account over 200 companies (including SMEs and larger companies) will be supported.

Therefore, based on averages for funding and partners of projects so far, we may expect around 130-40 projects to be funded, involving around 350 companies and approaching 200 research and other partners. The number of unique company beneficiaries is estimated to be 200-250. Given the level of repetition in partner organisations in the most recent awards, the numbers of unique partner organisations may only increase slightly on existing numbers – though we note that there may be more variation in the number of individual academics and departments involved.

A summary of the underlying logic chain (from activities to outcomes) is set out in Figure 7-1. This includes the timescales for activities, outputs and outcomes, indicating the potential wide ranges, especially for intermediate and final outcomes. It also includes the main assumptions underpinning the theory of change (in the blue boxes) and key external factors that are likely to affect the logic.

Figure 7-1: Headline logic chain



Range of external factors affecting theory of change, including:

- Abiotic and biotic factors
- Global commodity prices
- Exchange rates
- Skills/know-how/attitudes of agricultural businesses
- Policy objectives – in the UK and internationally

Any evaluation of the Catalyst should seek to test the extent to which the logic and theory of change holds true in practice, and so how far the intervention is bringing about outputs and outcomes that would not have happened otherwise. Existing literature provides some evidence to support the logic. We have not undertaken a formal literature review, though the following studies suggest that there is evidence to justify the logic:

- King and Woolley (2014)[26] combine data from the Office of National Statistics (ONS), UK Innovation Survey and Innovate UK to examine the effects of R&D grant support. They found that SMEs and large firms receiving grant support were more likely, as a group, to invest more in R&D, collaborate, engage in product or process innovation, and introduce new products to the market. Where projects involved cooperation with the research base, the additional effects were greater. The study did not find evidence of the effect on business performance (e.g. turnover), which was attributed to insufficient time having passed since the intervention.

[26] King, M. and Woolley, E. (2014) "Estimating the effect of UK direct public support for innovation", *BIS Analysis Paper Number 04*, BIS, London

Nevertheless, this evidence supports the steps in the logic to outputs and some of the intermediate outcomes.

- There is other evidence to support the link between R&D spend (an output in our logic model) and innovation behaviours (product and process innovations, an intermediate outcome) and also the link between innovation behaviours and business performance in terms of turnover and exports, translating into GVA (intermediate and final outcomes) – e.g. Coad *et al.* (2014)[27]; Harris and Moffat (2011)[28].

- The work of Coad *et al.* (2014) is interesting in indicating something on the processes of growth. They find that growth starts with employment, leading to increases in R&D spending, resulting in innovation behaviours such as new products to market, which in turn lead to sales. However, they do not find a feedback into new employment. Therefore, in the underlying logic set out in Figure 7-1, some testing of when the effect on employment takes place ought to be considered – in particular, employment effects may be found as part of the R&D phase (and so earlier) instead of or in addition to the market phase (e.g. as part of production or sales).

Key to the evaluation, therefore, will be to demonstrate the links in the logic within the context of agricultural technologies, and as far as possible how far new products and services developed are taken up in the marketplace to bring about potential wider benefits. As part of this, exploring the processes of growth and the value of research partnerships will need to be considered.

7.2. Key issues and challenges

A number of key issues are important in understanding the logic at the fund level and project level. Some of these issues reflect the nature of R&D and of the intervention design, which means that projects vary in different ways.

- The timescales of project delivery varies, and the time until the expected outcomes also varies across the project set. This particularly reflects the differing stages of R&D supported, for example with early stage projects at earlier Technology Readiness Levels relative to those at commercial assessment.

- The underlying logic of projects may vary to some extent, with different intermediate and final outcomes being more/less important for different projects and different participants within projects. For instance, for early stage R&D projects, subsequent collaboration and R&D investment, and progress through TRLs are likely to be more important in signifying outcomes from the Catalyst's funding than for late stage

[27] Coad, A., Cowling, M., Nightingale, P., Pellegrino, G., Savona, M. and Siepel, J. (2014), *Innovative Firms and Growth*, Report to BIS

[28] Harris, R. and Moffat, J. (2011) "R&D, Innovation and Exporting", *SERC Discussion Paper 73*, SERC, London

projects, where the outcomes relating to new products into the market and business performance effects may be more important.

Taken together, the two points above mean that there is no 'standard' model or set of outcomes that will be relevant to all projects funded. This is exacerbated when we consider the wider effects on productivity, international development and environmental outcomes, which will clearly depend on the nature of the R&D and technologies themselves. These effects will also be felt by third parties (or indirect beneficiaries) rather than direct beneficiaries, further adding to the complexity. This heterogeneity in timescales, causal pathways and outcomes presents a significant challenge to evaluation, because projects cannot be treated as a single uniform set.

The intervention design presents a further challenge for evaluation. As a competitive fund, it is deliberately selective, funding the projects scoring highest in the application process. The procedures for application also mean that there are a significant number of participating companies and research partners that are involved in multiple awards (and perhaps also involved in unsuccessful applications). In addition, the scale of the intervention is relatively small. Taken together, the intervention design does not lend itself to *empirical impact evaluation* (as described in the Magenta Book) because: the small size means that it will be difficult for statistical analysis to detect the effect on the treatment group relative to a comparison group, especially given that the heterogeneity (noted above) will require segmentation, which further reduces the sample size[29]; and identification of a comparison group will be imperfect because of the in-built selection bias. This latter issue can be overcome to some extent in evaluation design (e.g. trying to take advantage of a discontinuity between selected and non-selected projects such as the scoring threshold) or analysis (e.g. through use of approaches such as propensity score matching or use of a Heckman model). However, even if this were to be done, the small sample size is a deciding factor in the approach taken, with this exacerbated by the practical challenges of identifying a sufficiently-sized comparison group that does not have some involvement in a successful project.

The following points illustrate the size of effect that would need to be detected given certain assumptions[30] based on no segmentation and homogeneity of the intervention. This draws on data from SMEs, and so the numbers for the Catalyst are likely to vary somewhat given the involvement of large companies. The effect size required for R&D expenditure is reasonably modest, though this is based on SME data only; and the effect size required for turnover is large:

[29] This is dependent on the 'effect size' that we might expect. An issue here is that we know that the standard deviation of outcomes such as turnover for companies are high and this means that larger differences are required for the effect to be detectable.

[30] The calculations are based on the following assumptions: using a t-test with a Type I error rate of 0.05, and statistical power of 80%, and the assumption that the data are normally distributed (which may not be the case, and so require a transformation of data); 160 companies in each of the beneficiary and hypothetical comparison group; standard deviation of R&D = £300,000; standard deviation of turnover = £3,500,000. The standard deviations are drawn from data collected as part of the evaluation of Smart, and so relate to SMEs.

- To detect an effect on R&D expenditure, the difference between the change in means of the beneficiary and comparison group would need to be £94,000. That is to say the intervention would need to increase R&D by £94,000.

- To detect an effect on turnover, the difference between the change in means of the beneficiary and comparison group would need to be £1.1m.

We would emphasise that these numbers are illustrative only and based on data relating to Smart, a different kind of programme in many respects. They could be made more precise by exploratory work to generate better estimates of the standard deviation in the population. In particular, we would expect the standard deviation of R&D and turnover for Catalyst beneficiaries (and an equivalent comparison group) to be higher than the assumptions used because of the involvement of large companies. This will increase the size of effect required. For example, doubling the standard deviation means that the effect size required is twice as large.

Data linking could be an option, i.e. matching beneficiary firms to administrative datasets and identifying a comparison group of companies in similar sectors, again drawing data from administrative datasets. This might increase the sample sizes, because the whole beneficiary population could be considered (albeit with some likely to be lost given challenges in data matching) and a large cohort of comparison group companies could be included. However, administrative datasets provided limited amounts of data, and so surveys may still be required to help ensure a close match (e.g. in terms of innovation behaviour, technologies) and to estimate and control for other variables, such as participation in other support.

Therefore, the nature of the intervention and its underlying logic alongside the intervention design means that an *empirical impact evaluation* (as described in the Magenta Book) adopting a comparison group as the counterfactual is not feasible. That is not to say that evidence gathered from a comparison group of non-supported companies could not be useful as part of an approach. In particular, and as set out in the recommended approach (see below), this could provide evidence on activity/output additionality by testing the extent to which R&D projects are progressed by applicant companies that do not receive funding through the Catalyst, and could potentially provide evidence on differences in R&D investment between the beneficiary and comparison groups. The recommended approach suggests incorporating this into a mixed method 'theory-based' approach that seeks to establish the evidence on the underlying logic of the fund as whole and different types of projects, recognising the issues set out above on their heterogeneity.

The theory-based approach is likely to require an assessment based on something akin to contribution analysis, which was developed by Mayne (2001 and 2011)[31]. Contribution analysis aims to compare the proposed theory of change/underlying logic (i.e. as set out in Figure 7-1) against the evidence and to come to robust conclusions about the contribution

[31] Mayne, J. (2001) "Addressing attribution through contribution analysis: using performance measures sensibly" in *Canadian Journal of Program Evaluation* 16(1): 1–24.
Mayne, J. (2011) "Contribution analysis: addressing cause and effect" in Schwartz, R., Forss, K. and Marra, M. (eds) *Evaluating the Complex*, New Brunswick, NJ: Transaction Publishers, 53–96.

that the intervention itself has made to observed outcomes. In this way, the assessment will need to critically construct a “contribution story” that uses evidence to demonstrate the contribution made by the Catalyst, while also establishing the relative importance of other influences on outcomes (such as those external factors identified at Figure 7-1, the market environment and the strategic decision-making of businesses in the sector).

7.3. Recommended approach

7.3.1. Summary of approach

The overall approach recommended for the evaluation of the Catalyst Fund is a theory-based one, combining quantitative and qualitative methods. The mixed methods approach will develop evidence to inform judgements on: the types and scale of outcomes achieved; the extent to which the outcomes can be plausibly attributed to the intervention (i.e. the fund’s additionality); the estimated value for money of the fund; and the lessons on the types of projects and/or the contexts of projects that are associated with outcomes. The key methods suggested are as follows:

- A tracking survey of beneficiary companies of the fund and a group of non-beneficiary companies that do not receive funding but whose applications scored highly.

- Consultations/surveys with research partners involved in funded projects.

- A series of in-depth interviews and case studies with a smaller number of projects covering company partners and research partners as well as potentially indirect beneficiaries. These should include varying project types to cover a range of fund award types (i.e. early stage awards, industrial research awards and late stage awards), project durations, timescales anticipated to outcomes, and technologies/ applications/markets (e.g. UK agricultural productivity, reducing environmental effects, and international development objectives).

7.3.2. Methods

The details of each method, and the types of evidence and research question that the different methods should seek to cover, are set out in Table 7-1. We are aware that Innovate UK is exploring approaches to post-project data collection with successful projects although this process has not yet been established. The post-project process that is adopted may collect data covered in the evaluation components proposed in Table 7-1 and we recommend that the evaluation should not duplicate this. In addition, Innovate UK has just started an evaluation of the biomedical catalyst (currently at baseline assessment stage), and there may be lessons from this study.

Table 7-1: Methods and types of evidence

Method	Potential timing	Sample sizes	Key evidence/data
Tracking survey of beneficiary companies	3 or 4 key stages: • Baseline (application data?) • On project completion (monitoring/ survey?) • Post completion, e.g. 1 and 3 years afterwards. Note that given the staggered funding rounds, there are likely to be inconsistencies in where companies are in their projects/post-completion	Application and monitoring data should be a 'census' of projects/companies Post completion survey – aim for maximum realistic response rate of 50-60%, so >120 respondents	Output data on private sector R&D spend, new collaborations, initial outputs such as patent applications Outcome data on subsequent R&D, new products/services taken to market, take-up by the market, and commercial outcomes Evidence on self-reported additionality of project activity and outcomes to inform the contribution story Experience of the process of application, implementation, project closure
Tracking survey of non-beneficiary companies	2 stages: • Baseline (application data?) • 12-24 months after application (critical to test whether project went ahead anyway, or alternative R&D) Could also survey 12-24 months later to test any outcomes from these projects, though this is not essential and likely to be dependent on response rates from the first survey and agreement to be re-contacted As with beneficiaries, there are likely to be inconsistencies in where companies are in their respective processes	Population should be selected as the highest scoring applications that did not receive funding to ensure as good a match to beneficiaries (likely to need to be a trade-off between score and the need to ensure a sufficient sample) Application data should be a 'census' of projects/companies Subsequent survey – aim for maximum realistic response rate of 40-50% (target unknown at this stage)	Activity/additionality data on whether projects have gone ahead in absence of funding support to inform the contribution story Output data on private sector R&D spend occurring anyway, and assessment of differences in R&D investment (If tracking further into future, could collect any outcome data on projects progressing in any case)
Consultations/ survey of research partners	Upon project completion Post completion (e.g. 1-3 years subsequently) The same issues around inconsistencies in timings across research partners are likely to apply	Online/short phone survey could be undertaken to gather quantitative data, though need to be alert to potential small sample sizes In-depth consultations with a selection of project research partners (incl. as part of case studies – see below)	Output data on new collaborations Outcome data on feedback into new research, further collaborations with companies and other companies, informing the contribution story Experience of the process of application, implementation, project closure

Method	Potential timing	Sample sizes	Key evidence/data
Case studies	Upon project completion and post-completion (ideally allowing time for effects on users, though need to balance need for 'corporate memory' with allowing time for final outcomes – could be c. 2-3 years after completion) The same issues around inconsistencies in timings across case studies are likely to apply	Case study selection to ensure a cross section of projects covering: • Early stage, industrial research and late stage • Mix in no. of partners involved • Range of timescales • Focus, e.g. – UK markets/ international development; productivity/ environmental benefits • Mix in terms of success In order to ensure breadth, likely to need 10-15 case studies	Outcome data on subsequent R&D, new products/services taken to market, take-up by the market, and commercial outcomes, feedback into new research, further collaborations between research and industry Outcome data from indirect beneficiaries such as farming businesses (UK and overseas) Evidence on the extent to which outcomes attributable to the original R&D project and to Catalyst funding, other contributory factors to outcomes as part of the evidence on the contribution story Evidence on why projects were successful (or not), the contexts of projects (e.g. institutional, technological, market, cultural, policy), the key mechanisms leading to outcomes Feedback on fund processes, and also on links to other aspects of the Agri-Tech Strategy

Drawing on the evidence proposed in Table 7-1, the following types of analysis and assessment will be possible:

- Outcomes: analysis of outcomes achieved is likely to focus on those derived by direct companies involved and the research partners engaged. In addition, the time of the evaluation will need to balance the need to inform policy-makers and prevent memory decay of beneficiaries, and the elapsed time required to achieve outcomes. This means that outcomes may focus more on intermediate measures such as new products taken to market and early take-up rather than final commercial benefits achieved in the longer-term. Nevertheless, the case studies may enable greater exploration of longer-term commercial outcomes for direct beneficiaries and also the outcomes for indirect beneficiaries such as farmers. However, in these cases, the evidence will be 'by example' rather than representative across the fund.

- Counterfactual and causality: this assessment will need to draw together different strands of the evidence to come to a reasoned judgement, using a technique akin to contribution analysis, on the extent to which outcomes are likely to be attributable to the intervention. The evidence from the beneficiary vs non-beneficiary survey will give an indication of the extent to which there is project additionality (by assessing how many projects progress without funding) and output additionality (by assessing changes in R&D expenditure of the non-beneficiaries vs the beneficiaries). The tracking survey of beneficiaries and the case studies will supplement this by considering the extent to which project activities and outputs have led to outcomes, whilst taking into account the influence of other factors (e.g. through contribution analysis).

- What works for whom and in what context: the analysis of beneficiary survey data may indicate the types of projects that have been most successful in delivering outcomes. This analysis will be deepened through the case studies, which will provide an opportunity to explore the combinations of contexts (e.g. institutional, technological, market, cultural, policy-fit) and mechanisms (e.g. types of project, different elements of project, and ways in which projects are delivered) that lead to outcomes.

- Delivery processes: feedback on the processes of delivery will be gathered at a high level through a limited number of survey questions to benefiting companies and researchers, and with the opportunity for more detailed evidence through the case studies.

- Value for money/economic evaluation: the value for money assessment should, at a minimum, seek to estimate the net economic benefits compared to the public sector costs of the fund, and as far as data allow compared to both public and private sector costs.

    - The costs are reasonably straightforward to estimate, reflecting the capital inputs provided by Innovate UK, BBSRC and DFID and any estimates of running costs (especially on the part of Innovate UK, which manages the fund). Private sector costs should include an estimate of the private sector

contributions to R&D projects, which should be available from monitoring data.

- The estimate of net economic benefits is more complicated and will depend on the strength of evidence on outcomes and causality (as per the first two bullet points above). We suggest that quantitative estimates are derived for the steps of the logic drawing on different parts of the evidence available (also known as simulation modelling). For example, the net level of initial R&D brought about could be estimated using the beneficiary vs non-beneficiary survey data, the outcomes in terms of how R&D translates to new products to market could be estimated from the beneficiary survey, and the potential commercial outcomes of new products from the beneficiary survey and case studies. The commercial outcomes would probably need to be 'grossed up' and incorporate some forecasts given that there may be gaps in the evidence here. Sensitivity analysis would be required to reflect this uncertainty over outcomes.

As set out in the description of the analysis and assessment above, there are likely to be some limitations to the evaluation. In particular, the evaluation of the counterfactual and causality will rely on assessing the plausible contribution of the intervention by combining different strands of evidence, rather than through statistical/econometric analysis. In addition, the varying, and in some cases long, timescales to outcomes is likely to affect how far these can be assessed across the fund as a whole. Both of these issues have an effect on the value for money assessment, though here sensitivity analysis would be a useful means of addressing the uncertainty over the evidence on outcomes and causality.

7.3.3. Next steps and other options

An immediate next step is to ensure that application and monitoring data processes implemented by Innovate UK are collecting necessary data on baseline outcomes and outputs for all applicants and beneficiaries respectively. In addition, it is important to ensure that all applicants are asked to confirm that they are happy to be contacted by third parties for the purposes of monitoring and evaluation – this should be made compulsory as part of application to enable sufficient companies to be contactable to facilitate an evaluation that is as effective as possible.

Beyond this, the pattern of timescales of projects and future competitions needs to be considered in order to identify the most appropriate time to conduct an evaluation. This will inevitably require some trade-off to ensure that sufficient rounds are completed and that time is allowed for projects to run their course – whilst also recognising that policy-makers will require evidence to inform decision-making. As noted in Table 7-1, there are likely to be inconsistencies across fieldwork rounds in terms of when projects started, completed and expect to achieve outcomes. This is inevitable and reflects the intervention design and the heterogeneity of the project set. Such issues will need to be taken into account in interpreting the evidence. Based on our initial understanding of the timings of the intervention, the following timescale for evaluation may be appropriate:

- Initial round of fieldwork in 2016 with those whose projects are live or completed (and unsuccessful applicants)

- Second round of fieldwork in 2017 or 2018 with those projects live or completed (and unsuccessful applicants)

- Third round of fieldwork in c. 2020 (or just afterwards) with projects previously consulted.

The approach above sets out a comprehensive option for the evaluation. Of course, some refinements could be made, for example:

- Two rounds of the tracking survey of beneficiary companies (rather than three), in particular if monitoring processes collected some key data.

- Varying the number of case studies undertaken, and or making these more in-depth or indeed lighter touch.

A more radical refinement would be to consider combining the evaluation of the Agri-Tech Catalyst with other Catalyst funds operated by Innovate UK. This would have the benefit of providing higher numbers of companies, thereby increasing the scope of quantitative analysis that is possible. However, we would note that this would also add further complexity in terms of the heterogeneity that is discussed earlier in this Chapter.

8. Recommendation 2: evaluation of the Agri-Tech Centres for Innovation

8.1. Background to the Centres

The Government will invest £90m over four years to establish a small number of Centres for Agricultural Innovation to support advances in sustainable intensification. The Centres will leverage a further £90m, cash and in-kind, of private investment. The expectation is that there will be four to six Centres. The first, the Centre for Agricultural Informatics, was announced in the 2015 Budget with £11.8m of government funding. A consortium has been selected to deliver the Informatics Centre with the competitions to establish and run the remaining Centres expected to conclude later in 2015.

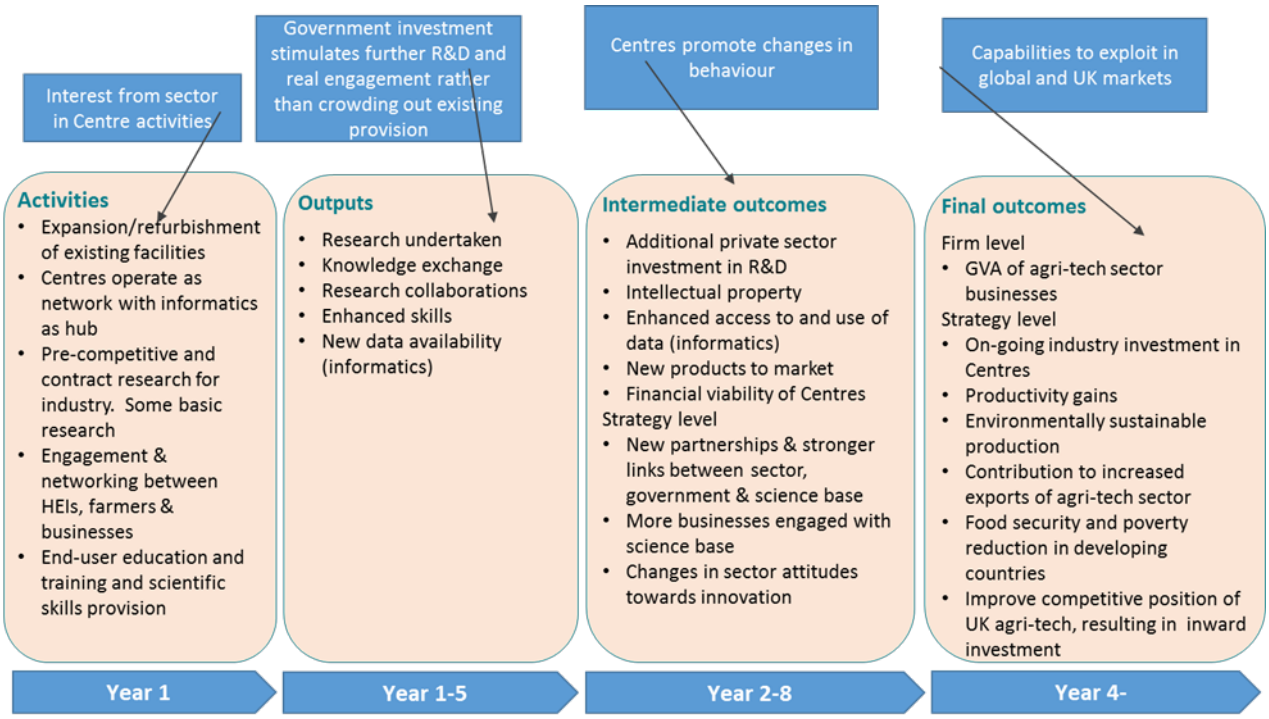
The Centres' objectives are to:

- Improve collaboration between academics, businesses and farmers in the sector
- Exploit different strengths in the country's science base to increase pre-competitive research to solve challenges facing the agricultural sector
- Better integrate the UK's expertise in science with Agri-Tech businesses and progressive food and farming businesses, stimulating increases in contract research
- Produce, though pre-competitive and contract research, viable new technologies for commercialisation
- Support the adoption and diffusion of knowledge and innovation throughout the supply chain and sector, resulting in improvements in sector productivity
- Become financially viable through a mixture of attraction of competitive grants, research funding and industry contract research.

They will be established as consortia of Higher Education Institutions (HEIs), Research and Technology Organisations (RTOs), Public Sector Research Establishments (PSREs) and industry and are expected to operate as a network with the Informatics Centre as the hub providing resources for the other Centres to draw on. They will undertake pre-competitive (and collaborative) and contract research and may also be funded to undertake some basic research. They will also provide end-user training programmes and develop the scientific and technical skills required by the sector.

A summary of the underlying logic chain (from activities to outcomes) is set out in Figure 8-1. This includes the timescales for activities, outputs and outcomes, indicating the potential wide ranges, especially for intermediate and final outcomes. It also includes the main assumptions underpinning the theory of change (in the blue boxes).

Figure 8-1: Headline logic chain



8.2. Key issues and challenges

Before discussing some of the issues the evaluation of the Centres will need to deal with, it is worth highlighting that the early stages of the Centres programme presents a practical difficulty in designing the evaluation. Only one topic area (informatics) is known and we do not, at present, have information on the specific types of information which the Centre will focus on, or targets for numbers and types of businesses. These issues can, of course, be resolved as and when the Centres are designated, but as well as decisions on sample sizes the scale and nature of activity will also influence the balance between different impact channels discussed below, which will also influence research design and sampling strategies. At the same time, the fact that none of the Centres has been launched yet presents an opportunity to try and ensure that appropriate data is collected. This will vary from Centre to Centre and will require further analysis once the topic areas are known.

The key issues are as follows:

- Potentially long-time scales between Centre outputs and commercialisation. Actual evidence of commercialisation may be too far ahead to provide useful learning to input into programme strategy and waiting until evidence is available may be of limited value as memories fade (unless progress is tracked systematically over time, which would be expensive). Moreover, disentangling the impacts of Centre outputs from other influences on commercialisation may be difficult. As a result, the evaluation of the Centres will need to focus on intermediate outcomes.

- The programmes of the Centres will, to at least some degree, concentrate research resources in selected areas. There may be benefits, such as those arising from profile and economies of scale. But there may also be displacement effects as research institutes not involved in the Centre choose, or are forced to, reduce activity. A review of non-Centre activity before and after the programme will therefore be necessary, but there will be real difficulties in identifying what other researchers might have done in the absence of the programme, and even more so in attempting to compare outputs.

- We expect that some research outputs will be available in the public domain through normal academic and other publications. It should be possible, via bibliometrics or peer review processes, to assess the quality of these outputs, but it is far more difficult, and in some cases impossible, to assess their use, much less their impact on commercial or policy decisions. Again this relates to difficulties in disentangling the effects of the Centres from other influences, of which there are likely to be many.

- The Centres are intended to promote engagement and networking between HEIs, farmers and companies and some of their activities will be directly concerned with this. However, it seems likely that there will also be impacts on engagement outside the Centre activities, for example in other knowledge exchange, teaching and research activities by the HEIs, and perhaps also spillover effects to other farmers and companies that are not directly engaged. Again these will be difficult to detect, but the implication is that the evaluation should consider impacts on consortia members' activities outside those associated directly with the Centre.

It is probably obvious from the above that we do not consider that control/comparison groups can be defined in any meaningful sense. To be specific, there are two options that have been considered, but discarded. The first option is the potential to use a comparison group of institutions offering similar services to the Centres. The programme itself precludes this, since although there are institutions currently offering similar services the additional funding and networking benefits that are part of the programme would render comparisons invalid. In addition, as mentioned above, the funding of the Centres may well lead to displacement, or at least a reduction, of activities by institutions outside the consortium. There may be international competitors to the Centres, but our experience is that the local context is typically so different that these cannot be used as comparators.

The second option is a comparison group of businesses that have not engaged with the Centre directly. This is less clear cut, but we have real doubts as to whether this will be possible. We suspect that the Centres will have a high enough profile that most businesses which are capable of benefitting will wish to engage, at least to some extent, and those which do not will be qualitatively different from those which do. To some extent this is an empirical question which can only be answered once the Centres are operational. But, even if it is possible to identify a comparison group there may be difficulties with sample sizes so far as any empirical analysis is concerned. Moreover, as discussed above, the elapsed time to outcomes may be long and vary between different businesses, and the outcomes themselves may also vary, adding to the complexity of analysis required. We would also reiterate that some businesses may benefit from access to research outputs without there being any record of engagement with the Centres.

8.3. Recommended approach

8.3.1. Summary of approach

The overall approach, as with the Agri-Tech Catalyst, is to adopt a theory-based evaluation, combining quantitative and qualitative methods in order to assess the contribution that the Centres have made to observed outcomes. The mixed methods approach will develop evidence to inform judgements on: the types and scale of outcomes achieved; the extent to which the outcomes can be plausibly attributed to the intervention (i.e. the Centres' additionality); the estimated value for money of the Centres; and the lessons on contexts that are associated with outcomes. The key methods suggested are as follows:

- Review of businesses directly engaged with Centres to consider whether comparators can be identified
- Consultations with consortia members to identify additional activities as a result of funding and impacts on non-funded activities
- Consultations with non-member PSREs/RTOs/HEIs to identify changes in their activities
- Survey of businesses directly engaged with Centres to assess benefits and constraints
- In-depth interviews and case studies with a smaller number of projects covering Centre and research partners to explore constraints and opportunities
- Consultations with stakeholders such as industry associations, government departments (and possibly foreign competitors) to collect views on Centre impacts on relationships between research base and businesses and policy influence
- Consultations with inward investors to assess influence of Centre(s) on location decisions
- Bibliometrics/peer review of research outputs.

8.3.2. Methods

The details of each method, and the types of evidence and research question that the different methods should seek to cover, are set out in Table 8-1. We have assumed that an interim evaluation would take place within 2-3 years and a later evaluation after 5-6 years.

Table 8-1: Methods and types of evidence

Method	Potential timing	Sample sizes	Key evidence/data
Review of businesses directly engaged with Centres to consider whether meaningful comparators can be identified	6-12 months after Centres established	N/A	Sector Size
Consultations with consortia members	0-6 months after set up to establish baseline 2-3 years to identify development 5-6 years to identify development	All partners	Current priorities Current engagement with: • Business • Farmers • Other research institutes (including abroad) Initial feedback on operational processes Changes in behaviour Processes of implementation and progress/feedback in relation to becoming financially sustainable Contribution to internationalisation objectives
Tracking survey of companies not directly engaged *(Contingent on review of participating businesses)*	As above if comparators can be identified	Unknown at this stage	R&D spend Size Relationships with science base
Survey of businesses directly engaged with Centres	Within 1 year to establish baseline Within 3 years to establish impacts	Census	Impacts of engagement Constraints and opportunities'

Method	Potential timing	Sample sizes	Key evidence/data
Case studies	2-3 years and 5-6 years	Case study selection to ensure a cross section of projects covering: • Range of business sectors and types • Level of involvement • Focus, e.g. – UK markets/ international development; productivity/ environmental benefits • Mix in terms of success In order to ensure breadth, likely to need 25-35 case studies across all Centres	Outcome data on subsequent R&D, new products/services taken to market, take-up by the market, and commercial outcomes (including exports), feedback into new research, further collaborations between research and industry Outcome data from indirect beneficiaries such as farming businesses (UK and overseas) Evidence on the extent to which outcomes attributable to the Centre Evidence on why projects were successful (or not), the contexts of projects (e.g. institutional, technological, market, cultural, policy), the key mechanisms leading to outcomes Feedback on Centre processes, and also on links to other aspects of the Agri-Tech Strategy Contribution to internationalisation objectives
Consultations with stakeholders	2-3 years after establishment	10-15	Inputs to: • policy design • developing networks • developing links between Centres • inward investment • business engagement with Strategy • progress to financial sustainability
Consultations with inward investors	Continuous	10-20	Influence of Centre(s) on location decision
Bibliometrics/ peer review of research outputs	3 years and at end of government funding	Census	Citations Impact factor

Drawing on the evidence proposed in Table 8-1, the following types of analysis and assessment will be possible:

- Outcomes: analysis of outcomes achieved is likely to focus on those derived by companies directly engaged with the Centre. In addition, the time of the evaluation will need to balance the need to inform policy-makers and prevent memory decay of beneficiaries, and the elapsed time required to achieve outcomes. This means that outcomes may focus more on intermediate measures such as business engagement and changes in R&D and innovation behaviours, and research outcomes. Nevertheless, the case studies may enable greater exploration of longer-term commercial outcomes for direct beneficiaries and also the outcomes for indirect beneficiaries such as farmers. However, in these cases, the evidence will be 'by example' rather than representative across the fund.

- Counterfactual and causality: this assessment will need to draw together different strands of the evidence to come to a reasoned judgement on the extent to which outcomes are likely to be attributable to the intervention. There will need to be examination of the evidence to support the different steps of the logic chain (e.g. through process tracing) and/or consideration of the alternative explanations for outcomes aside from the Centres programme (e.g. through contribution analysis). If a comparison group is possible, then this would be included as evidence to inform these judgements, but the evaluation must consider carefully the impacts on non-members of the consortia.

- What works for whom and in what context: the analysis of beneficiary survey data may indicate the types of projects that have been most successful in delivering outcomes. This analysis will be deepened through the case studies, which will provide an opportunity to explore the combinations of contexts (e.g. institutional, technological, market, cultural, policy-fit) and mechanisms (e.g. types of project, different elements of project, and ways in which projects are delivered) that lead to outcomes.

- Delivery processes: feedback on the processes of delivery will be gathered at a high level through a limited number of survey questions to benefiting companies and researchers, and with the opportunity for more detailed evidence through the case studies. Evidence from the consultations with consortia members and other stakeholders will also be analysed to draw out the lessons from operational aspects of the Centres in particular (including linkages between Centres), and the progress being made towards financial sustainability.

- Value for money/economic evaluation: the value for money assessment should, as far as is possible seek to estimate the net economic benefits compared to the public sector costs of the fund.

    - The costs are reasonably straightforward to estimate, reflecting the capital inputs provided by BIS and estimates of running costs

- The estimate of net economic benefits is more complicated and will depend on the strength of evidence on outcomes and causality (as per the first two bullet points above). We suggest that quantitative estimates are derived for the steps of the logic drawing on different parts of the evidence available (also known as simulation modelling). Given the diversity and complexity of impact channels for the Centre, a multi-criteria analysis could be appropriate which attributes scores to the various non-monetised benefits. Sensitivity analysis would be required to reflect this uncertainty over outcomes.

As set out in the description of the analysis and assessment above, there are likely to be some limitations to the evaluation. This particularly reflects the complicated nature of the intervention. The evaluation of the counterfactual and causality will rely on assessing the plausible contribution of the intervention by combining different strands of evidence, rather than through statistical or econometric analysis that compares a treatment to a non-treatment group. The outcomes themselves will be a mix of research, commercial and societal (e.g. environmental or those relating to international development outcomes. The case based nature of the evaluation and the long timescales to outcomes will make it challenging to estimate the scale of these in aggregate across the Centres at a particular point in time. This in particular places challenges on the value for money assessment, which may need to involve alternative metrics and approaches such as multi-criteria analysis and consideration of financial sustainability. Where outcomes can be quantified, sensitivity analysis would be a useful means of addressing the uncertainty over the evidence on outcomes and causality.

8.3.3. Next steps

An immediate next step is to ensure that Centres will collect the necessary data on baseline outcomes and outputs for all members and business participants. In addition, it is important to ensure that all business participants are asked to confirm that they are willing for their details to be shared with third parties for the purposes of monitoring and evaluation.

9. Recommendation 3: evaluation of internationalisation actions

9.1. Background to the internationalisation actions

The internationalisation actions of the Agri-Tech Strategy are led by UK Trade and Investment (UKTI), and delivered by a dedicated Agri-Tech Organisation (ATO) established within UKTI. The internationalisation actions covers two broad areas of activity:

- Exports: including the provision of support to UK Agri-Tech companies seeking to export to target markets overseas, including working with foreign governments to help them deliver their food security programmes, and the work of the UKTI Business Ambassador[32] to champion UK Agri-Tech and identify early stage markets for future growth.

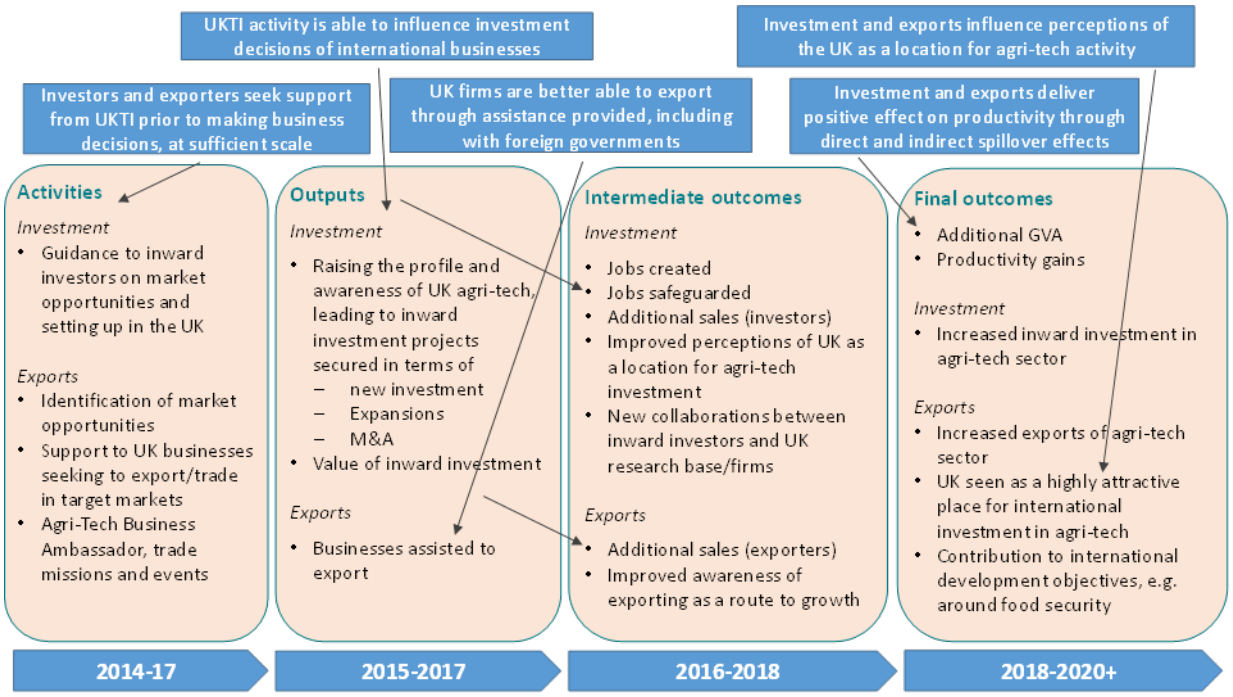
- Investment: advice and support to potential inward investors in the Agri-Tech sector on market opportunities and setting up/expanding in the UK. This includes advising on issues such as location, links to the research base and innovation assets, tax and legal issues, and recruitment.

The ATO has a team of 9 FTEs including trade/investment specialists, management and support functions, and also draws on the wider experience and capacity of UKTI's broader export advisers and investment specialists, including as a source of referrals of Agri-Tech firms. The ATO is one of a number of investment organisations established by UKTI seeking to promote investment and trade in key sectors.[33] The internationalisation actions are funded by UKTI.

A summary of the underlying logic chain (from activities to outcomes, and covering the exports and investment strands of activity respectively) is set out in Figure 9-1. This includes the timescales for activities, outputs and outcomes, indicating the potential wide ranges, especially for intermediate and final outcomes. It also includes the main assumptions underpinning the theory of change (in the blue boxes) and key external factors that are likely to affect the logic.

[32] Currently James Townshend of Velcourt Group plc,
[33] The other investment organisations (excluding the original Tech City UK) are in life sciences, financial services, the automotive sector, regeneration, offshore wind.

Figure 9-1: Headline logic chain



Range of external factors affecting theory of change, including:

- UK, European and international economic outlook
- Exchange rates
- Regulatory issues and trade rules/barriers
- Policy objectives – in the UK and internationally (e.g. on food security)

Any evaluation of the internationalisation actions should seek to test the extent to which the logic and theory of change holds true in practice, and so how far the intervention is bringing about outputs and outcomes that would not have happened otherwise. We have not undertaken a formal literature review. However, a range of literature suggests there is evidence to justify the logic. Specifically, research published by BIS[34] in 2011 identified the case for public support in international trade and investment. Key findings included:

- Exporting has significant positive effects on the productivity, innovation, and R&D of exporting firms – the productivity effects of exporting occur through several mechanisms including (i) firms which export benefit from increased economies of scale, and from increasing the commercial life of individual products or services, (ii) firms reallocate internal resources to focus more on their better performing products and (iii) firms gain exposure to productivity enhancing ideas and technologies, or ideas for new or improved products or services, stimulating innovation and leading to productivity gains. Exporting also stimulates innovation and R&D both through exposure to new ideas and competitors, and through increasing the returns to

[34] International Trade and Investment - the Economic Rationale for Government Support

investment in R&D, and revenues available for such investment.[35] However, market failures and other barriers deter UK firms from exporting including: difficulty gaining access to social networks that play a significant role in determining bilateral trade; a limited pool of UK business people with knowledge and expertise relating to overseas markets which are culturally more remote from the UK; and private sector cooperation hindered by problems such as lack of mutual trust, or by a tendency for some members to 'free ride' on the efforts of others, even when cooperation would bring significant collective benefits.

- Inward investment can contribute to productivity growth within UK firms, either through productivity enhancing spillovers, or through management change following mergers or acquisition. We note that evidence of significant productivity enhancing spillovers was found only for high quality projects, which were likely to be 'technology exploiting, and so the extent to which investment supported by the ATO are technology exploiting and generating spillovers will therefore need to be covered in the evaluation of Agri-Tech internationalisation activities. Barriers faced by potential inward investors are similar to those encountered by UK businesses seeking to enter overseas markets such as access to the right contacts and networks. Inward investors are also likely to need help include accessing other information not otherwise available, and guidance in navigating the legal and regulatory framework in the UK. Barriers to inward investment also include limited knowledge about the UK's attributes as a place to invest. Businesses in overseas markets who feel well informed about the UK tend to have more positive perceptions of the UK as a potential investment location.

- The evaluation evidence reviewed in the research indicated that: (i) export services consistently generate high benefit cost ratios, mainly as a result of increasing export related know how and enabling firms to overcome barriers to entering new overseas markets; and (ii) that advice and help to inward investors is an effective means of influencing investor decisions, both with respect to locating in the UK, and with respect to scale and scope of the project.

9.2. Key issues and challenges

A number of key issues are important in understanding the logic for the investment and export strands of activity, and informing evaluation options:

- The nature of the activity across the two strands varies substantially and will lead to different types of outputs and outcomes and over different timescales – for example, investment such as jobs created/safeguarded outcomes related to new investment may not start to emerge for a number of years as investment decisions are made, whereas potentially additional sales as a result of new exports links may start to

[35] Note that the BIS research also noted that exporting is not suitable for all firms, and can have significant negative effects on the productivity of firms which begin to export and then cease to do so. Hence it is most likely to benefit those which have the characteristics needed for sustained export success (International Trade and Investment - the Economic Rationale for Government Support, p72)

emerge rather sooner. Whilst there is some consistency in terms of final outcomes (GVA and productivity), the time-path to the delivery of outputs and intermediate outcomes may vary substantially.

- The level of attribution to the work of UKTI will be very different across different elements of activity: for example, the work of the Business Ambassador may play a role in forging initial linkages and relationships, or identify new market opportunities, but the importance of this compared to subsequent issues driving investment decisions or commercial deals is unlikely to be substantial. By contrast, the export support to identify new markets and potential leads may be more direct with benefits more attributable to the support (this notwithstanding the issue of additionality, and the extent to which firms may have been able to identify these opportunities without the work of UKTI).

- The implementation model causes an issue for robust evaluation, with the scale of the firms engaged being small (particularly in terms of investment) meaning that empirical impact evaluation (as described in the Magenta Book) and referred to is unlikely to provide evidence on the impact. Further, identifying a comparison group for the two strands of activity will be challenging for a number of reasons:

  - in terms of investment the wider population of relevant overseas firms are unlikely to be 'known' to UKTI or others in the UK in order to identify an appropriate comparison sample (and they would also be unlikely to be willing to engage in any primary research with little or no incentive to participate)

  - in terms of exports because there may not be data available to adequately match a comparison group of firms to the beneficiary cohort, with the intention to export (that is, at a similar stage in the exporting journey as firms that seek support from UKTI); whilst there is the potential to use as a comparison group firms that approach UKTI for support but do not subsequently take it up there is the issue of selection bias, and there is no formal scoring threshold that can be used to take advantage of a discontinuity between selected and non-selected firms

  - for both groups because the nature of the support provided to exports and investors is likely to vary considerably dependent on the needs of the specific firm, for example, dependent on the market in which firms are planning to export, or the scale and nature of the investment opportunity.

Taken together, these points suggest that an empirical impact evaluation adopting a comparison group as the counterfactual is not feasible. That is not to say that evidence gathered from a comparison group of non-supported firms cannot be used as part of a broader mixed-methods approach.

It is also worth noting that the options for evaluation of the internalisation actions can potentially be facilitated by existing UKTI monitoring and evaluation practice. Notably, the Performance and Impact Monitoring Survey (PIMS). PIMS is an on-going survey of UK businesses that have received support through UKTI's trade development services. PIMS

has been operational since 2006 and involves c.1000 interviews per quarter to provide consistent and robust evidence on the quality, impact and effectiveness of UKTI support.

Whilst the PIMS survey does not have an explicitly sectoral focus (with sampling undertaken by service rather than sector, note that PIMS currently categorises Agri-Tech firms under Advanced Engineering and Manufacture), and the work of the ATO has not been explicitly covered to date, (meaning PIMS cannot in itself provide the data required for the evaluation), there may be scope to utilise the existing research tools, and survey delivery mechanisms in order to minimise the cost of the required research for the evaluation of the internalisation actions.

9.2.1. Summary of approach

The overall approach recommended for the evaluation of the internalisation actions is a mixed-methods approach that combines a range of quantitative and qualitative research including case studies and tracking research. The approach covers both the export and investment strands of activity, although the emphasis in terms of quantitative research is on the exports strand, with qualitative research through case studies the principal focus of the approach to evaluating investment.

The key methods suggested are as follows:

- A tracking survey of UK-based Agri-Tech firms that have been supported by UKTI to identify market opportunities/export, and a survey of a group of non-beneficiary firms that also approached UKTI for support on exporting but did receive support, either because they decided not to progress with the opportunity, or because they were 'rejected' by UKTI owing to UKTI's capacity constraints. Note that the non-beneficiary survey is not a formal comparison group given the likely differences between the groups, but will provide evidence that can be triangulated with other sources. One or both of the tracking surveys could be delivered through a 'boost' to UKTI's regular PIMS survey of firms supported, and the non-supported firms survey, in order to maximise the cost-effectiveness of the evaluation. This requires further investigation by UKTI and may have implications for the timing and flexibility of the evaluation that would need to be considered by UKTI and partners.

- In-depth consultations with UK Agri-Tech firms that have benefited (directly or indirectly) from the work of the Business Ambassador including those that have been involved in trade missions or overseas visits led by the Business Ambassador.

- A series of firm-level case studies with inward investors that received support from UKTI on inward investment projects. This research will also include engagement with indirect beneficiaries, for example, suppliers, collaborators or clients of the inward investors in order to capture any evidence on wider spillover benefits from inward investment activity.

9.2.2. Methods

The details of each method, and the types of evidence and research question that the different methods should seek to cover, are set out in Table 9-1.

Table 9-1: Methods and types of evidence

Method	Potential timing	Sample sizes	Key evidence/data
Tracking survey of firms supported to export	2 or 3 stages: • Baseline stage (i.e. as soon as possible following approach to UKTI from 2015/16, not possible if using PIMS) • Around 6 months after the provision of the support (PIMS 4-7 months standard) • Around 18 months after the provision of the support (PIMS 16-19 months standard)	Population for the survey should be all firms supported by UKTI, with sampling to provide representative split of markets Sample size uncertain and dependent on scale of support provided: indicatively assume a population of 100 for 2015/16, with first year response rate of 50-60%, around 50-60 respondents, with anticipated 10% attrition each survey subsequently (i.e. 45-55 respondents at 6 months, and 40-50 respondents at 18 months).	Outcome data on additional sales, perceptions of exporting as a route to growth Evidence on self-reported additionality of support activity and outcomes Experience of the support process and quality of support from UKTI
Tracking survey of firms not supported to export	2 or 3 stages: • Baseline (i.e. as soon as possible following approach to UKTI from 2015/16, not possible if using PIMS) • Around 12 months after approaching UKTI for support (based on assumption that average support period is around six months, aligning timing to supported firm cohort) • Around 24 months after approaching UKTI for support (as above)	Population for the survey should be all firms that approached UKTI for support to export but were not supported, with sampling to provide representative split of markets. Sample selection will need to be undertaken to consistent criteria to ensure non-beneficiaries represent a reasonable match to the beneficiary group in terms of the nature of support sought given UKTI's varied levels of engagement with firms. Sample size uncertain and dependent on scale of demand: indicatively assume a population of 100 for 2015/16, with first year response rate of 35-40%, around 35-40 respondents, with anticipated 10% attrition each survey subsequently (i.e. 30-35 respondents at	Activity/additionality data on whether export activity has gone ahead without UKTI support Outcome data on sales from export without UKTI Both of these to inform judgements on net outcomes for the beneficiary group (though assessing empirically will not be possible given the small samples)

Method	Potential timing	Sample sizes	Key evidence/data
		12 months, and 25-30 respondents at 24 months).	
Consultations / surveys with firms that have benefited from the work of the Business Ambassador	Two rounds of consultations with firms (x15 in each round), around 12 months following engagement with work of the Business Ambassador	Sample uncertain at this stage, the firms will be selected to cover a range of markets and visits/missions where appropriate, but the focus will be on qualitative (rather than quantitative) evidence of outcomes These firms should be separate from those covered in the tracking survey	Self-reported outcome data on additional sales, perceptions of exporting as a route to growth
Inward investor case studies	Two wave research with a cohort of 10 inward investors that have been supported by UKTI. Wave 1 to be undertaken following completion of inward investment projects supported by UKTI (in 2014-16), with Wave 2 completed after a further 2 years	Selection of 10 firms from estimated sample of 30, to cover a range of locations, sub-sectors, and nature of investment (i.e. new investment, expansions)	Outcome data on jobs created, jobs safeguarded from supported firms Evidence on self-reported additionality of support activity and outcomes Evidence on potential spillover effects and productivity benefits Evidence on collaborations between investors and the UK research base and firms Experience of the support process and quality of support from UKTI

Drawing on the evidence proposed in Table 9-1 the following types of analysis and assessment will be possible:

- Outcomes: the evidence for outcomes will be based on the experience of the firms supported by UKTI, although in terms of the inward investment outcomes these will be examples of specific cases rather than representative in quantitative terms from across all projects (although the number of case studies could be increased, and monitoring data will be collected to enable some assessment of gross effects at an aggregate scale to be assessed).

- Counterfactual and causality: applying principles along the lines of contribution analysis as described above, this assessment will need to draw together different strands of the evidence to come to a reasoned judgement on the extent to which outcomes are likely to be attributable to the intervention, for exports and investment respectively (and separately), relative to the other factors that may have influenced the outcomes The evidence from the tracking survey of supported and non-supported exports will give an indication of the extent to which the UKTI support

under the Agri-Tech Strategy has resulted in additional benefits (by assessing how firms progressed their export ideas without this support) and output/outcome additionality (by assessing changes in the value of sales generated by exports between supported and non-supported firms). Some further qualitative evidence of self-reported additionality on export behaviour will also be provided by the in-depth consultations with firms benefiting from/involved with the work of the Business Ambassador. On the investment side, the case studies will provide case-specific evidence on the additionality of UKTI support – put simply, would these firms have made this investment in the UK without the support provided?

- Process considerations: the primary research with firms will provide evidence on the 'process' of support from UKTI, including the quality and appropriateness of the advice, and the extent to which the barriers and issues faced by potential exporters and inward investors were met effectively in order to inform on-going and future delivery.

- Value for money/economic evaluation: the value for money assessment should, at a minimum, seek to estimate the net economic benefits generated by the internationalisation actions compared to the public sector investment by UKTI. Cost data should be drawn from UKTI financial information, although data on the support costs from UKTI, and the work of the Business Ambassador, may not be straightforward given the need to apportion the cost of central UKTI services to the ATO; some appropriate estimates will have to be made on the proportion of total costs accounted for by Agri-Tech internationalisation actions. On the benefits side, the key metric will be the net GVA contribution, as evidenced through the additional sales generated by exporters and either additional sales or the value of additional jobs created from inward investment. These will be estimated through a mix of UKTI monitoring data and primary evidence from the surveys/case studies. Estimates on the net sales and employment effects will be reliant on the strength of evidence on outcomes and causality (discussed in the first two bullet points above).

As set out in the description of the analysis and assessment above, there are likely to be some limitations to the evaluation. In particular, the evaluation of the counterfactual and causality will rely on assessing the plausible contribution of the intervention by combining different strands of evidence, rather than through statistical/econometric analysis. Whilst not as significant an issue as for the evaluation of the Catalyst and the Centres, the varying timescales to outcomes is also likely to affect the assessment. Both of these issues have an effect on the value for money assessment, though here sensitivity analysis would be a useful means of addressing the uncertainty over the evidence on outcomes and causality.

9.2.3. Next steps and other options

An immediate next step is to investigate the potential to boost the PIMS survey to focus on Agri-Tech firms supported by the ATO, and potentially those that approached UKTI but were not supported. If this is not viable then a stand-alone surveying approach will be required for the tracking survey. Data on the expected number of firms to be supported to export should also be confirmed (these data were not available at the time of the scoping work).

UKTI should also ensure that contact data and other information (nature of the opportunity, support requirements) of firms that approach the ATO for support are recorded in order to inform the tracking survey of non-supported firms.

Beyond this, the time-scale of support and time-paths to impact will also need to be considered, taking into account both the need to provide some early evidence for an interim assessment, and allow time for intermediate outcomes to emerge. At this stage, the following timescale for evaluation may be appropriate:

- Initial round of fieldwork in 2016 to establish the baseline for the tracking surveys, and complete an initial round of interviews with firms that have benefited from the work of the Business Ambassador.

- Second round of fieldwork in 2017 to complete the second round of tracking surveys and complete Wave 1 of the investor case studies.

- Third round of fieldwork in 2018 to complete the third and final wave of the tracking survey, Wave 2 of the investor case studies and a second round of interviews with firms that have benefited from the work of the Business Ambassador.

The approach above sets out a comprehensive option for the evaluation. Of course, some refinements could be made, for example:

- a further round of the tracking survey of supported (and potentially non-supported firms) at a later date in order to provide evidence on the longer-term effects of the support – though attrition rates may mean that the sample sizes become very small

- including an additional cohort of firms into the tracking survey in the second or third year of research who would subsequently be surveyed at consistent intervals, extending the research to 2019 (and potentially beyond)

- varying the number of case studies undertaken with inward investors, and/or making these more in-depth or indeed lighter touch – more in-depth case studies may provide, for example, opportunities to explore spillover effects in further detail

- adopting a lighter-touch but broader approach to the research with firms that have benefited from the work of the Business Ambassador, for example undertaking an online survey of all relevant firms.

The timescale for the evaluation set out above would suggest the following indicative reporting schedule (for the internalisation actions alone):

- a baseline report for internalisation actions in 2016 that provides an initial overview of activity to date, the findings from the tracking survey and findings of early outcomes from the qualitative research with firms benefiting from the work of the Business Ambassador

- an interim report for internalisation actions in 2017, focused on the quantitative evidence from the tracking survey and findings of early outcomes from the qualitative research with inward investors

- a final report for internalisation actions in 2018 that provides an impact and process assessment.

10. Recommendation 4: evaluating the influencing and coordination roles of the Strategy

10.1. Background

This section primarily relates to the work of the Leadership Council. The delivery of the Agri Tech Strategy is overseen by the Leadership Council, made up of senior figures from organisations across the Agri-Tech sector. The Council acts as an overarching advisory board, using its knowledge and oversight of the sector to champion the Strategy's vision and to drive its implementation.

The Council will also steer and monitor the new investment in translational research. It will work with research funders and industry, encouraging private and overseas investment to generate a world-leading capacity for converting basic science into innovative outcomes across the Agri-Tech sector. Council members will act as leads for their communities. They will provide thought leadership on innovation and growth, facilitating new partnerships and building stronger links between industry, Government and the science base. Members will provide public leadership, in partnership with other groups, on the application of new technologies relating to the sector.[36]

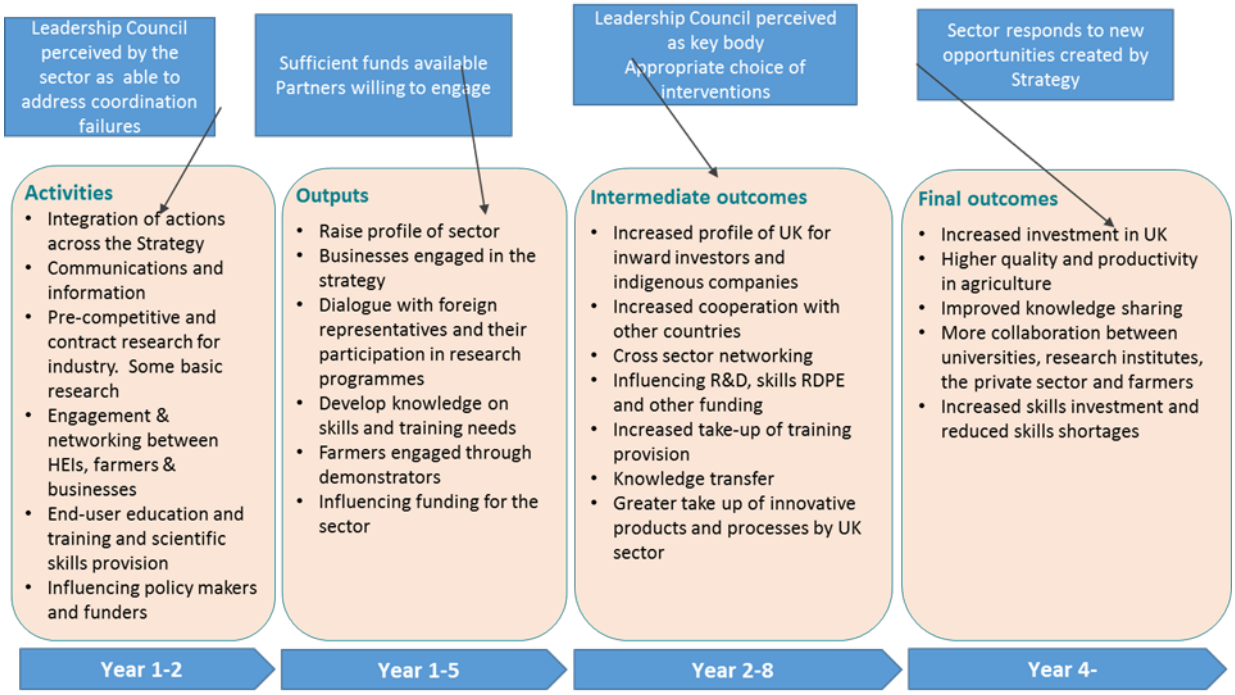
Some of these roles translate fairly directly to activities already underway or planned, for example the Centres are, amongst other aims, intended to make research more accessible for users and this will be assessed through the evaluations discussed elsewhere in this report. But the influencing and coordination roles are intended to generate impacts above and beyond direct activities and need to be evaluated as such.

We would also note that the existence of the Strategy may be an important influence over and above those arising from activities generated by the Leadership Council. There is, for example, anecdotal evidence that some global businesses welcome the commitment the Strategy demonstrates to the sector and may influence their willingness to invest in the UK. Similarly, some LEPs have included the Agri-Tech sector in their Growth Deal bids.

A summary of the underlying logic chain (from activities to outcomes) is set out in Figure 10-1. This includes the timescales for activities, outputs and outcomes, indicating the potential wide ranges, especially for intermediate and final outcomes. It also includes the main assumptions underpinning the theory of change (in the blue boxes).

[36] *A UK Strategy for Agricultural Technologies* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/227259/9643-BIS-UK_Agri_Tech_Strategy_Accessible.pdf

Figure 10-1: Headline logic chain



10.2. Key issues and challenges

This part of the evaluation faces three main challenges:

- The familiar challenge of defining the counterfactual. Given the nature of the Strategy the only possible control group would be other countries and underlying differences in context, as well as evaluation costs, rule this out

- Influencing others may mean long time periods to impact, both because it will not be a single event and if an when it does lead to relevant activities these may themselves take a long time to generate outcomes. Evaluation may, therefore, need to focus on activities and outputs

- Most important, however, are the difficulties in detecting the effects of influencing and coordinating activities. Individuals and organisations will be subject to many influences and the impact of Strategy 'information' on an individual may be small although significant in aggregate. In addition, individuals and organisations which are influenced by the Strategy may not always be aware that this is the source of the influence or information.

10.3. Recommended approach

10.3.1. Summary of approach

The recommended approach relies heavily on consultations with key organisations which the Strategy is seeking to influence and or coordinate with. It also a number of actions intended to provide additional evidence on impacts which would be triangulated with the consultations. In summary, it comprises:

- Establishing a base-line of recent expenditure on research relevant to the Strategy and pre-Strategy cooperation between organisations. We understand that the Leadership Council intends to undertake a study to map research, translation and innovation funding in the private and public sectors and this could provide much, if not all, of the required information
- Monitoring of the media to identify references to the Strategy and its components
- Consultations with and surveys of key public and private organisations to gather views on the impacts of the Strategy
- Tracking the results of specific initiatives to assess whether they are translated into new programmes and activities. At present these include: identifying research skills and requirements; mapping of skills needed by the sector and the identification of gaps in provision; establishing on-farm demonstrators through links with the Centres; and dialogue with the sector to inform Rural Development Programme for England (RDPE) design.

10.3.2. Methods

The details of each method, and the types of evidence and research question that the different methods should seek to cover, are set out in Table 10-1.

Table 10-1: Methods and types of evidence

Method	Potential timing	Sample sizes	Key evidence/data
Establish pre-Strategy base line for R&D funding and cooperation between relevant organisations	Within the next 12 months to as up-to-date data becomes available Update every five years	N/A	Baseline for judging influence on R&D spend and cooperation
Monitoring media	Continuous process Should include policy relevant literature to assess potential policy impacts as well as more general awareness	N/A	Awareness of Strategy

Method	Potential timing	Sample sizes	Key evidence/data
Survey/ consultations with key organisations in public and private sector.	Every 3-5 years	Online/short phone survey could be undertaken to gather information from wide range of stakeholders In-depth consultations with key policy makers and partners in implementation to gather views on whether cooperation is leading to more effective programmes Should also include organisations such as LEPs (where the Strategy may have influenced their strategies) and authorities bidding for EU funds such as Interreg	Success in influencing and coordination
Tracking results of specific initiatives especially relating to: • Skills • Inward investment • RDPE • Supply chains	On-going process dependent on timing of initiatives.	N/A Consultations with delivery partners. This should also provide feedback on the process for launching new initiatives. As and when new initiatives move to programme status they should be subject to separate evaluations in the same ways as the Catalyst and Centres	Effectiveness in stimulating new programmes
Survey inward investors to assess whether Strategy has influenced location decision	As inward investment occurs or significant expansion of existing facilities	All major investments	Influence on inward investment decision

Method	Potential timing	Sample sizes	Key evidence/data
Establish expert panel for Delphi exercise	Every 3-5 years	The expert panel would comprise up to 100 individuals from the sector and research and higher education. Some should be foreign-based with knowledge of the UK sector as well as other countries. The Delphi exercise would entail circulating a range of statements to panel members asking them to assess likelihood of occurrence/level of agreement. The responses are analysed and the results circulated again with the similar questions. The aim is to converge towards a consensus and at least one iteration is normal.	Opinion on Strategy's impact

The evidence provided would be almost all qualitative and mainly reliant on views and opinions rather than actual events. It will, however, provide valuable insights into awareness of the Strategy and the extent to which it is influencing others. We also believe that some aspects, especially the tracking of specific initiatives, would also serve as process evaluations and could provide useful lessons for future activities.

10.3.3. Next steps

We understand that a survey of R&D spend in the public and private sectors has been undertaken and the first step will be to examine whether this is suitable as a base line for current R&D spend. We expect that the study will also provide information on cooperation between different funding bodies and this also needs to be reviewed.

The influencing and coordinating elements of the Strategy will take some time to generate detectible impacts and, with the exception of media monitoring, five yearly interview for evaluations are probably appropriate. As such there are few immediate steps which need to be taken. However, in preparation for the evaluations:

- A list of organisations and key individuals which would be targets to influence could be prepared

- Consideration of members of the Delphi Panel. Potential members may be readily identified, but if not consideration should be given to a preparatory co-nomination analysis.

10.3.4. Options

We considered whether reviewing a sector which had not been selected as one of the Industrial Strategies might provide useful insights into the impacts of the role, but our conclusion was that differences between sectors would mean any such comparison would be fraught with difficulties and unlikely to provide robust evidence. In addition, it would add substantially to the costs of evaluation. However, there may be merit in reviewing any evidence on influencing and coordination roles in relation to the other Industrial Strategies. Simple comparisons will not be appropriate but such an exercise might help to identify what sorts of activities have been successful, in a specific context, and the extent to which they have been adopted by Agri-Tech. We are not suggesting that additional evaluations of other strategies be undertaken, but assume that similar issues will be considered in relation to all strategies.

11. Recommendation 5: evaluating the Overall Strategy

11.1. Introduction

Previous Chapters of this report have made recommendations for evaluating various components of the Strategy. This Chapter draws together the different strands and discusses priorities and process issues.

11.2. The baseline projections

A key component of the project was the development of projections for the Agri-Tech sector based on current sector structures and trends; the aim being to model the scale of activity if the Strategy had not been implemented. The methodology adopted, and projections to 2030, are presented in Chapter 3. The aim of the projections is, therefore, to provide a pseudo-counterfactual for evaluations undertaken in the future. However, the projections made now cannot simply be compared to actual outcomes in the future and the difference attributed to the Strategy. This is due to two key reasons, explained as follows:

- Various assumptions about future UK and global markets have been made and these are unlikely to be accurate in practice. All assumptions and the model's structure have been explained so that it can be rerun when actual data on these assumptions are available. Thus, for example, if the assumptions concerning world demand are incorrect then the projections can be recalculated using actual data. Some of the assumptions relate to variables which will not be influenced by the Strategy, such as world prices. But others, such as the UK share of world markets could be and these should not be adjusted on the basis of actual outcomes.

- Perhaps more complex, the composition of the Agri-Tech sector could change over the lengthy time scale envisaged for evaluation in that some current sectors could exit and new ones enter as the demands for products and services change over time. If these changes are significant then the current projections will obviously give a misleading impression of the Strategy's impacts. The composition of the sector needs to be monitored and if significant changes are identified then the underlying model structure, in terms of the sub-sectors (and their proportions included within Agri-Tech), will need to be recalibrated. This may require another survey to identify which businesses are in the sector and it will be necessary if there are reasons to believe there have been significant changes.

In addition to the potential adjustments discussed above, we would emphasise that any differences between actual outcomes and the projections cannot be uncritically attributed to the Strategy. Any evaluation must also establish a connection between changes and activities arising from the Strategy and the evaluations of the individual components obviously have a key role here. This is discussed further below.

11.3. Synergies between the evaluation components

The component evaluations are obviously important in their own right as a means of testing impacts, value for money and informing future developments. But there are also methodological synergies between them and the results need to be considered as a whole. These arise because of the following issues:

- As was mentioned above, simply comparing baseline projections with actual outcomes is not sufficient. Thus, if the sector was found to have grown faster than expected and, for example, this could be attributed to the adoption of new technology then evidence that the Centres or the Catalyst (or other activities related to the Strategy) were contributing to this should be sought.

- There may be operational synergies between activities, for example outputs from the Centres could support Catalyst activity and more generally, relationships between and within the science-base and businesses stimulated by one activity could contribute to the success of another. These connections need to be reflected in any component evaluation.

- There may be methodological lessons from one evaluation which can be used to improve another, or possibly data which can be shared.

In the evaluation plan for influencing and coordination (Chapter 10) we recommended a Delphi exercise to assess impacts. Such an exercise could also be very valuable in the overall evaluation. The results of the Delphi exercise are important in their own right, but it would also be possible to present conclusions from the evaluations to the panel in order to validate these findings.

The factors discussed here also have implications for evaluation management which are discussed at the end of this Chapter.

11.4. Evaluation priorities

We are not able to recommend priorities, in part because this depends on many factors outside the scope of the current project, but also because so far only a few programmes have been identified and choices will need to be made as the Strategy develops. However, there are some general principles which should inform prioritisation:

- The scale of public investment, with higher levels of investment meaning that a particular intervention should be a higher priority for evaluation.

- The extent to which the programme is itself innovative, in order to draw lessons from the programme under consideration as well as to decide whether continuation is justified – the more innovative an intervention the higher the priority.

- ‘Evaluability’ – the extent to which robust evaluations are possible and whether it will be possible to demonstrate impacts, with greater evaluability indicating a higher priority.

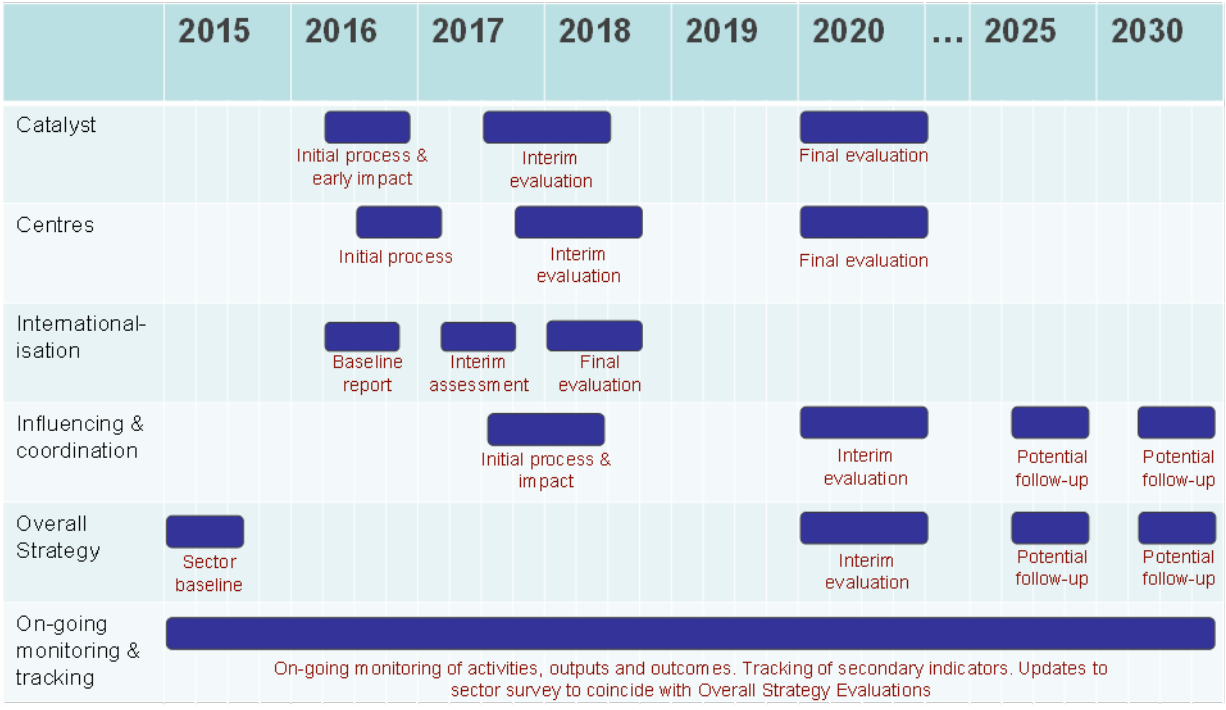
Of the programmes which have so far been defined, this suggests a high priority for the Catalyst and Centres. Public investment in the Catalyst is of the same order as the Centres (although lower) and both are much higher than for the internationalisation activities. The Catalyst evaluation will be complex, but of the three components considered we believe this one is most likely to generate robust impact assessments. The Centres evaluation will be more complex, but they are the most innovative of the interventions foreseen at present.

11.5. Managing evaluations

This final section provides an indicative timetable for the programme of evaluation work and suggests responsibilities for the component evaluations and the overall evaluation of the Strategy.

In Figure 11-1 we set out the overall indicative timetable for the evaluation of the Agri-Tech Strategy. This sets out the potential timings of different component evaluations, and the evaluations of the Overall Strategy. As can be seen there are synchronisations of evaluations in late 2016 (providing an early assessment of processes for different components alongside some evidence on impact/expected impact for the Catalyst and a baseline report on Internationalisation), 2017/18 (covering interim evaluations of the Catalyst, Centres, and Influencing and Coordination actions, and interim and then final assessments of the Internationalisation actions) and 2020, when the first overall assessment of impact may be most feasible. Earlier syntheses of findings could be possible around 2017/18, in particular to provide **early evidence** of progress to inform spending discussions.

Figure 11-1: Overall timetable



The responsibilities for the different evaluations are fairly self-evident given the key roles that different departments and agencies have for the components of the Strategy. These are set out in Table 11-1. In addition, BIS and Defra, and where appropriate DFID and BBSRC, will want to be involved in steering the different evaluations. We have also acknowledged the role of the Leadership Council itself in evaluating the influencing and coordination component of the Strategy. For other components, we envisage that the Leadership Council would be a key audience for the results and recommendations.

Table 11-1: Evaluation responsibilities

Evaluation component	Monitoring responsibilities	Lead evaluation responsibility	Further steer from…
Catalyst	Innovate UK	BIS, Defra	DFID and BBSRC
Centres	BIS, working with Centres	BIS	Defra
Internationalisation	UKTI	BIS	Defra
Influencing and coordination	BIS and Defra, working with Leadership Council	BIS and Defra	DFID (also involving Leadership Council)
Overall (modelling and synthesis)	BIS and Defra (re tacking surveys)	BIS and Defra	DFID

In addition to the above, cutting across and overarching the component evaluations, BIS and Defra should take the responsibility of evaluation management. This needs to undertake the following tasks:

- As the Strategy develops new programmes may well be introduced, and evaluation plans may be required for these.
- There could be synergies between evaluations, and these should be exploited where possible (e.g. sharing methodologies and data). There is also a more fundamental coordination role to ensure, for example, that business surveys do not take place in the same weeks/months to avoid companies being contacted by different evaluations at the same time.
- Consider whether evaluations unconnected with the Strategy might inform the evaluation programme. Innovate UK, for example, is evaluating other Catalysts (and is soon to evaluate the Catapults which have similarities to the Centres) and the methodologies may be transferable. It might be the case that inferences about the Agri-Tech Catalyst could also be drawn from other Catalyst evaluations.
- Consider whether evaluations of other Industrial Strategies are transferable to Agri-Tech. In practice differences between sectors are such that this is unlikely to be the case, but there may be similarities between Strategies in relation to the influencing and coordinating role, or it may be informative to undertake comparative assessments of how influencing and coordinating roles are deployed in different ways between Strategies.

- Consider whether impacts outside the Agri-Tech sector also need to be considered. The evaluation recommendations have only been concerned with impacts arising through the Agri-Tech sector but there may be spillovers, for example to food processing. Developments need to be reviewed and evaluations extended if appropriate.

Annex A. Estimating the size of the Agri-Tech sector

The method for calculating the estimates is illustrated by the calculations for the contribution of two activities: manufacture of agricultural tractors (SIC 28301) and Manufacture of other chemical products n.e.c. (SIC 20590). Contribution from manufacture of agricultural tractors (SIC 28301)

A.1. Contribution from manufacture of agricultural tractors (SIC 28301)

The Annual Business Survey (ABS) provides data for the broader sector, SIC 2830. The detailed sectoral employment data from BRES reports that 12.7% of employment in SIC 2830 is in the manufacture of agricultural tractors. The ABS reports value-added for SIC 2830 of £410m in 2013. The contribution attributed to SIC 28201 is assumed to be in line with its 12.7% share of employment of the broader 4-digit sector, so being just over £52m. The definition of Agri-Tech assumes that the all of the manufacture of agricultural tractors is within the sector. The manufacture of agricultural tractors is only identified within the engineering and precision farming subsector, and so the contribution of £52m is attributed entirely there.

A.2. Manufacture of other chemical products n.e.c. (SIC 20590)

This activity is identified directly in the ABS. Its value-added in 2013 is reported to be £1.615bn and its employment estimated at 16,000. Not all of the activity is related to Agri-Tech. UK Input-Output tables do not identify SIC 20590 explicitly; rather it is within the broader aggregation of activity of SIC 20500 (other chemical products). The Tables report 0.6% of all intermediate use (ie as inputs to production, rather than as final consumption) of other chemical products was in the production of core agriculture and fishing (SIC 01, 03). This share is taken to be the proportion of the Manufacture of other chemical products n.e.c. (SIC 20590) that is within the Agri-Tech sector. The activity therefore contributes £9-10m in value-added and around 100 jobs to the overall Agri-Tech sector.

The mapping of the Agri-Tech sector identifies the Manufacture of other chemical products n.e.c. (SIC 20590) as contributing to three subsectors. Its contribution to each subsector is assumed to be equal, namely around £3m and 30 jobs.

Annex B. Estimates for share of activity in Agri-Tech

Table B-1: Estimates for share of activity in Agri-Tech

SIC	Sector description	Coefficients for Input-Output sectors the activity is within		Estimates from Firm survey for broader industry the activity is within						Other Judge-ment
		Intermediate demand from agriculture as share of total intermediate demand	Intermediate demand from agriculture as % of total output	Number of firms	Employment	Turnover	GVA	Capital expenditure	Exports	
10910	Manufacture of prepared feeds for farm animals	85	55	78	79	86	86	59	83	
20150	Manufacture of fertilisers and nitrogen compounds	8.5	2							100
20200	Manufacture of pesticides and other agrochemical products	22	6							100
20590	Manufacture of other chemical products n.e.c.	0.6	0							
21100	Manufacture of basic pharmaceutical product	1.2	0.2	1	0.6	0.2	0.2	0.2	0.7	
21200	Manufacture of pharmaceutical preparations	1.2	0.2	9.1	1.7	0.4	0.4	6.1	5.5	
22110	Manufacture of rubber tyres and tubes	0.9	0.6							

SIC	Sector description	Coefficients for Input-Output sectors the activity is within		Estimates from Firm survey for broader industry the activity is within						Other Judge-ment
		Intermediate demand from agriculture as share of total intermediate demand	Intermediate demand from agriculture as % of total output	Number of firms	Employment	Turnover	GVA	Capital expenditure	Exports	
25110	Manufacture of metal structures and parts of structures	1	0.7							
26511	Manufacture of electronic measuring, testing etc. equipment, not for industrial process control	0	0							
27400	Manufacture of electrical lighting equipment	0.5	0.2							
27900	Manufacture of other electrical equipment	0.5	0.2							
28220	Manufacture of lifting and handling equipment	0.1	0							
28250	Manufacture of non-domestic cooling and ventilation equipment	0.1	0							
28290	Manufacture of other general-purpose machinery n.e.c.	0.1	0							
28301	Manufacture of agricultural tractors	5.6	0.8	74.5	60.4	60.3	60.3	52.9	54.8	100
28302	Manufacture of agricultural and forestry machinery (other than agricultural tractors)	5.6	0.8	74.5	60.4	60.3	60.3	52.9	54.8	

SIC	Sector description	Coefficients for Input-Output sectors the activity is within		Estimates from Firm survey for broader industry the activity is within						Other Judge-ment
		Intermediate demand from agriculture as share of total intermediate demand	Intermediate demand from agriculture as % of total output	Number of firms	Employment	Turnover	GVA	Capital expenditure	Exports	
28990	Manufacture of other special-purpose machinery n.e.c.	0.1	0							
33120	Repair of machinery	0.5	0.5							
33200	Installation of industrial machinery and equipment	0.5	0.5							
36000	Water collection, treatment and supply	3.4	1	8.3	0.4	0.4	0.4	0	0	
38210	Treatment and disposal of non-hazardous waste	0.2	0.1	2.8	1.8	1.4	1.4	0.5	0	
38320	Recovery of sorted materials	0.2	0.1							
41201	Construction of commercial buildings	0.6	0.3							
42210	Construction of utility projects for fluids	0.6	0.3							
43220	Plumbing, heat and air-conditioning installation	0.6	0.3							
46110	Wholesale of agricultural machinery, equipment and supplies	2.2	0.7							100
46210	Wholesale of grain, unmanufactured tobacco, seeds and animal feeds	2.2	0.7							100

SIC	Sector description	Coefficients for Input-Output sectors the activity is within		Estimates from Firm survey for broader industry the activity is within						Other Judge-ment
		Intermediate demand from agriculture as share of total intermediate demand	Intermediate demand from agriculture as % of total output	Number of firms	Employment	Turnover	GVA	Capital expenditure	Exports	
46460	Wholesale of pharmaceutical goods	2.2	0.7							
46610	Wholesale of agricultural machinery, equipment and supplies	2.2	0.7							100
46900	Non-specialised wholesale trade	2.2	0.7							
55209	Other holiday and other collective accommodation	0.3	0							
58290	Other software publishing	0.1	0							
62012	Business and domestic software development	0	0							
62020	Computer consultancy activities	0	0							
62090	Other Information Technology Service Activities	0	0							
70229	Management consultancy activities other than financial management	0	0							
71122	Engineering related scientific and technical testing activities	0.1	0.1							
71129	Other engineering activities	0.1	0.1							
71200	Technical testing and analysis	0.1	0.1							

SIC	Sector description	Coefficients for Input-Output sectors the activity is within		Estimates from Firm survey for broader industry the activity is within						Other Judge-ment
		Intermediate demand from agriculture as share of total intermediate demand	Intermediate demand from agriculture as % of total output	Number of firms	Employment	Turnover	GVA	Capital expenditure	Exports	
72110	Research and experimental development on biotechnology	0.4	0.2	2.4	3.3	6.6	6.6	4.4	7	
72190	Other research and experimental development on natural sciences and engineering	0.4	0.2	12.6	5.2	3.2	3.2	3.4	2	
74901	Environmental consulting activities	0.1	0	9.7	4.3	3.6	3.6	2.2	7	
74909	Other professional, scientific and technical activities	0.1	0	9.7	4.3	3.6	3.6	2.2	7	
75000	Veterinary activities	46	5.8	19.1	7.1	7.8	7.8	9	11.7	

Annex C. Model assumptions

Table C-1: Overview of key assumptions for sub-sector projections

Issue	Assumptions
Farming 1 - agriculture	
'Function'	• All farming/support activities to crop/animal production (equivalent to SIC07 sector 1). • Accounts for 47% of Agri-Tech turnover and 67½% of farming sub-sector turnover
Export market driver	• Growth in global demand for agriculture products (around 2% pa (based on growth in world agriculture output projections from OECD).
Domestic market driver	• UK demand for agriculture products.
Farming 2 - chemicals	
'Function'	• Manufacture of pesticides, agrochemicals and pharmaceutical preparations that are direct inputs to agriculture production • Accounts for 1¼% of Agri-Tech turnover and 1¾% of farming subsector turnover
Export market driver	• Global growth in agriculture production
Domestic market driver	• Growth in UK agriculture production (Farming 1 – agriculture)
Farming 3 - engineering	
'Function'	• Manufacture of agricultural machinery satisfying investment demand from the farming 1 agriculture sector • Accounts for 1¾% of Agri-Tech turnover and 2½% of farming turnover
Export market driver	• Global demand in investment by agriculture sector
Domestic market driver	• Growth in investment by UK agriculture (Farming 1 – agriculture)

Issue	Assumptions
Farming 4 - advisory	
'Function'	• Professional and technical testing (largely engineering/technical testing) – input to production to agriculture • Accounts for <¼% of Agri-Tech turnover and ¼% of farming turnover
Export market driver	• Growth in agriculture production globally
Domestic market driver	• Growth in UK agriculture production (Farming 1 – agriculture)
Farming 5 - other	
'Function'	• Water treatment, wholesale of grain etc., and holiday-lets. • Accounts for 19½% of Agri-Tech turnover and 28% of farming turnover[37]
Export market driver	• Global growth in agriculture production.
Domestic market driver	• Growth in UK agriculture production (Farming 1 – agriculture)
Plant	
'Function'	• Elements of horticulture/propagation, but mainly fertilisers/agro chemicals, with small amount of R&D/testing. As majority (c90%) is agrochemicals, the sub-sector mainly meets the material input needs of plant farming. • Make-up of the sector is similar to a combination of farming sub-sectors 2 and 4: chemicals and advisory • Accounts for 5% of Agri-Tech turnover
Export market driver	• Growth in global production of cereals and oilseeds.
Domestic market driver	• Growth in UK agriculture production (Farming 1 – agriculture).

[37] This is one component where there current estimate for the size of the sector is questioned. In particular, should wholesale activities and holiday lets should be included in Agri-tech, and that that part of demand for water treatment services that is 'agri-tech' should be limited to that part related to clean-up of pre/post crops water.

Issue	Assumptions
Animal	
'Function'	• Support activities for animal production, animal feed other pharmaceuticals and R&D in biotech. Majority is animal feed so this sector serves the farming 1 agriculture sub-sector • Accounts for 10% of Agri-Tech turnover
Export market driver	• Growth in global production of meat.
Domestic market driver	• Growth in UK agriculture production (Farming 1 – agriculture)
Environment & physical	
'Function'	• Elements of support for crops, manufacture of machinery, ICT and technical testing. Bulk of the sector is agricultural machinery (75%) followed by support for crop production/post-harvest activities (20%) • Overall composition is similar to a mixture of farming sub-sectors 3 and 1: engineering and agriculture. The environment & physical sector is driven by demand from these sub-sectors. • Accounts for 1¼% of Agri-Tech turnover
Export market driver	• Growth in agriculture production globally.
Domestic market driver	• Growth in UK agriculture production (Farming 1 – agriculture).
Engineering & precision farming	
'Function'	• Large majority of the sector deals with the wholesale of agricultural machinery (85%). The remainder includes manufacture/repair of machinery and other professional/scientific activities • Accounts for 11¾% of Agri-Tech turnover
Export market driver	• Global demand in investment by agriculture sector.
Domestic market driver	• Growth in investment UK agriculture (Farming 1 – agriculture).

Issue	Assumptions
ICT systems & decision support	
'Function'	• Software publishing, consumer programming and ICT. Facilitates new farming techniques and capital equipment; hence, demand is linked to agriculture investment in new technology. • Accounts for <¼% of Agri-Tech turnover • The UK is seen as a leader in this field. This is taken into account by boosting exports and domestic demand growth by 1pp pa.
Export market driver	• Global demand in investment by agriculture sector.
Domestic market driver	• Growth in investment by UK agriculture (Farming 1 – agriculture).
Advisory services & professional intermediates	
'Function'	• Largely comprised of agricultural agents. Also includes vets and some crop support activities. Domestic agents work on exports, imports and domestic production in agriculture. • Accounts for 1¾% of Agri-Tech turnover
Export market driver	• Growth in agriculture production globally.
Domestic market driver	• Growth in UK agriculture production + imports (Farming 1 – agriculture) as agents is this sector work with local farmers on both their domestic and global transactions.
Infrastructure	
'Function'	• Equipment manufacturing, construction (including related consultancy and water collection. Serves demand from agriculture. • Accounts for ¾% of Agri-Tech turnover
Export market driver	• Global demand in investment by agriculture sector.
Domestic market driver	• Growth in investment by UK agriculture (Farming 1 – agriculture).

Annex D. Model projections

Table D-1: Growth in Value-added in Agri-Tech

	Growth, % pa				
Subsector	2013-17	2017-20	2020-25	2025-30	2013-30
Farming	0.5	0.6	0.5	0.7	0.6
… of which					
….. Agriculture component	0.5	0.5	0.4	0.6	0.5
….. Chemicals component	1.1	2.3	1.9	1.8	1.7
….. Engineering component	1.4	1.1	0.7	0.8	1.0
….. Advisory component	1.2	1.8	1.7	1.7	1.6
….. Other	0.5	0.5	0.4	0.6	0.5
Plants	1.4	1.6	1.5	1.6	1.5
Animal	1.7	1.7	1.6	1.8	1.7
Environment & physical	0.9	1.3	1.2	1.3	1.2
Engineering and precision farming	1.9	1.1	1.3	1.5	1.4
ICT systems and decisions support	2.8	2.1	1.3	1.5	1.8
Advisory services and professional intermediates	1.0	1.0	1.0	1.0	1.0
Infrastructure	1.9	1.1	0.3	0.5	0.9
TOTAL	0.8	0.8	0.7	0.9	0.8

Table D-2: Growth in Employment in Agri-Tech

Subsector	Growth, % pa 2013-17	2017-20	2020-25	2025-30	2013-30
Farming	1.7	-0.2	-0.7	-0.6	0.0
… of which					
….. Agriculture component	1.8	0.2	-0.7	-0.6	0.0
….. Chemicals component	0.0	1.8	1.4	0.6	0.9
….. Engineering component	-0.6	-0.7	-0.8	0.2	-0.4
….. Advisory component	-0.4	-0.4	-0.2	-0.2	-0.3
….. Other	-0.6	-0.4	-0.5	-0.4	-0.5
Plants	0.3	1.2	0.9	0.4	0.7
Animal	0.5	1.2	0.8	1.0	0.9
Environment & physical	0.2	0.4	0.5	1.2	0.6
Engineering and precision farming	0.4	0.0	0.2	0.4	0.3
ICT systems and decisions support	1.5	-0.1	-0.8	-1.0	-0.2
Advisory services and professional intermediates	-0.1	0.6	0.4	0.4	0.3
Infrastructure	0.8	0.2	-0.5	0.0	0.1
TOTAL	1.5	-0.1	-0.5	-0.4	0.1

Table D-3: GVA (£2010m)

	2013	2014	2015	2016	2017	2020	2025	2030

Subsector								
Farming	10249	10409	10460	10479	10465	10645	10889	11252
… of which								
….. Agriculture component	9259	9407	9448	9464	9446	9597	9798	10109
….. Chemicals component	164	164	167	168	171	183	201	219
….. Engineering component	106	108	110	111	112	116	120	125
….. Advisory component	51	52	52	53	53	56	61	67
….. Other	669	679	683	684	682	694	709	732
Plants	755	770	782	790	798	837	901	977
Animal	1112	1139	1159	1175	1187	1249	1351	1477
Environment & physical	194	196	198	200	201	208	221	235
Engineering and precision farming	1083	1123	1142	1161	1168	1208	1286	1383
ICT systems and decisions support	2	2	2	2	2	2	2	2
Advisory services and professional intermediates	532	538	544	550	554	571	599	628
Infrastructure	201	208	211	215	216	224	227	234
TOTAL	14126	14385	14498	14572	14590	14943	15477	16189

Table D-4: Employment (000s)

	000s							
Subsector	2013	2014	2015	2016	2017	2020	2025	2030

Subsector	000s 2013	2014	2015	2016	2017	2020	2025	2030
Farming	478	515	514	514	511	508	491	478
….. Agriculture component	462	499	498	498	495	492	476	462
….. Chemicals component	2	2	2	2	2	2	2	2
….. Engineering component	2	2	2	2	2	2	1	1
….. Advisory component	1	1	1	1	1	1	1	1
….. Other	12	12	12	12	11	11	11	11
Plants	8	9	9	9	9	9	9	9
Animal	21	21	21	21	21	22	23	24
Environment & physical	4	4	4	4	4	4	4	4
Engineering and precision farming	20	20	21	21	21	21	21	21
ICT systems and decisions support	0	0	0	0	0	0	0	0
Advisory services and professional intermediates	8	8	8	8	8	8	8	8
Infrastructure	4	4	4	4	4	4	4	4
TOTAL	542	579	579	579	577	575	560	548

Annex E. Metrics – long-list

Table E-1: Output indicators

Output metric	Theme(s)	Priority/ supplementary	Source(s) and Responsibilities
Number of collaborations between private sector and research base	Agri-Tech Centres for Innovation; Catalyst	Priority	Centres Monitoring data (BIS/individual Centres); Catalyst monitoring (Innovate UK)
Number and value of paid-for research contracts (public and industry)	Agri-Tech Centres for Innovation	Priority	Centres Monitoring data (BIS/individual Centres)
Number of businesses involved in skills activities	Agri-Tech Centres for Innovation	Priority	Centres Monitoring data (BIS/individual Centres)
Number of individuals gaining technical skills	Agri-Tech Centres for Innovation	Priority	Centres Monitoring data (BIS/individual Centres)
R&D spend by private sector (total and into projects with international development focus)	Catalyst; International development	Priority	Catalyst monitoring (Innovate UK)
Number and value of new cross-national collaborations with a focus on international development outcomes	International Development	Supplementary	Monitoring of activities (DFID)
Businesses assisted to export	Internationalisation - Inward Investment and Exports	Priority	Monitoring of activities (UKTI)
Inward investment projects secured (split by type)	Internationalisation - Inward Investment and Exports	Priority	Monitoring of activities (UKTI)
Value of investment (£)	Internationalisation - Inward Investment and Exports	Priority	Monitoring of activities (UKTI)
Media profile/value generated for the Agri-Tech sector by key government and agency	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Priority	Media analytics (Leadership Council/BIS/ Defra)

Output metric	Theme(s)	Priority/ supplementary	Source(s) and Responsibilities
partners and the Leadership Council			
Readership/use/citations of research outputs	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Supplementary	Citation analysis (Leadership Council/BIS/ Defra – potentially incorporated as part of evaluation)
Agri-Tech businesses/ organisations engaged, e.g. through communications	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Priority	Monitoring of activities (Leadership Council/ BIS/Defra)
Number of farmers reached with demonstrations	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Supplementary	Centres Monitoring data (BIS/individual Centres)
Policies engaged/influenced by Leadership Council	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Supplementary	Monitoring of activities (Leadership Council/ BIS/Defra)

Table E-2: Intermediate outcomes

Intermediate outcome metric	Theme(s)	Priority/ supplementary	Source(s) and Responsibilities (note that most will require commissioned surveys or will need to be included as part of evaluation)
No. of new products/services taken to market (in UK; and in developing countries)	Agri-Tech Centres for Innovation; Catalyst; International development	Priority	Centres follow-up surveys (BIS/individual Centres); Catalyst follow-up surveys (Innovate UK)
£ of new turnover for UK Agri-Tech companies (and % that are exports, and % exports to developing countries)	Agri-Tech Centres for Innovation; Catalyst; International Development; Internationalisation	Priority	Centres follow-up surveys (BIS/individual Centres); Catalyst follow-up surveys (Innovate UK); UKTI monitoring (UKTI)
Employment created in UK Agri-Tech companies	Agri-Tech Centres for Innovation; Catalyst; Internationalisation	Priority	Centres follow-up surveys (BIS/individual Centres); Catalyst follow-up surveys (Innovate UK); UKTI monitoring (UKTI)
No. of agriculture businesses taking up new products/processes (UK and overseas)	Agri-Tech Centres for Innovation; Catalyst; International Development	Priority	Centres follow-up surveys (BIS/individual Centres); Catalyst follow-up surveys (Innovate UK)
No. of projects/technologies progressing through TRLs	Catalyst	Supplementary	Catalyst follow-up surveys (Innovate UK)
Number of firms licensing technology	Agri-Tech Centres for Innovation	Supplementary	Centres follow-up surveys (BIS/individual Centres)
Number of patents filed (total and from projects with international development focus)	Agri-Tech Centres for Innovation; Catalyst; Internationalisation	Priority	Centres follow-up surveys (BIS/individual Centres); Catalyst follow-up surveys (Innovate UK)
Inward investment enquiries, conversions (and value) relating specifically to existence of Centres	Agri-Tech Centres for Innovation	Supplementary	Centres follow-up surveys (BIS/individual Centres)
Increase in private sector R&D investment	Agri-Tech Centres for Innovation	Supplementary	Centres follow-up surveys (BIS/individual Centres)

Intermediate outcome metric	Theme(s)	Priority/ supplementary	Source(s) and Responsibilities (note that most will require commissioned surveys or will need to be included as part of evaluation)
Change in skills and attitudes of agricultural businesses for the purposes of adopting innovations	Agri-Tech Centres for Innovation	Supplementary	Centres follow-up surveys (BIS/individual Centres)
Take up of innovations in developing countries – needs to be broadly defined (e.g. irrigation techniques, pest control, crop varieties)	International Development	Supplementary	Primary research (may be resource intensive) (DFID)
Value of exports from developing countries to UK	International Development	Supplementary	Primary research (may be resource intensive) (DFID)
Employment created in developing countries	International Development	Supplementary	Primary research (may be resource intensive) (DFID)
Improved awareness of exporting as a route to growth amongst UK Agri-Tech firms	Internationalisation - Inward Investment and Exports	Supplementary	Primary research (UKTI)
Improved perceptions of UK as a location for investment	Internationalisation - Inward Investment and Exports	Supplementary	Primary research (UKTI)
Number of collaborations between inward investors and research base firms	Internationalisation - Inward Investment and Exports	Supplementary	UKTI monitoring (UKTI)

Intermediate outcome metric	Theme(s)	Priority/ supplementary	Source(s) and Responsibilities (note that most will require commissioned surveys or will need to be included as part of evaluation)
Additional sales (£) of inward investors	Internationalisation - Inward Investment and Exports	Supplementary	UKTI monitoring (UKTI)
Measure of 'sense' of existence of sector	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Supplementary	Survey of Agri-Tech sector (BIS/Defra)[38]
Profile of the UK Agri-Tech sector within the UK and externally	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Priority	Survey of Agri-Tech sector (BIS/Defra)[39]
Measure of networking within the sector	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Priority	Survey of Agri-Tech sector (BIS/Defra)[40]
£ funding for on-farm demonstrations influenced	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Priority	Tracking funding influence (BIS/Defra/ Leadership Council)
£ R&D and innovation funding influenced	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Priority	Tracking funding influence (BIS/Defra/ Leadership Council)
£ RDPE funding influenced	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Priority	Tracking funding influence (BIS/Defra/ Leadership Council)

[38] Baseline survey question asked as follows: "I am now going to read out some statements about agri-tech. For each please tell me the extent to which you agree or disagree. It does not matter if you do not know for sure, we are just interested in your general impressions." Statement read out as follows: "Agri-tech comprises related businesses forming a sector in its own right".

[39] Baseline survey question asked as follows: "I am now going to read out some statements about agri-tech. For each please tell me the extent to which you agree or disagree. It does not matter if you do not know for sure, we are just interested in your general impressions." Statements read out as follows: "Agri-tech is dynamic, with good long-term prospects"; "Agri-tech in the UK has an international profile"; and "The UK is seen as a first choice for inward investment in agri-tech by foreign firms".

[40] Baseline survey question asked as follows: "Have you done any of the following in the last 12 months?" Options: "Participated in any events organised by industry association or similar bodies"; "Worked with customers or suppliers to develop new products/services"; "Collaborated with competitors to develop new products/services"; and "Sponsored development work at a university or research institute"; "None of these"; and "Don't know".

Intermediate outcome metric	Theme(s)	Priority/ supplementary	Source(s) and Responsibilities (note that most will require commissioned surveys or will need to be included as part of evaluation)
£ Skills investment (public and private) influenced	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Priority	Tracking funding influence (BIS/Defra/ Leadership Council)
Influence of HEIs with respect to courses/course provision	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy; Agri-Tech Centres for Innovation	Priority	Tracking policy influence (BIS/Defra/ Leadership Council)

Table E-3: Final outcomes

Final outcome metric	Theme(s)	Priority/ supplementary	Source(s) and Responsibilities
Impact on exports of Agri-Tech sector	Agri-Tech Centres for Innovation; Catalyst; Internationalisation	Priority	Estimate of exports generated (under intermediate outcomes) versus change in overall exports based on survey of Agri-Tech sector (separate responsibilities for BIS/Individual Centres; Innovate UK; UKTI – for all this will require evaluation)
GVA effects through businesses engaged	Agri-Tech Centres for Innovation; Catalyst; Internationalisation	Priority	Derived from intermediate outcomes; and can be scaled to overall sector size derived from Survey of Agri-Tech sector (separate responsibilities for BIS/Individual Centres; Innovate UK; UKTI – for all this will require evaluation)
Overall size of the sector in the UK (employment & number of firms)	Agri-Tech Centres for Innovation; Catalyst; Internationalisation; Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Priority	Survey of Agri-Tech sector (BIS/Defra – through sector tracking survey)
Impact on inputs used (i.e. water, fertiliser, pesticides, fuel, animal feed etc.)	Agri-Tech Centres for Innovation; Catalyst	Supplementary	Primary research – based on outcomes of investments/activities (separate responsibilities for BIS/Individual Centres; Innovate UK – for both this will require evaluation)
Impact on inward investment (£ and jobs)	Agri-Tech Centres for Innovation; Internationalisation	Supplementary	Estimate of value generated (under intermediate outcomes) versus change in overall levels (drawn from surveys of inward investment) (separate responsibilities for BIS/Individual Centres; UKTI – for both this will require evaluation)

Final outcome metric	Theme(s)	Priority/ supplementary	Source(s) and Responsibilities
Contribution to international development. Metrics might be: household income; consumption of calorie, protein and micronutrient rich food; prevalence of stunting and underweight amongst under 5s	International Development (incl. through Catalyst projects and Internationalisation)	Priority (though metrics/focus will need to be determined)	Primary research (if resources to deliver through DFID)
Price and availability of crops in target countries	International Development (incl. through Catalyst projects)	Supplementary	Primary research and estimation of effects (if resources to delivery through DFID)
Attitudes towards quality/productivity amongst Agri-Tech businesses	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Priority	Survey of Agri-Tech sector to measure change in conditions (BIS/Defra – through sector tracking survey)[41]
% of businesses in the agriculture sector using new products/processes	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Supplementary	Draw on Defra's Agriculture in the UK survey to measure change in conditions (BIS/Defra/ Leadership Council)
Impact on productivity - Total Factor Productivity, Labour Productivity yields	Catalyst, Centres (+ Internationalisation subject to resources available)	Priority	Draw on existing sector-wide data Farm level-survey data in relation to evaluation of specific activities (Separate responsibilities for BIS/Individual Centres; Innovate UK; UKTI – for all this will require evaluation)
Productivity of agriculture sector (broken down by crop and livestock)	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Supplementary	Draw on Defra's Agriculture in the UK survey to measure change in conditions (BIS/Defra/ Leadership Council)

[41] Baseline survey asked two related questions of non-agricultural sector respondents: "For sales to the agricultural sector, do you compete mainly on the basis of price, or mainly on the basis of quality?" with options for "Mainly quality", "Mainly price", "Balance between price and quality", and "Other"; "Are you currently seeking to change this, e.g. by moving more towards lower price or higher quality?" with options for "Yes – moving towards lower price", "Yes – moving towards higher quality", "No – not seeking to change", "Don't know" and "Refused".

Final outcome metric	Theme(s)	Priority/ supplementary	Source(s) and Responsibilities
Impact on environmental indicators - energy use, (greenhouse gas (GHG) emissions, nitrogen inputs (both total amounts associated with the sector and per unit of output), nutrients balance	Centres, Catalyst (+ Internationalisation subject to resources available)	Priority	Draw on existing sector-wide data Farm level-survey data in relation to evaluation of specific activities (Separate responsibilities for BIS/Individual Centres; Innovate UK; UKTI – for all this will require evaluation)
£ investment in capital by UK Agri-Tech businesses	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Priority	Survey of Agri-Tech sector to measure change in conditions (BIS/Defra – through sector tracking survey)
£ investment in skills per employer	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Priority	Employer Skills Survey to measure change in conditions (BIS/Defra/ Leadership Council)
Inward investment in Agri-Tech	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Priority	Primary research – added influence of Leadership Council (BIS/Defra/ Leadership Council)
Status as a highly attractive place for investment	Internationalisation - Inward Investment and Exports; Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Supplementary	Primary research (BIS/Defra/Leadership Council)
% employers reporting skills gaps and skills shortages in i) agriculture sector and ii) Agri-Tech research businesses	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Supplementary	Employer Skills Survey to measure change in conditions (BIS/Defra/ Leadership Council)
No./% graduate level jobs in Agri-Tech sector	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Priority	Survey of Agri-Tech sector or SIC/SOC analysis (BIS/Defra/ Leadership Council)
Wages in Agri-Tech sector	Leadership, Influencing and Coordination Actions of the Agri-Tech Strategy	Priority	Survey of Agri-Tech sector (BIS/Defra/ Leadership Council)

Annex F. Evaluating the Catalyst Intervention details

Brief description

Proof of concept fund (c. £70m public inputs and c. £30m industry match) for 3 types of project: early stage feasibility, industrial research awards and late stage awards/commercial assessments. Fund to operate between 2014 and 2017.

Treatment group

Expected that there will be 100+ projects, so anticipate a treatment group of 200+ companies (SMEs and larger companies eligible) – working with research organisations (projects have to be collaborative, with R1 awards including many with several partners).

Outputs

Main outputs will include: R&D spend by private sector (and subsequent investment), new patents filed, new collaborations between industry and research base, new commercial applications. The delivery of these will vary depending on the award – some projects are 12 month duration, so first outputs could be delivered by end of 2015; others can be 3 year projects so potential for outputs to be delivered nearer to 2020.

Intermediate outcomes

Main outcomes will include: new products taken to market; take-up of new products (including to support international development) – leading to potential turnover benefits. For later stage awards this could be within c. 3 years; though for earlier stage and longer R&D projects, these may be in 2020s.

Final outcomes

Main final outcomes: GVA (through business performance); productivity (for agricultural businesses taking up products); environmental benefits (resulting from take-up); international development objectives (resulting from take-up). Some may be by 2020 (for later stage awards), others into the 2020s.

F.1. Impact evaluation design options

What options exist for assessing the counterfactual? Consider: formal experiments; any discontinuities that could be used e.g. eligibility, spatial, application processes; other comparison groups.

- Note: Randomised Control Trial (RCT) not possible given the scheme is already underway, and no discontinuity can be exploited for a Regression Discontinuity Design.

	Option 1	Option 2	Option 3
Counterfactual option	Unsuccessful applicants	Matched sample of similar companies drawn from business population	Matched sample of agricultural businesses not taking up products – to cover outcomes on indirect beneficiaries
Scale & nature of counterfactual group	Uncertain – Rounds are receiving 100+ applicants, with R1 making 26 awards. On this basis, might expect a good number for a comparison group	Depends on ability to generate a matched sample from secondary datasets – potentially a large company register to draw on	Depends on ability to collect comprehensive data on beneficiary group, and then generate a matched sample from secondary datasets, e.g. using Agriculture in the UK survey
Potential bias/ weakness	Unsuccessful applicants may be successful in subsequent rounds; would expect unsuccessful applicants to be of less good quality given that they are rejected; likely to be high degree of specificity on projects	Limited variables with which to generate an appropriate match (e.g. in terms of firms operating in similar markets, at similar technology levels)	Issues likely to be in identifying relevant groups given that these are indirect participants In addition, other key issue is ensuring match in terms of attitudes/ behaviours re improving productivity, environment etc. Can only reasonably cover UK effects
Means of minimising bias/ weakness	Can potentially filter out those successful later (though only when all funding awarded) Can seek to include only those unsuccessful of 'better quality', i.e. closest to being funded	Use datasets such as Community Innovation Survey to improve match, or include screening questions (though comes at cost)	Use indicators from Agriculture in the UK survey
Data availability on outputs/outcomes, incl. timing	Would need to track a comparison group over similar timeframe to beneficiary group to gather data on whether projects go ahead anyway, what else they do instead, alternative R&D spend, patents, business performance etc. (e.g. through a survey)	As per option 1, need to track through a survey. Would expect response rate to be smaller (given need for screening and the fact that calls will be 'cold' with no named contact)	Potential to track through indicators in Agriculture in the UK survey, and could explore adding questions to this to minimise costs
Data availability on other variables affecting outputs/ outcomes, incl. timing	Could be collected through the survey mentioned above	Could be collected through the survey	Use of existing survey

	Option 1	Option 2	Option 3
Additional data requirements	If possible, 'scores' on applications	None	Will need to add questions to existing survey
Analytical requirements	Econometric/statistical analysis to compare differences in outcomes	Econometric/statistical analysis to compare differences in outcomes	Econometric/statistical analysis to compare differences in outcomes
Overall assessment	Surveys of two groups with at least two data collection points along with design, analysis and reporting. Likely issues on match and sample sizes making statistical/ econometric analysis challenging	Data matching using secondary datasets, surveys of two groups with screening, along with design, analysis and reporting. Likely issues on match, and feasibility issues regarding data collection – making statistical/econometric analysis challenging	Data matching using secondary datasets, supplementary questions, along with design, analysis and reporting.. Builds on existing survey, but likely to be issues on coverage due to reliance on data collection on indirect beneficiaries

F.2. Alternative evaluation of impact

What other options should be considered for outcome/impact evaluation? (In particular if counterfactual evaluation is likely to be challenging or not feasible, but also to help add to the evidence base).

	Option 1	Option 2
Method adopted to test outcomes/ impact	Surveys and case studies with participating companies	Surveys/consultations and case studies with participating research partners
Potential bias/weakness	Reliant on self-reported effects	Reliant on self-reported effects
Means of minimising bias/weakness	Evaluation would need to test competing hypotheses on how outcomes might have occurred otherwise	Evaluation would need to test competing hypotheses on how outcomes might have occurred otherwise
Data availability on outputs/outcomes, incl. timing	Would need to be tracked through a survey over period of time (likely to be 3+ years)	Could be done ex post through surveys/consultations, or to improve assessment through two waves (i.e. early effects, later effects)
Data availability on other variables affecting outputs/ outcomes, incl. timing	Collected through surveys; and also discussions with experts, non-participating firms	Through surveys/consultations
Additional data requirements	None	None

	Option 1	Option 2
Analytical requirements	Quantitative analysis Potential triangulation of findings between methods or between theories	Likely to be mainly qualitative analysis
Overall assessment	At least two rounds of surveys, along with design, analysis and reporting. Case studies would depend on the number of rounds and level of detail. 10 detailed case studies over 2 rounds. This option could also be used alongside Option 1 or 2 from table above – esp. given feasibility issues/ weaknesses identified above.	One/two rounds of fieldwork along with design, analysis and reporting. Option could complement other options.

F.3. Process and other evaluation

What other evaluation approaches could be adopted to answer key evaluative questions?

Evaluative question	Evaluation option	Pros	Cons	Overall assessment
Application process and customer journey, including fit with wider landscape of support	Document review, survey questions for applicants, process consultations	Can be done fairly comprehensively, and complementing other methods Can provide early evidence on progress of the process	None	Likely to be a useful first exercise
Links to other aspects of Agri-Tech Strategy	Stakeholder consultations – alongside any relevant feedback from businesses and research base partners	Can provide early evidence on fit within wider Strategy	Reliant on perceptions to some extent, and may be limited by bounded rationality of interviewees	Relatively low cost
Routes to international development (see also separate note for more bespoke evaluation of progress on international development objectives)	Case studies/in-depth interviews on projects with this focus	Potential to provide detailed feedback on small numbers of cases	Not necessarily representative of wider project set	Would provide evidence on individual cases alongside more representative feedback under other options above
Any transformative projects	Case studies/in-depth interviews on particular	Potential to provide detailed feedback on small	Not necessarily representative of wider project set	Would provide evidence on individual cases

Evaluative question	Evaluation option	Pros	Cons	Overall assessment
	projects	numbers of cases		alongside more representative feedback under other options above
Improvements to business-research collaboration generally	Case studies or in-depth consultations with businesses and research partners	Potential to cover small number of cases, but also identify issues more generally and how they have been/could be addressed	Not entirely representative, though could be designed to identify findings with some generalizability about barriers and enablers	Would provide useful learning

Annex G. Evaluation options for Agri-Tech Centres

Brief description

Joint public-private funding for consortia of HEIs/PSREs/RTOs to establish Centres to provide collaborative and contract research to businesses. Up to six centres envisaged; first in informatics, other areas to be decided

Treatment group

Businesses and farmers. Sectors to be decided.

Outputs

Information (form Informatics Centre)

More generally:

- Research
- Training

Intermediate outcomes

Additional private sector investment in R&D

IP outcomes, e.g. new patents filed, firms licensing technology

Improved access to (and in turn increased use of) data and knowledge

New products successfully taken to market (with associated turnover effects)

Creation of new partnerships and building of stronger links between industry, Government and the science base

More businesses become engaged with the research base and/or extent of engagement increases

Amongst agricultural businesses, the attitudes towards innovations change, and skills to implement them improve … leading to…

Take-up of new technological products and processes by agriculture sector in the UK and overseas

Inward investment attracted to the UK as international companies want to be proximate to expertise within Centres

Final outcomes

GVA of Agri-Tech sector businesses

On-going industry investment in Centres for Agricultural Innovation

Productivity gains in agriculture sector in the UK

More environmentally sustainable agriculture in the UK

Contribution to increased exports of Agri-Tech sector

Improve competitive position of UK Agri-Tech, resulting in inward investment

G.1. Intervention details

G.2. Impact evaluation design options

What options exist for assessing the counterfactual? Consider: formal experiments; any discontinuities that could be used e.g. eligibility, spatial, application processes; other comparison groups.

- Note: RCT not possible s, and no discontinuity can be exploited for a Regression Discontinuity Design.

	Option 1	Option 2 (combined with 1)	Option 3
Counterfactual option	Unsuccessful applicants to become Centre	Companies which do not engage	Centres abroad
Scale & nature of counterfactual group	N/K	N/K	N/K
Potential bias/ weakness	Constrained because of funding to centres and may reduce relevant activity	Failure to engage likely to reflect fundamental differences in companies	Context too different for comparisons
Means of minimising bias/ weakness	Interviews to explore response	Analyse engagement	
Data availability on outputs/outcomes, incl. timing	Self-reported	Dependent on identifying relevant firms	
Data availability on other variables affecting outputs/ outcomes, incl. timing	Self-reported	Self-reported	
Additional data requirements	None	None	
Analytical requirements	Consider econometric/statistical analysis to compare differences in outcomes but sample size may be too small	Consider econometric/statistical analysis to compare differences in outcomes but sample size may be too small	

G.2.1. Alternative evaluation of impact

What other options should be considered for outcome/impact evaluation? (In particular if counterfactual evaluation is likely to be challenging or not feasible, but also to help add to the evidence base).

	Option 1	Option 2	Option 3	Option 4
Method adopted to test outcomes/ impact	Surveys and case studies with consortia members	Surveys and case studies with participating companies	Interviews stake holders	Interviews inward investors
Potential bias/weakness	Reliant on self-reported effects	Reliant on self-reported effects	Reliant on self-reported effects	Reliant on self-reported effects
Means of minimising bias/weakness	Evaluation would need to test competing hypotheses on how outcomes might have occurred otherwise	Evaluation would need to test competing hypotheses on how outcomes might have occurred otherwise	Evaluation would need to test competing hypotheses on how outcomes might have occurred otherwise	Evaluation would need to test competing hypotheses on how outcomes might have occurred otherwise
Data availability on outputs/outcomes, incl. timing	Would need to be tracked through a survey over period of time (likely to be 2+ years)	Would need to be tracked through a survey over period of time (likely to be 3+ years)	One off survey	One off survey
Data availability on other variables affecting outputs/ outcomes, incl. timing	Collected through surveys; and also discussions with experts, non-participating firms	Through surveys/consultations	Through consultations	Through consultations
Additional data requirements	None	None	None	None
Analytical requirements	Qualitative analysis Potential triangulation of findings between methods or between theories	Likely to be mainly qualitative analysis	Likely to be mainly qualitative analysis	Likely to be mainly qualitative analysis

G.3. Process and other evaluation

What other evaluation approaches could be adopted to answer key evaluative questions?

Evaluative question	Evaluation option	Pros	Cons	Overall assessment
Application process and customer journey, including fit with wider landscape of support	Document review, survey questions for applicants, process consultations	Can be done fairly comprehensively, and complementing other methods Can provide early evidence on progress of the process	None	Likely to be a useful first exercise
Links to other aspects of Agri-Tech Strategy	Stakeholder consultations – alongside any relevant feedback from businesses and research base partners	Can provide early evidence on fit within wider Strategy	Reliant on perceptions to some extent, and may be limited by bounded rationality of interviewees	Relatively low cost
Routes to international development (see also separate note for more bespoke evaluation of progress on international development objectives)	Case studies/in-depth interviews on projects with this focus	Potential to provide detailed feedback on small numbers of cases	Not necessarily representative of wider project set	Would provide evidence on individual cases alongside more representative feedback under other options above
Any transformative projects	Case studies/in-depth interviews on particular projects	Potential to provide detailed feedback on small numbers of cases	Not necessarily representative of wider project set	Would provide evidence on individual cases alongside more representative feedback under other options above
Improvements to business-research collaboration generally	Case studies or in-depth consultations with businesses and research partners	Potential to cover small number of cases, but also identify issues more generally and how they have been/could be addressed	Not entirely representative, though could be designed to identify findings with some generalizability about barriers and enablers	Would provide useful learning.

Annex H. Evaluation options for Internationalisation actions

Brief description

Inward investment: support to potential inward investors in the Agri-Tech sector on market opportunities and setting up in the UK, including on location, tax and legal issues, and recruitment.

Exports: support to UK Agri-Tech firms to identify market opportunities and undertake export activity.

Also includes work of the Agri-Tech Business Ambassador leading trade missions and events.

Treatment group

Inward investment: target of C. 30 inward investors supported so anticipate a treatment group of around 30 firms for inward investment strand.

Exports: uncertain, to be confirmed

Outputs

Main outputs will include: for inward investment number of investment projects secured (new investment, expansions, mergers and acquisitions), and value of inward investment; for exports number of businesses assisted to export. Delivery is up and running, so outputs should be generated in the next 12 months as projects are secured and exporting activity commences.

Intermediate outcomes

Main outcomes will include: for inward investment the key quantitative outcomes will be jobs created/safeguarded and additional sales (of inward investors in UK); for exports, the key quantitative outcomes will be additional sales (through exports). Outcomes may be delivered within a year of inward investment/exporting outputs although for some they may take longer to flow through.

Final outcomes

Main final outcomes: GVA (through additional sales from inward investors and exporters), increased inward investment in Agri-Tech sector, increased exports of Agri-Tech sector, and contribution to international development objectives (through exports). Final outcomes to be realised by 2020.

H.1. Intervention details

H.2. Impact evaluation design options

What options exist for assessing the counterfactual? Consider: formal experiments; any discontinuities that could be used e.g. eligibility, spatial, application processes; other comparison groups.

- Note: RCT not possible given the scheme is already underway, and no clear discontinuity can be exploited for a Regression Discontinuity Design given informal application process and nature of support provided.

- Note; options focus on the **exports strand only** – given the expected scale and nature of the treatment group (i.e. overseas firms) of the inward investment strand, experimental/quasi-experimental evaluation options not considered viable. Potential assessment of impact for inward investment considered in 'Alternative evaluation of impact' section below.

	Option 1	Option 2	Option 3
Counterfactual option	Non-supported firms; firms that make an initial approach to UKTI but do not subsequently receive support	Matched sample of similar Agri-Tech companies drawn from business population (non-exporters)	Comparison group of known non-exporters in the Agri-Tech sector that have not received support from UKTI
Scale & nature of counterfactual group	Uncertain, reliant on both demand and capacity of UKTI to support firms	Depends on ability to generate a matched sample from commercially available secondary datasets – potentially a large company register to draw on	Uncertain, firms would be identified through the business survey for this scoping/baseline study and/or PIMS research with non-supported firms in the Agri-Tech sector, although a top-up screen survey may be required
Potential bias/ weakness	Comparison group firms may seek support from UKTI in the future (once export potential further developed), may receive support from non Agri-Tech UKTI services, and would expect that firms that did not receive support are less export-ready or viable compared to supported firms	Limited variables with which to generate an appropriate match based on business performance metrics only, not including experience, skills, ambition etc. May require as screening survey to identify if firms are considering exporting	Selection bias, as firms that are not seeking support may be less sophisticated than those seeking support
Means of minimising bias/ weakness	Include only those firms that were viable propositions, but did not receive support owing to capacity at UKTI and/or business decisions; UKTI monitoring data to ensure no firms included that receive other support from UKTI	Include screening questions on export ambition and skills; matching of comparisons group based on characteristics from treatment group (employment, location, sub-sector etc.).	As per option 2

	Option 1	Option 2	Option 3
Data availability on outputs/outcomes, incl. timing	Would need to track a comparison group over similar timeframe to beneficiary group to gather data on whether exporting is undertaken, the results of export activity, and wider business performance metrics (e.g. through a survey)	As per option 1, need to track through a survey. Would expect response rate to be smaller (given need for screening and the fact that calls will be 'cold' with no named contact)	Would require surveys of both supported firms and comparison group of existing exporters
Data availability on other variables affecting outputs/ outcomes, incl. timing	Could be collected through the survey mentioned above	Could be collected through the survey	Could be collected through the survey
Additional data requirements	Any evidence collated on business performance export potential, and export experience/skills of business leaders on initial contact	As per option 1 UKTI monitoring data to ensure comparison group firms have not received support historically	As per option 2
Analytical requirements	Econometric/statistical analysis to compare differences in outcomes; would need up to three (ideally five) years post-support/non-support to provide robust data on outcomes	As per option 1	As per option 1
Overall assessment	Likely issues on match and sample sizes making statistical/ econometric analysis challenging	Likely issues on match, and feasibility issues regarding data collection – making statistical/econometric analysis challenging	Potential to utilise existing evidence in order to develop comparison group to maximise value for money

H.2.1 Alternative evaluation of impact

What other options should be considered for outcome/impact evaluation? (In particular if counterfactual evaluation is likely to be challenging or not feasible, but also to help add to the evidence base).

	Option 1	Option 2	Option 3
Method adopted to test outcomes/ impact	Surveys and case studies with participating companies – exports	Surveys and case studies with participating and non-participating companies (and potentially others in the supply-chain) – inward investment	Research on effects of the Business Ambassador through surveys and consultations with participants
Potential bias/weakness	Reliant on self-reported effects for participating companies	Reliant on self-reported effects for participating companies, with additional evidence potentially from inward investors in the Agri-Tech sector that did not received support from UKTI	Reliant on self-reported effects for participating companies or organisations Time-paths to impact and level of attribution to the event likely to reduce potential for robust assessment
Means of minimising bias/weakness	Evaluation would need to test competing hypotheses on how outcomes might have occurred otherwise	Evaluation would need to test competing hypotheses on how outcomes might have occurred otherwise	Evaluation could include repeat surveys at intervals to allow time for effects to be realised
Data availability on outputs/outcomes, incl. timing	Would need to be tracked through a survey over period of time (likely to be 3+ years)	Could be done ex post through surveys/consultations, or to improve assessment through two waves (i.e. early effects, later effects)	Would need to include post-event surveys, potentially in the short term (i.e. post event), and at an agreed later period for those firms/organisations where potential effects identified (e.g. 2/3 years)
Data availability on other variables affecting outputs/ outcomes, incl. timing	Collected through surveys/consultations	Through surveys/consultations, and also with those UK organisations impacted potentially by the inward investor e.g. supply-chain, competitors, research organisations	Collected through surveys/consultations
Additional data requirements	None	None	Data on any deals/agreements secured following Business Ambassador events/activities

	Option 1	Option 2	Option 3
Analytical requirements	Quantitative analysis Potential triangulation of findings between methods or between theories	Likely to be mainly qualitative analysis, although potential or some modelling of spill-over effects based on evidence from related organisations may be possible	Qualitative analysis focused on perceptions and any self-reported outcomes
Overall assessment	This option could also be used alongside Option 1 or 2 from table above – esp. given feasibility issues/ weaknesses identified above.	Option could complement other options.	Surveys with participating firms/agencies in a number of locations where Business Ambassador activity has been delivered. depending on number of locations and sample sizes required - Option would complement other options.

H.3. Process and other evaluation

What other evaluation approaches could be adopted to answer key evaluative questions?

Evaluative question	Evaluation option	Pros	Cons	Overall assessment
Links to other aspects of Agri-Tech Strategy	Stakeholder consultations – alongside any relevant feedback from businesses	Can provide early evidence on fit within wider Strategy	Reliant on perceptions to some extent, and may be limited by bounded rationality of interviewees	Relatively low cost
Case studies of major inward investment 'successes'	Case studies/in-depth interviews on particular projects	Potential to provide detailed information on large individual cases with potential significant economic effects	Would not be representative of the full treatment group	Would provide evidence on individual cases alongside more representative feedback under other options above
Effects of the Strategy on UKTI strategy and activity	Consultations with UKTI senior management and delivery staff in other sectors, including proximate sectors	Understand extent of influence of Strategy on wider UKTI activities and linkages to other sectors	May be challenging to understand levels of influence on other activities	Would provide evidence on context for Agri-Tech and effects on UKTI. Limited costs

Evaluative question	Evaluation option	Pros	Cons	Overall assessment
Markets where investment and export activity respectively been successful, and why	Consultations with in-market contacts, case studies on investors from/exported to specific locations	Provide evidence on key areas of growth and/or potential	Would not be representative of the full treatment group	Would provide broader evidence on international effects

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Department for Business, Innovation and Skills
1 Victoria Street
London SW1H 0ET
Tel: 020 7215 5000
Email: enquiries@bis.gsi.gov.uk

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