State-of-Play Reference Document for Land Use Transformations Project JHI-C3-1

Please cite as: Keith Matthews, Kirsty Blackstock, Dave Miller, Douglas Wardell-Johnson, Gianna Gandossi, Lee-Ann Sutherland, Alba Juarez-Bourke, Rachel Creaney, Stanislav Martinat, Hebe Nicholson, Alessandro Gimona, Marie Castellazzi, Bethany Wilkins, Matt Aitkenhead, Malcolm Coull, Thomas Parker, Mike Rivington, Emmanuel Udugbezi. (2022) *State-of-Play Reference Document for Land Use Transformations Project (JHI-C3-1)*, Project Milestone Report Milestone 10, pp21.

The James Hutton Institute is supported by the Scottish Government's Rural and Environment Science and Analytical Services Division (RESAS). Research funded through grant JHI-C3-1 and previous Strategic Research Programmes.

Contents

Exec Summary

This is the *State of Play Reference Document* for the *Land Use Transformations* project (C3-JHI-1). This is an output of the start-up process for the project (April to June 2022) and presents a high-level summary accessible to "beyond-research" audiences. The start-up process was a series of project-level workshops (see Section 2) building on off-line data collation tasks.

The objective of the start-up process was to kick-start interdisciplinary working. Since the Project has ambitions to exploit closer integration, team building, familiarisation with others' work and shared terminology is essential. A key element of the start-up phase was to look at the Quantitative Story Telling (QST) process for science-policy engagement (see Figure 3 in Appendix 1). QST combines the strengths of qualitative research methods (looking at how issues are framed and interpreted) with quantitative empirical or model-based analysis (typically assessing the consequences of policy options) and doing this in direct cooperation with policy analysts and officials.

Internally, the document is part of the baseline for the monitoring and evaluation tasks. The document will also have potential value for collaborators in other SRP and related projects to communicate how the Land Use Transformation project is thinking of tackling the research questions posed.

Externally the document can serve those with interest in the thinking behind the research, and in defining the capability and capacity of the research team. The document can also serve to stimulate thinking on the kinds of policy relevant and policy-led questions that can be addressed via the QST phases of the project.

The outputs from the start-up process (QST0) are a Glossary, Conceptual Framing, Capability Statement, Data Catalogue, Scope and Focus Summary and SWOT Analysis, each summarised below.

Glossary - It has long been recognised that a shared language is key part of interdisciplinary team building. As part of QST0 a list of key terms (and acronyms) was generated and definitions derived for the most significant, with the intent that the others will be completed over time and new terms added as they become significant. See Section 3.1.

Conceptual Framing - Beyond sharing the background framings used by the teams, the start-up process also sought to generate a more concrete shared conceptual framing for research on Land Use Transformations to identify how the elements of the research may fit together to address higher level policy questions. This framing drawing on land use systems, societal metabolism and multi-level governance is presented in Section 3.2.

Capability Statement - The Project has a broad range of skills available across natural, social and computational sciences. All teams are experienced in interdisciplinary working. For transdisciplinary (science-policy) working there is both theoretical and practical experience with SG analysis and policy teams. A review of capability against Conceptual Framing highlighted relative strengths and priority opportunities for cooperation with other SRP projects. See Section 3.3.

Data Catalogue - A catalogue of the datasets created, or used, by the teams was compiled (n=131). This was motivated by the intuition that existing data holdings could be more fully exploited across the teams and that new options for data integration would be stimulated by greater awareness of the data "in hand". The catalogue codified source, topic, coverage, granularity, data and empirical or model based. See Section 3.4.

Model Base – The creation of new computer-based models is not the main focus of the research in the project with a preference for a focus on their application or improvement through making better quality data available to use in them. Key opportunities are including farm structure data into land use change models, including adaptation issues within assessments of mitigation measures, needs and effectiveness assessments, and linkage with Agent Based Modelling in Large Scale Modelling (C5-JHI-1).

Scope and Focus Summary

The ambition for the Project remains to keep the scope broad, focusing on how the elements fit together, rather than narrowing to "know more and more about less and less". Key issues to be clarified include what "land use (transformation)" is interpreted as meaning (and for who), what the key overarching or "parent" policies are, and how does post-CAP agriculture support fit with these. The latter links into the wider consideration of policy coherence – vertically between objectives, measures, and implementation, and horizontally between policy domains. See Section 3.6.

SWOT – gathers together some of the key elements above, with the SWOT categories helping to shape actions, maximise benefits or to mitigate risks.

Strengths – are in the experience of the teams in the research domains but also in interdisciplinary and science-for-policy working. Better exploiting the existing strength in spatial datasets across the research teams is a key priority.

Weaknesses – in capacity and experience have been anticipated and can be mitigated by clear project focus and the staff commitment to step into the QST methods. The issues of key data gaps in spatially explicit land management may be addressable by initiatives by SG Census and RPID (in discussion).

Opportunities – include greater potential for more transformative policy measures and similar commitments to policy focused research in other SRP Topics/Projects so there is greater scope for cooperation in delivering policy-led analysis.

Threats – the key threat to achieving impact is when policy and research timelines cannot be aligned. This can be mitigated by anticipation by researchers and being more proactive in reaching out to policy teams at the earliest opportunity and by policy teams investing time in co-construction.

Next Steps - Other WP formal start-ups are scheduled in Q2 and Q3 2022, Adaptation (WP3.1), Mitigation WP3.3), and Governance and Land Use Narratives (WP3.4). The first cycle of QST (till March 2023) is being scoped with the aspiration that it can complement analysis being undertaken in the Economic Advice & Related Services to Support Development of a New Rural Support Scheme for Scotland (RESAS/005/21).

1 Introduction

1.1 What is this document?

This is the *State of Play Reference Document* for the *Land Use Transformations* project (C3-JHI-1). This is an output of the start-up process for the project (in first three months – April to June 2022). The document links together a series of other documents created (both formal and informal) and presents a high-level summary accessible to "beyond-research" audiences.

1.2 Objectives and Outputs

The key objective of the start-up process was to kick-start interdisciplinary working. The project is being delivered by a core of experienced team leads and staff but for many this is the first SRP project. Several teams have collaborated previously but again not necessarily in the SRP. The teams encompass a wider range of disciplinary expertise than in the antecedent project in the previous SRPs so since the Project has ambitions to exploit closer integration, then team building, familiarisation with others work and shared terminology is essential. The start-up process also gave the team a chance to review the project description. Beyond clarification no substantive changes were proposed.

A key element of the start-up phase was to look at the Quantitative Story Telling (QST) process for science-policy engagement (see Figure 3 in Appendix 1). QST combines the strengths of qualitative research methods (looking at how issues are framed and interpreted) with quantitative empirical or model-based analysis (typically assessing the consequences of policy options) and doing this in direct cooperation with policy analysts and officials.

The Outputs of the start-up process are a series of documents summarised by this State of Play Reference that will serve as baseline for later evaluations of research progress and impact. The specific outputs are presented in Section 3 (below). Some of these are living documents (noted in the text) with the expectation that they will continue to be developed over the course of the Project.

1.3 Audiences

Who might use the document?

Externally the document can serve those with interest in the thinking behind the research, and in defining the capability and capacity of the research team. The document can also serve to stimulate thinking on the kinds of policy relevant and policy-led questions that can be addressed via QST parts of the project.

Internally, as noted above this is part of monitoring and evaluation, but the document also has value for orientation of new staff that can be expected to join the project over the course of a five-year project. The document will also have potential value for collaborators in other SRP and related projects to communicate how the Land Use Transformation project is thinking of tackling the research questions posed.

1.4 Next steps

Other WP formal start-ups are scheduled in Q2 and Q3 2022, Adaptation (WP3.1), Mitigation WP3.3), and Governance and Land Use Narratives (WP3.4). Informal work preparing for these WPs has been ongoing since start of project e.g., on data sharing between teams and on key ideas. The first cycle of QST (till March 2023) is being scoped with the aspiration that it can complement analysis being undertaken in the Economic Advice & Related Services to Support Development of a New Rural Support Scheme for Scotland (RESAS/005/21). There will also be periodic review and refresh of "living" documents to chart progress, conceptual and practice change.

2 Process

The start-up process (referred to here as QST0) is detailed in in Figure 4 in Appendix 1. There was a series of workshop meetings – pre-kick-off (14 March 2022), project kick-off (18 April 2022), QST0.1 (12 May 2022), QST0.2 (2 June 2022). All conducted as virtual meetings via WebEx. A mix of plenary discussion and small group working breakouts (mixing teams) was used. Data from the workshops was captured via working texts, recordings, chat notes, annotated meeting notes. Materials were also sought from teams before meetings and in follow up actions e.g., on glossary entries and the data catalogue. Materials are summarised as the State of Play Reference (this document). All the materials are also saved for use in the project monitoring and evaluation processes (in WP4).

3 Outputs

The outputs from the QST0 process are a Glossary, Conceptual Framing, Capability Statement, Data Catalogue, Scope and Focus Summary and SWOT Analysis, each summarised below.

3.1 Glossary

It has long recognised that a shared language is key part of interdisciplinary team building. As part of QST0 a list of key terms (and acronyms) was generated and definitions derived for the most significant, with the intent that the others will be completed over time and new terms added as they become significant. The focus in QST was on research relevant terms and on ideas linked to land use transformations. Terms can be formalised as an "ontology" – single, unambiguous, precise, definitions, e.g. for use in computer models. In this case such precision is not necessary nor practical as what was desired was a "working language" for a research community of practice (a "folksonomy" presented as a Glossary). It important to recognise that multiple meanings may be implied for the same terms by stakeholders in land use narratives. Understanding why and how terms are used is part of the research. Beyond team building, a Glossary can have a role in highlighting when terms that are being used synonymously may be unhelpful or misleading and where it might be useful to differentiate or be more precise.

For each item in the Glossary an explanation and links to citations is provided but also a noting of issues and/or points of difference. The document will continue to be added to and updated.

The Glossary will also help with transdisciplinary working clarifying the language of policy – trivially acronyms but also how the actors and entities within government fit together and operate (formally and informally), e.g., organograms of ARE and ENFOR or the roles of policy forums like ARIOB.

3.2 Conceptual Framing

The conceptual framing work catalogued theories and framings previously used by team leads and others that shaped the project proposal. Foregrounding theory/framing helps to make explicit the underlying (tacit) assumptions or worldviews that can underpin choices methods and what is considered evidence. Shared framings across the teams included socio-ecological systems and complex systems; preference for empirical and inductive methods; and theories that see science-policy interaction in terms of deliberative democracy and interpretive approaches. Overall, the discussion of theory and framing confirmed a fair degree of compatibility between teams. This was not wholly unexpected given roles in writing the project and previous collaborations but was useful in opening the issue to new staff and collaborators. Beyond sharing these background framings, the start-up process also sought to generate a more concrete shared conceptual framing for research on Land Use Transformations to identify how the elements of the research may fit together to address higher level policy questions.

3.2.1 Shared Conceptual Framing

A conceptual framing is helpful in shaping decisions on project scope, on what the key entities are and how the entities are thought to interact. The starting point for the conceptual framing here is land use systems and metabolism (see Figure 1). This draws heavily on ideas of Giampietro et al. (2012), Allen and Giampietro (2016) and Giampietro (2018), operationalised in the EU Horizon 2020 MAGIC project that used societal metabolism to study how EU policies such as CAP delivered the Sustainable Development Goals (Matthews et al., 2020). See the presentation of this work to RESAS staff from 2021 for a summary.

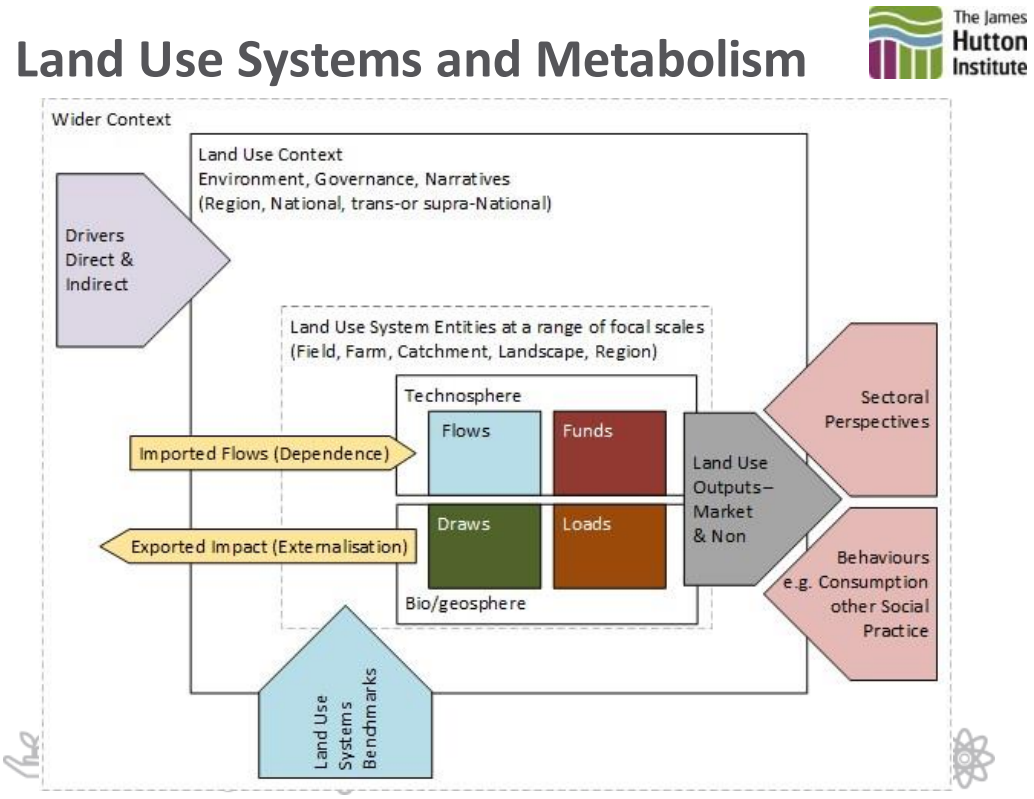

Figure 1: Initial shared conceptual framework for Land Use Transformations project.

Two key aspects of societal metabolism theory have salience for Land Use Transformations analysis.

The first is that the issue is inherently multi-scale / multi-perspective, and this is true both in geographical space (field, farm, catchment) but also between contrasting sectors or including households (domestic perspectives). In the framing above the centre of the figure is the focal scale of analysis (that is where the analysis starts from) but recognises that the land use system operates to generate market and non-market goods that interact with both other sectors and the wider population via their consumption and other social practices. Land use systems (beyond subsistence) depend on imported materials (fertilisers, feed or technologies) and these imply both a dependence on the availability of these inputs but crucially also a footprint of impacts where those inputs are created (externalisation). The latter is key to understanding the intensity of production systems in the EU and the potential that Net Zero objectives are most readily achieved by farming less and shifting the problem elsewhere. The muti-scale analysis also recognises that any system exists in (usually more than one) context. The conceptual framing here seeks to draw on more detailed analyses of components of the system via benchmarks (this links to other SRP studies) and to take care to understand that there are drivers from the wider (even global) context that need to be

understood – in this case global emission trajectories that imply the need for adaptation. Linking the wider context and the focal scale(s) is the land use context – the wider physical environment within which the land use system exists but also the socio-political context where narratives and discourses shape how the system is expected to operate, and how its performance is evaluated. The study of these processes via primary social research has a key objective of increasing policy coherence and to highlight alternative narratives.

The second key aspect of societal metabolism is the way in which it makes the organisation of studies of complex systems more tractable by providing a reusable accounting methodology. The four elements in the centre of the figure (Funds, Flows, Draws and Loads) have proven to be an adaptable way to characterise systems performance that combine biophysical and socio-economic valuations in meaningful ways allowing characterisation of trade-offs within the system and between the system and its context(s), see Matthews et al. (2021)[1].

Discussion of the conceptual framework clarified the role of the figure, not as a systems diagram or formal DPSIR[2] figure but as a "useful abstraction", a way to try and frame what can otherwise be overwhelmingly complex webs of interactions. Questions were raised on the labelling of the bio-geosphere in the focal scale – noting that bio-geosphere is potentially all encompassing (and raising questions of encapsulation between socio-economic and natural systems). This needs to be better presented to clarify the key issue that the consequences of activity expressed by draws, funds and flows can for many phenomena only be understood if the locale in which they occur is defined. Geography matters since the same activity in differing environments may have differing outcomes, leaving aside any questions of aggregate consequences when concentrations of activities exceed buffering capacities for wide areas.

The conceptual framework will continue to be refined though its use in shaping analysis within the QST and other research processes.

3.3 Capability statement

As part of QST0 details of formal training and experiential learning by team or staff members was collated. Again, the mix of skills was not unexpected since teams were specially sought for their expertise, but the exercise highlighted opportunities coming from new staff and having a different range of teams from previous SRPs. The Project has a broad range of skills available across natural, social and computational sciences, in line with the expectations of *land use science* (Aspinall, 2008). The project team is especially strong in spatial analysis, interpretivist governance analysis and participatory/creative methodologies to understand land-based behaviours. All teams are experienced in interdisciplinary working, specifically Mode 2, problem-led analysis (Tait et al., 1999). For transdisciplinary working i.e., research conducted with policy teams, there is both theoretical and practical experience. All teams have worked with SG analysis and policy teams in the past, with some new team members taking the opportunity to gain more experience in this kind of work. All teams can also bring international perspectives, gained for example via EU projects.

Visualising the balance of capabilities against the conceptual framework was undertaken in the second QST0 workshop by adding dots to express, per team member, the degree of capability or experience. See Figure 2, where the dots are colour-coded per team. The figure shows that there is

[1] Flows and Funds are the resources shaped by human decisions, with flows entering, leaving and funds remaining over time. Draws are the resources diverted from their natural pathways for human use but being beyond human control (e.g., rainfall) and loads are the (typically) undesired by-products or losses from the system that need to be dissipated within local (or wider) environment.

[2] DPSIR = Driver-Pressure-State-Impact-Response Framework.

some degree of coverage for all aspects of the conceptual framework but that there are areas where capacity may depend on individual capacity or overall experience is limited (e.g., externalisation, and land use system interaction with markets). The balance cross natural and social sciences is fairly even. For both, though, the potential wide range of tasks means that depth of new analysis will have to be limited and the focus will need to be on better exploiting and integrating capabilities. Where capacity is limited, there will need to be very careful consideration of how these resources are best deployed to maximise impact (thinking particularly about the balance between the policy-relevant (WP) and policy-led (QST) elements).

Inevitably there are other desirable capabilities, for example empirical, spatial, Agent Based Modelling with which to undertake analysis of the consequences of policy uptake or other pro-environmental behaviours (for example the mix of Enhanced Conditionality (Track 2) measures). Discussions with the Large-Scale Modelling (C5) topic lead (Gary Polhill) are underway to see the degree to which the QST phases can be combined with the C5 "sprints".

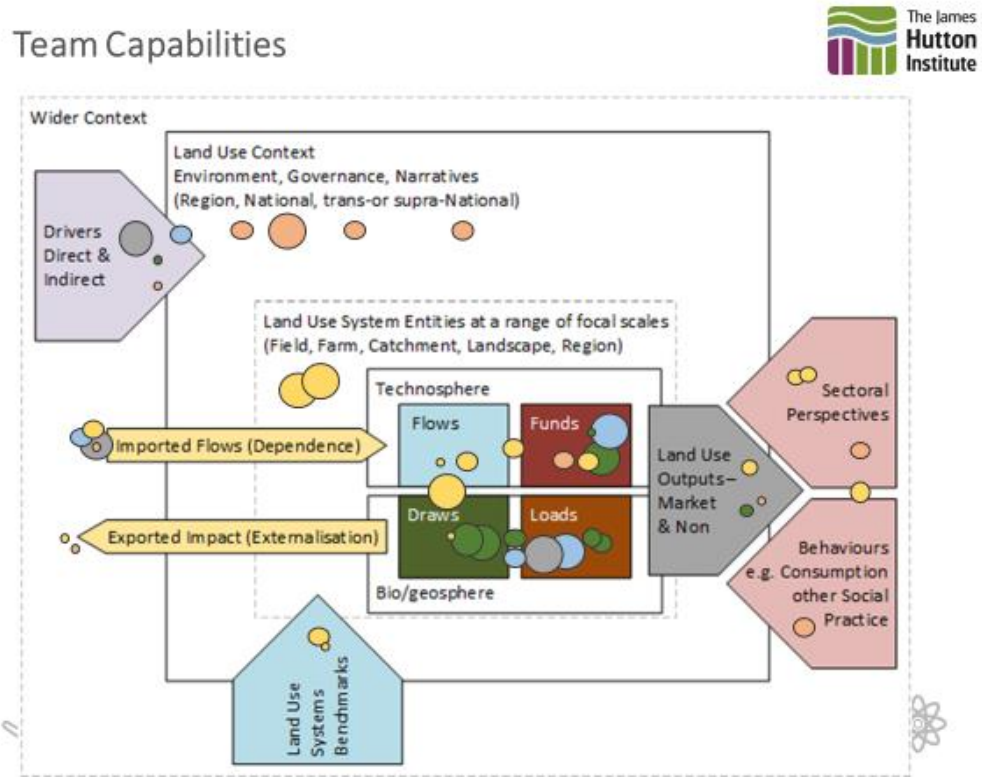

Figure 2: Maping project team expertise and experience onto the shared conceptual framework for the project

3.4 Data Catalogue

A catalogue of the datasets created, or used, by the teams was compiled. This was motivated by the intuition that existing data holdings could be more fully exploited across the teams and that new options for data integration would be stimulated by a process that generated greater awareness of the data "in hand". Per dataset (n=131) the catalogue codified source (research, SG administration or other[3]), topic, coverage, granularity, data and empirical or model based. The catalogue also recorded how many teams used the datasets and identified collections of datasets that have been previously integrated to deliver research outcomes.

[3] Typically, local authority data.

Even with limited time, a large number of datasets were identified and catalogued (n=131). Most teams are making use of a wide range of data (count is 18-48 per team[4]) with the balance of research to administrative sources (83 to 42) emphasising the importance to research of access to datasets with primarily administrative purposes (see Table 1 in Section 5.2 - Data catalogue summary slides). The specialisation in the use and creation of qualitative data by the socio-economic teams (SEGS) is highlighted in Table 2. Linkage of qualitative and quantitative research remains challenging, but the ambition is that QST should allow teams to play to their strengths – qualitative analysis shaping the framing and interpretations, Stages 1 and 5 in QST, with quantification undertaken in Stage 3. The key to making QST work, though, is in navigating what to represent (Stage 2) and how to present and contextualise metrics (Stage 4) where this translation between qualitative and quantitative analysis occurs.

The predominance of single use datasets (71 of 131) indicates opportunities for wider use. The most-used research datasets under Biophysical include data soil and derived parameters, for Administrative derived the Ordnance Survey data, and for Climate the HADRM3 change scenarios. Grouping datasets into topics give a different view with land use just outstripping soils for numbers of use cases. It is also clear from the table that each of the teams has distinctive domains and that combining their expertise with these datasets has potential to allow bigger picture questions to be addressed. Strengths of SEGS team are in management (where quantitative data is weaker), and in primary data collection on policy (rather than data derived from policy sources).

Many datasets have been used in integrated ways before. There are many shared data sets but opportunities have been identified (see examples from Hutton Land Systems Research Team in Figure 5. Data linking projects to collections of datasets has been collated and can be used as a baseline for the evaluation processes over the course of the project.

One potential data issue for the project may be assessing and using secondary, quantitative, socio-economic data beyond farm systems. The team have some experience (from EU SMILE and MAGIC projects) but it will be important to continue to work with Hutton research teams now deployed in other Topics (e.g. E1 Rural Economy).

3.5 Model Base

Taking an inclusive definition of "model" there are several that will be used – formal models (land use change, cropping systems), data set integrations (for example for land capability for agriculture) or combined spatial datasets (e.g. examples in Land Systems Team see Figure 5).

There was an expressed preference for back casting over forecasting, given the complexity of systems being studied. This implies working back in two stages – defining goal states (i.e., marketing planning, that links to land use narratives) and then assessing how to get there, the steps/stages and schedules. Combined these allow testing of policy robustness.

Key opportunities for modelling:

1. Including farm structure data into land use change modelling. The importance of farm structures (who owns/uses the land) is that it defined the mix of what they do now and what resources they have, and imply path dependencies i.e., limits on likely land use change actions.

[4] The range excludes the socio-economics team since their research has had a strong emphasis on primary data collection rather than use of secondary sources.

2. Including adaptation needs. While there is a priority for mitigation to minimise impact, entrained CC is real, and analysis of adaptation need and its potential to undermine mitigation needs to be considered.
3. Linkage to Large Scale Modelling (C5-JHI-1) – especially the agent-based modelling (ABM) team. Capability not in C3-JHI-1 but potential for joint working via their policy "sprints" and our QST. Also shared staff with CentrePeat (D3-JHI-1) to link on peatland restoration.

3.6 Scope and Focus Summary

The scope and focus discussions, reviewing the commissioned definition of work (DoW), confirmed the basic assumptions of the project, aspiring to policy relevance through Scotland-wide (macro) and integrative analyses. Wherever possible the intention was to keep the scope broad, focusing on how the elements fit together, rather than narrowing to "know more and more about less and less".

The core WP level topics are defined by the project DoW, but the topics for QST are more open. To maximise the coherence of the Project the QST topics need to deliver to the overall Project goal of understanding what land use transformations are needed to deliver Net Zero and what role increased policy coherence might have in facilitating or driving those changes. Definitional questions raised were:

1. Clarifying what land use (transformation) can be interpreted as meaning in different discourses (e.g., synonymously with cover, use, management, users, rights, etc), this is partly addressed in the Glossary.
2. What are the key "parent policies" that define the land use policy domain? The suggestion has been that the starting point be Green Recovery, Just Transition, Climate Change Plan and Land Use Strategy but recognising that Agricultural Support payments represent a key lever in financial terms.
3. Coherence was seen as essential both within a policy domain – vertically between objectives, measures and implementation (or not) – and between domains (horizontally e.g. objectives vs objectives) see Figure 6 from (Blackstock et al., 2018)[5].

The balance of policy-relevant and policy-led working was also discussed. There was recognition of the need for flexibility in responding to policy-led issues but also that this needs to be managed carefully. The need for phases of "closing down" to make analysis tractable within resources was highlighted, balancing the more appealing phases of "opening up" issues and potential analyses.

3.7 SWOT Analysis

The SWOT analysis to a degree gathers some of the key elements above, with the SWOT categories helping to shape actions, positive to maximise benefits or to mitigate risks.

3.7.1 Strengths

Experience. The Project teams have a wealth of experience (the six team leads alone have >120 years) working in the domain with a good mix of biophysical and socio-economic capability – all teams have done interdisciplinary working before.

Building a shared conceptual framework – not agreement in detail but no conceptual dissonance/conflict.

[5] Also noted was the potential importance of *diagonal coherence* e.g., measures for Objective 1 underpinning or undermining achieving Objective 2.

Data and data integration. Substantial progress can be made just by using existing datasets across teams – e.g., farm structure for land use change models.

Data to ground deliberations – the outputs from the Project can serve as boundary objects for policy deliberations.

Networks. Project teams have good networks within Hutton and beyond with the potential to draw in results or benchmarks – but recognising that lack of capacity for collaboration, or ability to shape research questions with other teams, can be a weakness.

Iteration. The 5-year timescale has the potential to allow QST to be used iteratively at different stages of policy design, implementation, and evaluation. The within-Project evaluation can generate lessons for good practice in science-policy working (post-Project legacy).

3.7.2 Weaknesses

Capacity vs the scope of the topic. Land use transformations is a potentially huge topic even at overview level. Capacity issues can be mitigated by accepting "good enough" answers. The Project team "*have to be comfortable with doing less than you would want to*".

Gap in experience of using QST methods. This it true both as way of working and for policy-led working. Team members are though positive about responding to the challenge and seeking opportunities to see their research used in policy making.

Known data gaps. Site/holding specific land management remains a key limitation and is necessary for considering impacts as the outcome of pressures versus local environment. Such data exists as surveys (Farm Business, Fertiliser Usage, Pesticide Usage) but the lack of explicitly spatial data is limiting. See paper on this issue for the EU Farm Accounts Data Network (FADN) by Matthews et al. (2021). The modular June Agricultural Census may though provide an opportunity to collect more of such data and in any case the Project will feed into SG data collection strategies formally and informally.

3.7.3 Opportunities

Policy freedom. No longer tied to the EU CAP (what degree of alignment is desired), it is possible to make land use policies "fit for Scotland's purposes". There is the potential for a step-change with qualitatively different measures to deliver policy objectives.

New tools and technologies (online mapping, visualisations, others). These can assist in communicating, interrogating, and interpreting the large volumes of data that can be generated in support of policy options appraisals. The challenge remains in how best these tools and outputs get deployed in science-policy engagement processes (see Threats).

Linkage with other projects. Highlighting potential for linking with Large Scale Modelling (C5-JHI-1) as noted above and beyond the SRP to the work by Forest Research that complements the agricultural systems expertise in Hutton.

3.7.4 Threats

Alignment of policy and research timelines. Policy timelines can be substantially shorter than typical for research projects, and this means researchers need to be adaptable and pragmatic on what can be achieved. Later than necessary involvement of researchers can, though, limit inputs to summarising generic knowledge rather than allowing delivery of bespoke analysis. Anticipation by researchers is needed and potentially being more proactive in reaching out to initiate co-construction of policy-led research rather than being only reactive.

4 Conclusions

Conclusions are limited to the value of the start-up process for the Project. The formalising of the start-up process with the workshops was both symbolically and practically valuable. Symbolically it was useful in emphasising the ambition to try and bring together the strengths of the teams and to capitalise on the potential synergies. Practically it generated new knowledge and stimulated debate between team members. Subsequent shaping of the research team leads seems to have benefited from discussing the shared conceptual framing. The write up of the process (this document) and the other "living documents" is also worthwhile to try and capture a baseline for where the project team are starting from and as a way to better judge progress over the course of the SRP. The time needed to prepare for, conduct and write up the start-up process is not insignificant but at this stage looks to have been a good investment and would likely be included in any other multi- and interdisciplinary research proposal.

Next Steps - Other WP formal start-ups are scheduled in Q2 and Q3 2022, for Adaptation (WP3.1), Mitigation WP3.3), and Governance and Land Use Narratives (WP3.4). The first cycle of QST (till March 2023) is being scoped with the aspiration that it can complement analysis being undertaken in the Economic Advice & Related Services to Support Development of a New Rural Support Scheme for Scotland (RESAS/005/21)

5 Appendix 1

5.1 Supplementary Figures

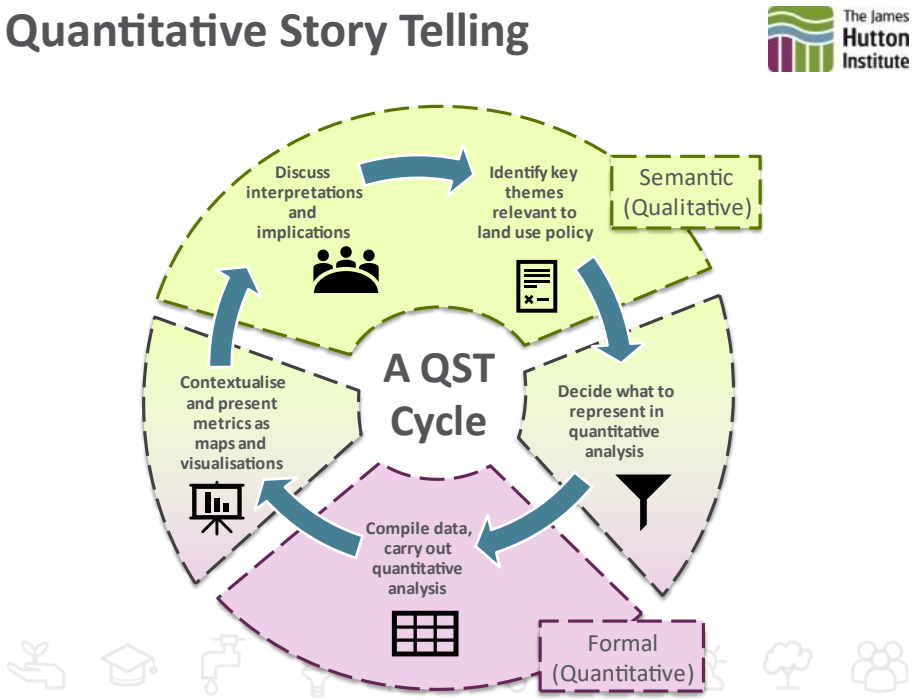

Figure 3: Stages of the Quantitative Storytelling Process

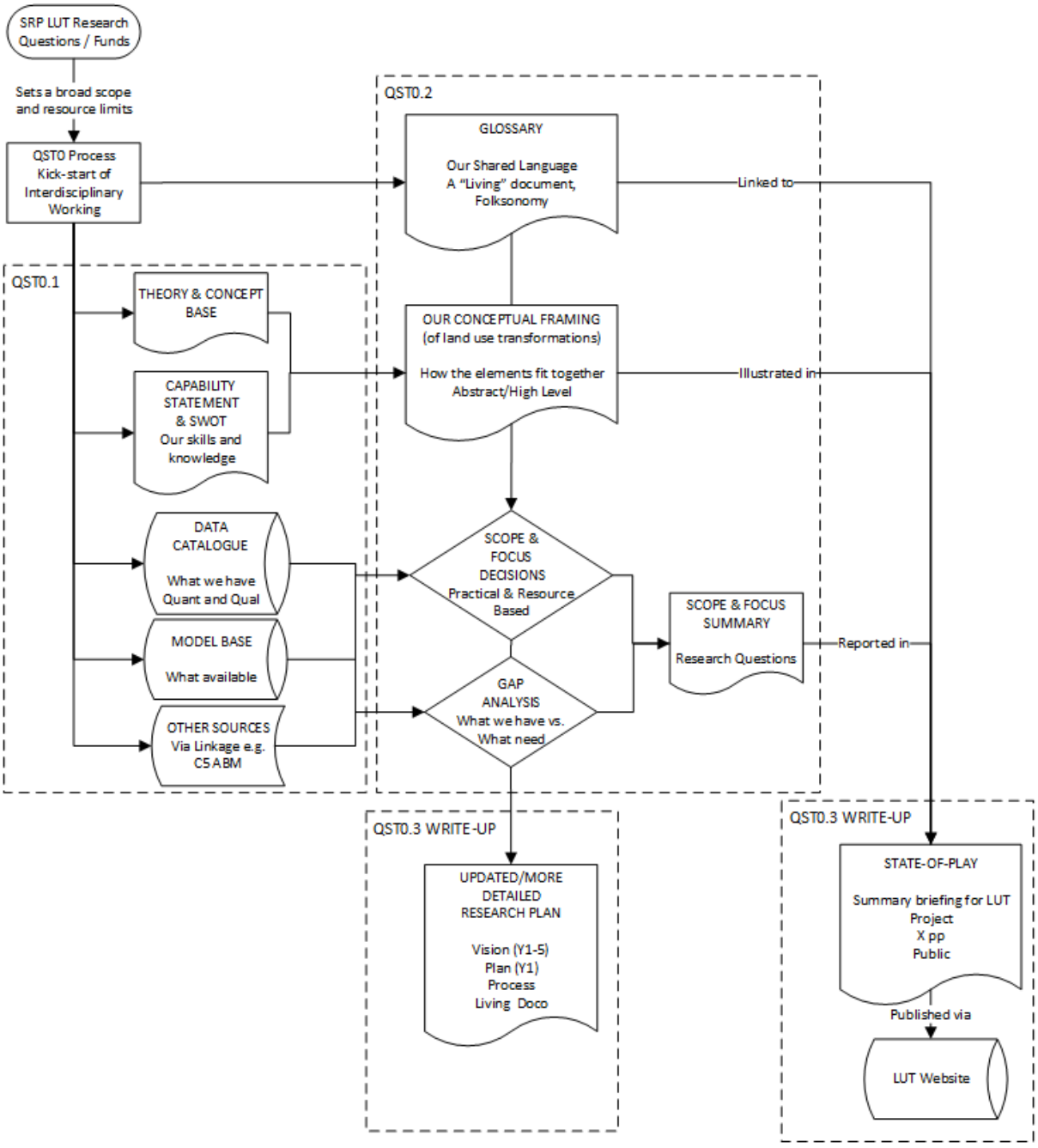

Figure 4: The Land Use Transformations project start up process (aka QST0).

Taken from Land Systems Research Team [webpage]

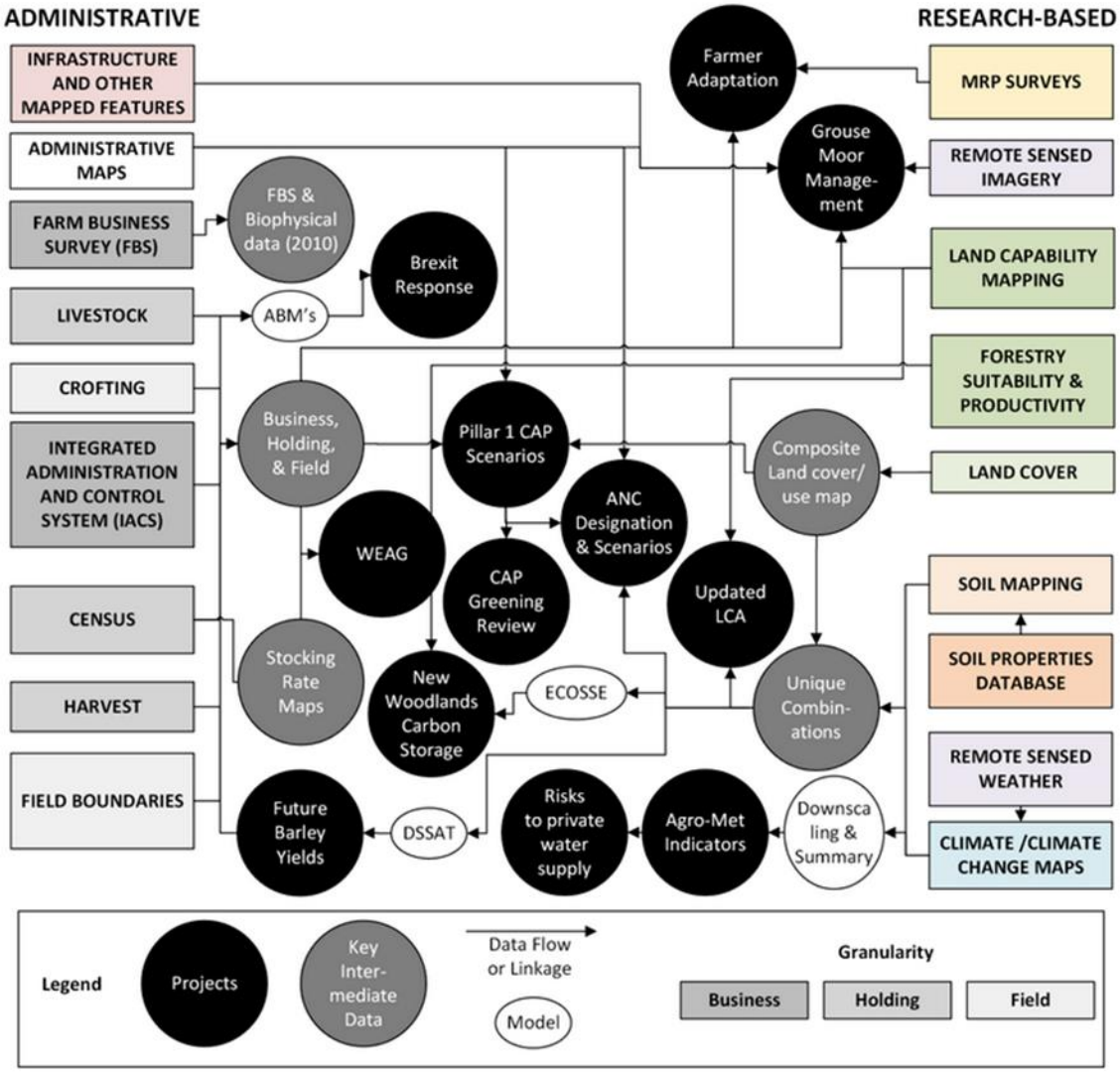

Figure 5: Integration of administrative and research-based data for policy-led research

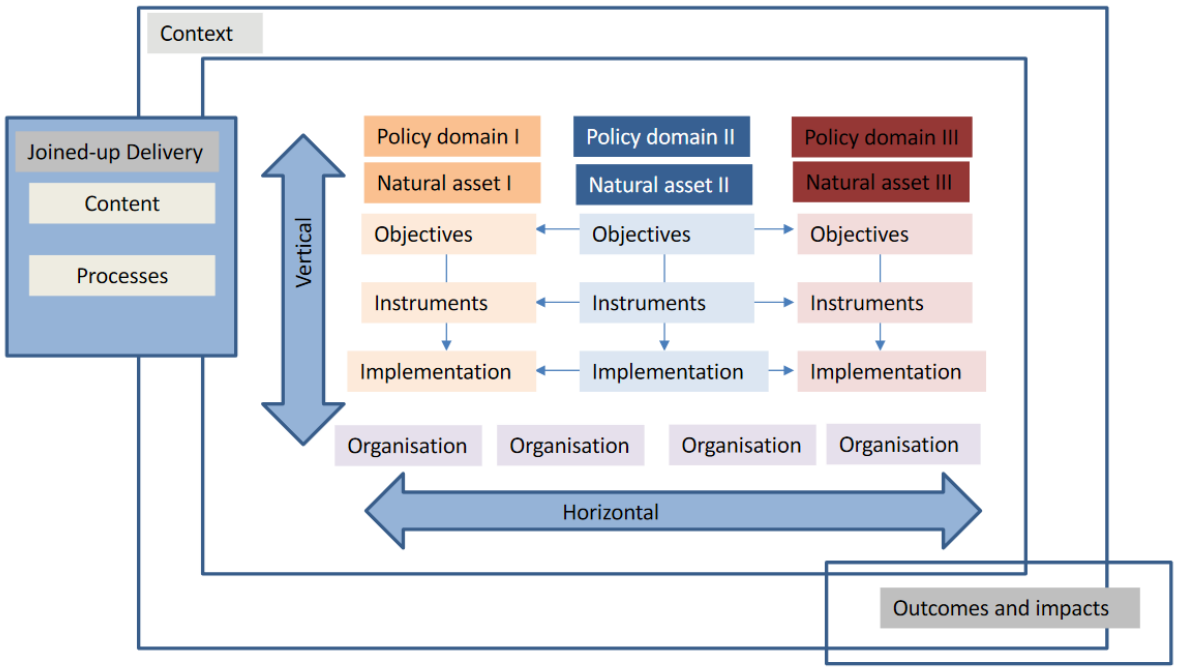

Figure 6: Policy Coherence conceptual model

5.2 Data catalogue summary slides

Table 1: Dataset counts by type and team

Source	All	KBM	MA	AG	MR	SEGS
Research	83	21	17	20	13	12
Admin	42	26	4	10	2	
Other	6	1	2		3	
All Sources	**131**	**48**	**23**	**30**	**18**	**12**

Table 2: Dataset counts by team qualitative and quantitative types

Type of data	All	KBM	MA	AG	MR	SEGS
Qualitative	12					12
Quantitative	119	48	23	30	18	
All Types	**131**	**48**	**23**	**30**	**18**	**12**

Table 3: Datasets by count of users, overall and per team.

Users Ct	All	KBM	MA	AG	MR	SEGS
1	71	25	6	17	11	12
2	36	16	9	6	5	
3	24	7	8	7	2	
All Cts	**131**	**48**	**23**	**30**	**18**	**12**

Table 4: Most frequently used datasets by team

Dataset	All	KBM	MA	AG	MR	SEGS
Research	**83**	**21**	**17**	**20**	**13**	**12**
LCM (All)	3	1	1	1		
Soils databases (SSKIB)	3	1	1	1		
Soil maps (soil series and soil map units)	3	1	1	1		
DEMs	3	1	1	1		
HOST classes (Hydrological soil types)	3		1	1	1	
Land Capability for Agriculture (old)	3	1	1	1		
River network/water bodies	2	1		1		
Peat condition map	2	1	1			
LCS88	2	1	1			
Bias Corrected UKCP18	2	1	1			
Peat depth map	2	1	1			
AgCensus (livestocks)	2		1	1		
SolarGIS Solar Radiation Data	2	1			1	
Land Capability for Agriculture (new)	2	1			1	
Bias Corrected HADRM3	2	1	1			
Admin	**42**	**26**	**4**	**10**	**2**	
Ordnance Survey MasterMap Topography Layer	3	1	1	1		
National Forest Inventory	2	1		1		
MIDAS Weather Data	2	1			1	
Crop Survey	2	1			1	
Ordnance Survey Basemaps	2	1		1		
Designated Areas	2	1		1		
UKGRID Weather	2	1	1			
Farm/field boundary	2	1	1			
June Agricultural Census	2	1		1		
Other	**6**	**1**	**2**		**3**	
Private Water Supplies – risk maps	3	1	1		1	
Private water supplies - locations	2		1		1	
All Datasets	**131**	**48**	**23**	**30**	**18**	**12**

Table 5 Count of datasets used grouped by topic

Topic	All	KBM	MA	AG	MR	SEGS
Use	23	9	2	6	3	3
Soil	22	4	8	5	5	
Cover	14	8	2	4		
Climate	13	5	3		5	
Structure	12	6	2	4		
Water	10	2	2	2	4	
Management	9	3				6
Topography	5	2	1	2		
Capability	5	2	1	1	1	
Biodiversity	5			5		
Remote Sensing	4	2	2			
Tenure	2	2				
Policy	2					2
ESS	1			1		
Socio-Economic	1	1				
Finance	1	1				
Demography	1					1
Ownership	1	1				
All Topics	**131**	**48**	**23**	**30**	**18**	**12**

6 References

Allen, T.F.H., Giampietro, M., 2016. Narratives and Transdisciplines for a Post-Industrial World. Systems Research and Behavioural Science 23, 595-615.

Aspinall, R.J., 2008. Basic and Applied Land Use Science, in: Aspinall, R.J., Hill, M.J. (Eds.), Land Use Change: Science, Policy and Management. CRC Press, Taylor and Francis, pp. 3-16.

Blackstock, K., Waylen, K., Prager, K., Juarez-Bourke, A., Maxwell, J., Tindale, S., 2018. Is joined-up policy the answer to effective delivery of public goods? Insights from a review of Scottish Policy Instruments", Scotland's biennial Land Use and Environment Conference XII: Rewarding the Delivery of Public Goods, Edinburgh.

Giampietro, M., 2018. Anticipation in Agriculture, in: Poli, R. (Ed.), Handbook of Anticipation: Theoretical and Applied Aspects of the Use of Future in Decision Making. Springer International Publishing, Cham, pp. 1-35.

Giampietro, M., Mayumi, K., Sorman, A.H., 2012. The Metabolic pattern of societies : where economists fall short. 408.

Matthews, K.B., Blackstock, K.L., Waylen, K.A., Juarez-Bourke, A., Miller, D.G., Wardell-Johnson, D.H., Rivington, M., Hague, A., Fisher, D., Renner, A., Cadillo-Benalcazar, J., Schyns, J., Giampietro, M., 2020. Report on EU sustainability goals: insights from Quantitative Story Telling and the WEFE nexus. MAGIC (H2020–GA 689669) Project Deliverable 5.1, 31st July 2020, Online: https://magic-nexus.eu/documents/deliverable-51-report-eu-sustainability-goals, p. 136.

Matthews, K.B., Renner, A., Blackstock, K.L., Waylen, K.A., Miller, D.G., Wardell-Johnson, D.H., Juarez-Bourke, A., Cadillo-Benalcazar, J., Schyns, J.F., Giampietro, M., 2021. Old Wine in New Bottles: Exploiting Data from the EU's Farm Accountancy Data Network for Pan-EU Sustainability Assessments of Agricultural Production Systems. Sustainability 13.

Tait, J., Williams, R., Brice, A., Lyall, C., 1999. Interdisciplinary Integration in the Fifth Framework Programme (II-FP5) Guidelines for Interdisciplinary Researchers and Research Managers, pp. 1-6.