Interdisciplinary working in food systems research

Lessons from the TUKFS programme

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Executive summary

- This project was funded by a Synergy grant from the 'Transforming UK food systems' (TUKFS) programme. A key requirement of TUKFS funding was that projects should take an interdisciplinary 'food systems' approach, working across the natural and social sciences. Our 'Interdisciplinary working in food systems' Synergy project sought to draw together the views of programme participants and to make some recommendations regarding future interdisciplinary research programmes.

- The report draws on a survey of TUKFS researchers regarding their experience of working across disciplinary boundaries and a workshop, where group discussions were used to formulate recommendations for future research in this and related areas.

- The report also identifies some additional resources that TUKFS participants found useful in pursuing various kinds of interdisciplinary research.

- The project aimed to understand the advantages of taking an interdisciplinary approach to food systems research and the models of multi-, inter- or trans-disciplinary research employed across the programme.

- We asked how researchers and funders best prepare to undertake large-scale interdisciplinary research projects and how experiences of interdisciplinarity might differ between those writing grant proposals and those carrying out such research.

- We investigated what challenges arise at different points in the project lifecycle and how these can be most effectively addressed.

- We also considered which collaboration skills (such as team building and respect for disciplinary conventions) are required for effective interdisciplinary research and what training PhD students and Early Career Researchers (ECRs) need in order to undertake successful interdisciplinary research.

- Based on the evidence collected, our report challenges the normative framing of interdisciplinarity as a self-evident good, focusing both on participants' positive and negative experiences of working across disciplinary boundaries.

- Positive views of interdisciplinarity included the production of richer analyses, novel outputs and more socially relevant research.

- Negative experiences, referred to below as the 'dark side' of interdisciplinarity, included the hidden labour involved in interdisciplinary working, potential career penalties and unacknowledged power relations.

The survey findings revealed:

- Overwhelming agreement that some degree of interdisciplinarity is necessary for effective food systems research.

- Widespread agreement that supervisors and senior researchers need training in interdisciplinary working, not just PhD students and ECRs.

- Frequently mentioned challenges around communication and language barriers.

- In terms of the inter-, multi- and/or trans-disciplinary nature of the projects, references to interdisciplinarity dominated but with significant spread across all categories.

- Involvement with non-academic stakeholders was widespread with significant value placed on co-production and impact outside academia.

- Successful interdisciplinary working requires early relationship (team) building, the development of a common framework, strong leadership and project management, setting clear goals, agreed ground rules and transparent expectations.

The workshop findings confirmed:

- The range of skills that participants felt were necessary for successful interdisciplinary research; the importance of understanding power differentials within research teams and processes; the need for academic humility in recognising the limits of one's knowledge.

- The additional time and resources required for successful interdisciplinary working, the importance of developing a shared language and/or recognising disciplinary differences including what is recognised as valid knowledge and what constitutes 'good science'.

- The under-valuing of professional service staff, such as project managers and administrators, who are often involved in the labour of brokering between disciplines.

- The particular challenges for those who join a research team part way through the project, where there is pressure to get up to speed quickly, and for PhD students who are required to work across institutions which might have different administrative, training and supervisory requirements.

- The potential conflict between 'team science' and individual career progression.

In the main report, our recommendations are structured according to different audiences and different stages of a research project. They include:

■ Funders should acknowledge the complexity and uncertainty of interdisciplinary working and provide additional/more flexible resources.

■ Funders should recognise that transdisciplinary research (with non-academic partners) is particularly time-consuming and adequate resources (time and money) should be allocated for this.

■ Funders should ensure that peer reviewers have the necessary expertise to assess interdisciplinary research proposals, acknowledging that additional training may be required to fulfil this role.

■ Funders and Higher Education (HE) institutions should consider how best to develop the 'collaborative' skills identified as necessary for successful interdisciplinary research, acknowledging that these skills may be harder to teach than more technical skills.[1]

■ Funders should provide better guidance about the kind of interdisciplinarity that is being sought in programmes such as TUKFS and how to produce an effective Theory of Change, incorporating appropriate transdisciplinary links.

■ UKRI should consider whether its requirement to have a lead Council for each of its joint programmes inhibits the development of interdisciplinary research.

■ HE institutions should provide more support for interdisciplinary collaboration including possible revisions to academic promotion criteria.

■ Principal Investigators (PIs) should pay close attention at the bid-writing stage to ensure that sufficient professional services support is included to meet the demands of interdisciplinary working.

■ PIs should pay upfront attention to discussing the principles and practices of interdisciplinary working with their research teams, allowing space for critical reflection as projects develop.

■ Key terms (such as 'systems thinking') should be the subject of explicit discussion at the start of a project to ensure mutual understanding.

■ Where appropriate, postdoctoral researchers could be included as Researcher Co-Investigators, recognising their input into shaping the research process rather than simply delivering research that has been designed by others.

[1] Some moves in this direction were taken by UKRI's recent Cross-Council Responsive Mode scheme which made a clear distinction between multi- and inter-disciplinary research and required all projects to demonstrate co-design, reciprocal benefits and integration of disciplines.

- Non-academic stakeholders should be included at an early stage in the research process to maximise the prospects for co-production, acknowledging that co-design and co-production are at the heart of effective transdisciplinary research. Appropriate exit strategies should also be discussed.

- Research teams should acknowledge that there are different publishing conventions in different disciplines and establish a publication protocol at the outset of the project.

- Sufficient administrative time and resources should be included in research budgets to allow for Centre for Doctoral Training (CDT) coordination across multiple institutions including better integration across separate research 'kernels'.

- Financial resources should be provided for student-led events including cross-cohort working.

- Regular events should be provided to help reduce student/staff isolation and encourage programme-level integration.

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Background

The 'Transforming UK Food Systems for Healthy People and a Healthy Environment' (TUKFS) programme aimed to fundamentally transform the UK food system by placing healthy people and a healthy natural environment at its centre. The TUKFS programme was a £47.5 million investment, supported by UKRI's Strategic Priorities Fund in partnership with: the Global Food Security Programme, BBSRC, ESRC, MRC, NERC, Department for Environment, Food and Rural Affairs, the Department of Health and Social Care, the Office for Health Improvement and Disparities, Innovate UK and the Food Standards Agency (https://ukfoodsystems.ukri.org/about-us/).

A key requirement of programme funding was that projects should be interdisciplinary in their approach to transforming the health and sustainability of UK food systems. Although this was a programme requirement, little or no guidance was provided on what was meant by interdisciplinarity and projects were left to interpret the meaning and operationalization of the term for themselves. This report, and the Synergy project on which it was based, captures and reflects on the diverse experience of TUKFS researchers in meeting the challenges of working across disciplinary boundaries, highlighting the benefits of interdisciplinarity and identifying lessons for future UKRI (and related) research programmes.

Our project sought to identify a range of voices from researchers across the programme and at different career stages. As reflected in the wider literature, their experience ranged from those who insist that embracing heterogeneity and plurality strengthens interdisciplinary understanding (Vienni-Baptista et al. 2022) at one end, to those who declare themselves 'against interdisciplinarity' (Petersen 2008) at the other – and many of those in between.

As well as undertaking original research for this Synergy project we also draw on the findings of two Call 1 consortia (H3 and Mandala) both of which conducted empirical research on interdisciplinarity within their respective projects (see Boxes 1 and 2).[2] The main part of this report draws on our own empirical data collected through a survey of TUKFS researchers (including PhD students and professional services staff) and a workshop, where survey findings and group discussion were used to formulate recommendations for future research in this and related areas. This report should be read alongside another TUKFS Synergy project which focused on the role of co-production in transforming UK food systems. The project's findings (Shaw et al. 2024) highlight areas of 'messiness' and complexity; challenges associated with applying co-production approaches; and practical solutions. Four key shared principles for co-production were identified, relating to relationships, knowledge, power and inclusivity. Our discussion of transdisciplinarity (below) links closely to the idea of co-producing research with non-academic partners.

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[2] TUKFS funding was allocated in three waves. Call 1 funding led to the establishment of four large consortia (FixOurFood, FoodsEqual, H3 and Mandala). Calls 2 and 3 funded 13 smaller projects and a separate Call led to the funding of the Centre for Doctoral Training (CDT). For more details of the projects, see https://ukfoodsystems.ukri.org/research–projects–training–reports/.

Box 1: H3 Inter-D interview project

Led by Academic Advisory Board member Professor Anne Murcott, the H3 inter-D project sought to capture the views and understandings of researchers during the period they were engaged in an interdisciplinary research programme. The H3 project sought to transform UK food systems 'from the ground up' through an integrated programme of research on 'Healthy soil, Healthy food, Healthy people' (www.h3.ac.uk). Participants ranged from PhD students and ECRs to senior academics leading work packages and cross-cutting themes. For some researchers, interdisciplinary working involved combining the specific disciplines in which they were trained, while others aimed to transcend their original disciplines in collaboration with colleagues from other fields. The inter-D project elicited assumptions and (often implicit) understandings of researchers' experiences of interdisciplinary working through video-recorded, semi-structured interviews. More than 20 hours of recording were completed, including Murcott's own reflections recorded by another H3 team member. While this research will be reported separately, key themes include: the importance of clear working definitions (with interdisciplinarity understood as collaborative integration on the same question, rather than parallel multi-disciplinary strands); recognition that 'transdisciplinary' is used both for co-production with practitioners and for work that goes beyond disciplinary boundaries altogether; the centrality of translation and shared language across methods and evidence standards; the need for humility in learning from other fields; persistent structural barriers in funding, review and publishing systems that still favour single disciplines; and practical enablers such as early alignment meetings and explicit authorship/data protocols. Collectively, the interviews emphasise that effective interdisciplinary work is problem-led, relational, and planned, requiring deliberate structures to turn rhetoric into integrative, real-world impact.

Box 2: Mandala reflections on interdisciplinarity

The Mandala Consortium (www.mandala-consortium.org) is a five year research programme, about urban food systems change, designed around the principles of a 'collaborative interdisciplinary systems approach'. It has involved researchers and engagement and policy professionals spanning ten disciplines, across ten institutions in England. Early reflections on how the interdisciplinary dimension of the approach worked, documented through analysis of project documents, discussion with the research team and the authors' deep knowledge of the process, are available in a paper by Sawyer et al. (2025). The paper describes how interdisciplinarity helped the project to assess the whole breadth of the urban food system, by providing a range of analytical lenses and a comprehensive methodological arsenal for understanding the system and evaluating change. But there have been challenges: differences over terminology (e.g. 'system map') and methods (e.g. what constitutes a systematic review), and potential power differentials, where disciplines with more representation in Mandala (e.g. public health) had arguably more power to shape the ways of working. Mandala is currently drilling down deeper into its interdisciplinary approach in a workstream as part of its project synthesis work package, involving Dr Kelly Parsons. This involves interviews with researchers and stakeholders about their experience of interdisciplinary research, and multiple rounds of reflections collected from the research team during face-to-face project meetings. The results of this research will be reported separately. Key themes from the data collected so far include: how interdisciplinary and transdisciplinary collaboration with stakeholders enriches the research experience, and the science, including learning how others approach a problem; that individual researchers feel they have benefited from exposure to ideas and methods of other disciplines, including by improved understanding of their own discipline and how it relates to others; it is hard work and there are challenges around use of jargon and approaches to terms and tools such as 'system map' and 'model'. Benefits - in particular for the study of food systems - include how exposure to other disciplines can broaden the range of (food system) 'outcomes' which researchers now consider when formulating questions, or analysing the implications of findings, even if their actual methods stay within their disciplinary lane. Enablers identified include: good communication; trust - which takes time to build; building in time to drill down into disciplinary methods and philosophical underpinnings; more regular in-person meetings; dedicating time to address how to enact interdisciplinarity in practice; and having a 'translator', with a surface understanding of multiple fields, who can break things down so everyone can understand it.

Introduction

Despite the importance attached to interdisciplinarity by research funders, including the TUKFS funder UKRI, there is little consensus on terminology among those who advocate inter-, multi-, or trans-disciplinary working (Vienni-Baptista et al. 2023). There has also been little systematic attempt to capture researchers' experience of interdisciplinary working or to provide guidance on best practice and lessons learnt. Though it finished more than 10 years ago, in the UK many still look back to the Rural Economy and Land Use (RELU) programme (2004-13) for insights into 'what works' in terms of collaborative interdisciplinary research (Van den Eynden 2011, Ward & Phillipson 2021). The programme website declared that 'All RELU projects are interdisciplinary and involve both natural and social scientists working together to investigate the social, economic, environmental and technological challenges faced by rural areas. RELU researchers come from >40 disciplines, from agricultural economics and food science to physical geography and water engineering': www.relu.ac.uk/research/Interdisciplinarity.html. The RELU programme was also distinctive in investing in the preparatory work needed to prevent project teams from becoming a collection of disparate researchers.

In devising this Synergy project, we aimed to answer the following questions:

- What models of multi-, inter- or trans-disciplinary research have been employed across the programme and which are best suited to addressing different kinds of research questions?

- What are the specific advantages of taking an interdisciplinary approach to 'grand challenge' topics such as food security and sustainability?

- What practical steps can be taken to reduce any potential disadvantages?

- How can researchers and funders best prepare to undertake large-scale interdisciplinary research projects?

- How might experiences differ among those (PIs and others) writing grant proposals that advocate interdisciplinary research and those charged with carrying out such research in practice?

- What training do PhD students and ECRs need in order to position themselves for undertaking successful interdisciplinary research?

- What challenges arise at different points in the project lifecycle and how can these be most effectively addressed?

- What 'collaborative skills' (such as team building and respect for disciplinary conventions) are required for effective interdisciplinary research?

Working definitions

While the Synergy project sought to capture a range of experiences of working across disciplinary boundaries, we found it helpful, in the workshop discussion and across the project, to provide some working definitions of our key terms, drawing on previous guidance from the **Research Excellence Framework**: https://2021.ref.ac.uk/about-the-ref/interdisciplinary-research/index.html and **UKRI**: https://www.ukri.org/opportunity/ukri-cross-research-council-responsive-mode-pilot-scheme-round-2/.

Multidisciplinary:

Where researchers from different disciplines work largely independently of each other to address a common problem but there is little or no integration of disciplines

Interdisciplinary:

Collaboration that involves significant interaction between two or more disciplines and/or moves beyond established disciplinary foundations in applying or integrating research approaches from other disciplines

Transdisciplinary:

Research that crosses disciplinary boundaries and co-creates knowledge between academic and non-academic partners such as policymakers, businesses or civil society organizations.

These are preliminary definitions, designed to orientate subsequent discussion. As will become clear in the rest of the report, there is little consensus on these definitions and they are often used inconsistently in different circumstances.

Literature review

Before starting the empirical research, we undertook a literature review to help us frame and understand the nature of interdisciplinary collaboration with a particular focus on food systems research.[3] This section reports the results of that search.

Recent years have seen a growing imperative to undertake interdisciplinary, transdisciplinary, and multidisciplinary research in order to address complex, systemic challenges such as those found in food systems. Projects funded under the UKRI's Transforming UK Food Systems (TUKFS) programme - including the Fix Our Food, FoodSEqual, H3 and Mandala consortia and the Centre for Doctoral Training (CDT) - are emblematic of this shift. These initiatives are explicitly designed to bring together diverse disciplines and sectors to confront interconnected problems around sustainability, health, equity, and planetary boundaries. However, despite the increasing prevalence of collaborative research across disciplinary lines, the operationalisation of interdisciplinarity remains deeply uneven. While calls for interdisciplinary research have become commonplace in funding programmes and structures, what interdisciplinarity actually means in practice, how it is negotiated among researchers and stakeholders, and what kinds of knowledge and power relations it mobilises or forecloses, are far from settled questions.

This review was undertaken to provide a targeted, conceptual and analytical overview to inform the Synergy project's development of a cross-programme survey and follow-up workshop. Rather than offering an exhaustive account of all debates in the field, it identifies key definitional framings, recurrent challenges, and useful analytical tools that may support both the interpretation of project experiences and the formulation of recommendations for future interdisciplinary collaboration. The review draws particularly on recent contributions by Vienni-Baptista et al. (2023), the methodological reflections of the Mandala consortium (Sawyer et al. 2025), and Freeth and Caniglia's (2020) framework for understanding collaborative research across five dimensions. These are considered alongside foundational insights from Lang et al. (2012), Klein (2017), and critiques such as Petersen's (2008) intervention 'against interdisciplinarity', which together offer conceptual clarity and critical distance from what is often treated as an inherently positive or self-evident good.[4]

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[3] This was a standard academic literature review not a formal systematic review, governed by the protocols that apply in medical and health–related research.
[4] To guard against an exclusively positive interpretation of interdisciplinarity we challenged workshop participants to explore their experiences of the 'dark side' of interdisciplinarity as well as their positive experience.

Interdisciplinarity and food systems

There is growing recognition that food systems - characterised by complexity, feedback loops, and dynamic interactions - require methodological and epistemological approaches that are similarly systemic. Ericksen (2008: 237), for instance, advocates for food systems research to be "fully inter-disciplinary, aiming for a marriage of natural and social sciences", while Brunori et al. (2020) argue that the field is not only open to, but may require, interdisciplinarity to grasp the relational nature of coupled socio-ecological systems. More recently, in a special issue dedicated to reporting the findings of the TUKFS programme, Horton et al. (2025) emphasised the need for interdisciplinarity (where research questions in one discipline are informed by linked research in another discipline) and trans-disciplinarity (where key players from the wider food system are engaged in co-design and co-delivery of research projects and programmes such as TUKFS). These perspectives have helped catalyse a broader turn toward 'food systems thinking', a conceptual shift that positions complexity, interconnection, and transformation as central organising principles (Sage 2022, Sonnino et al. 2019). Similarly, the IFSTAL programme which promotes Interdisciplinary Food Systems Teaching and Learning, positions 'food systems thinking' as a key workplace skill for those working in this complex interdisciplinary field (Ingram et al. 2020, see also Pope et al. 2021).

This body of work challenges siloed knowledge production and calls instead for holistic approaches that recognise non-linear causality, system feedback, and the entanglement of structure and agency across scales (Allen and Prosperi 2016). Within this frame, interdisciplinarity is not merely instrumental, but foundational to the capacity of food systems research to deliver meaningful, equitable, and sustainable change.

It is within this context that we now turn to definitional debates surrounding the terms multidisciplinarity, interdisciplinarity, and transdisciplinarity.

Defining and distinguishing modes of collaboration

A persistent source of confusion in interdisciplinary research stems from the conflation of multiple terms, particularly interdisciplinarity, transdisciplinarity, and multidisciplinarity, which refer to distinct approaches to collaboration. While definitions vary across contexts and traditions, some broad distinctions are more widely accepted and provide a useful starting point.

Multidisciplinarity typically refers to situations where researchers from different fields work in parallel on a shared issue, bringing their respective disciplinary expertise to bear without necessarily attempting to integrate methods, theories, or epistemologies. It is often characterised by additive knowledge production, where insights remain relatively siloed but are placed in dialogue (Choi and Pak 2006, Klein 2010).

Interdisciplinarity, by contrast, implies a more intentional integration of perspectives, where the aim is to create new insights or frameworks through the synthesis of different disciplinary approaches. It is this form of collaboration that is often valorised in programmes like TUKFS, particularly when systemic change is the goal (Klein 2017, Vienni-Baptista et al. 2023). In an oft-quoted definition, the US National Academy of Sciences defines interdisciplinarity as a mode of research

that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines to advance understanding or solve problems beyond the scope of a single field (National Academy of Sciences 2004).

Transdisciplinarity goes further still, extending collaboration beyond the academy to include non-academic actors - such as policymakers, third sector representatives, communities, and industry stakeholders - in both the co-production and application of knowledge. It is frequently associated with participatory or action-oriented research, and with a commitment to transformative outcomes grounded in real-world contexts (Lang et al. 2012, Pohl & Hadorn 2007). Lang et al. (2012) conceptualise transdisciplinary research as unfolding in three interconnected phases: co-framing the research problem, co-producing knowledge across academic and societal actors, and re-integrating this knowledge into practice. This phased model is particularly useful in projects where the goal is to identify and deliver actionable interventions. Transdisciplinary research can also be defined as research which goes 'beyond' disciplines to create new forms of knowledge.

As discussed previously, interdisciplinarity was framed as research that achieves outcomes not possible within a single discipline, involving significant integration of approaches, concepts, or methods across disciplines. Multidisciplinarity was referred to as collaborative arrangements where researchers work in parallel within their disciplinary boundaries, without integration. Transdisciplinarity, meanwhile, was characterised by the co-production of knowledge between academic and non-academic actors - such as communities, policymakers, and third sector partners - with the aim of addressing real-world challenges.

Nevertheless, definitional clarity does not automatically translate into clarity of practice. As Vienni-Baptista et al. (2023) note, different disciplines and institutional contexts carry diverse expectations about what counts as interdisciplinary work, and the same terms may be used differently even within a single project. Moreover, funders often mandate interdisciplinary collaboration without adequately supporting the infrastructure, time, or recognition mechanisms required to sustain it. As Klein (2017) has argued, interdisciplinarity is not merely a methodological matter, but involves 'boundary work' - the often invisible and affective labour of negotiating conceptual, institutional, and epistemological divides.

Challenges, critiques, and power dynamics

While interdisciplinary and transdisciplinary research are frequently promoted as inherently beneficial, particularly in the context of sustainability, food systems, and public health, such approaches are far from straightforward in practice[1]. As Petersen (2008) notes, the normative framing of interdisciplinarity as a self-evident good can obscure the deep epistemological and institutional tensions that often emerge in collaborative work. Practical challenges such as coordination difficulties, conceptual misalignment, and disputes over authorship and recognition are well-documented (Klein 2017, Vienni-Baptista et al. 2023). These issues are not merely logistical, but symptomatic of broader structural dynamics, including disciplinary hierarchies and unequal access to institutional resources. In particular, power asymmetries between

[1] For a good account of the requirements and tensions involved in undertaking transdisciplinary food system research, especially for ECRs, see den Boer (2024).

fields - especially between quantitatively oriented or technical disciplines and those in the Arts, Humanities and Social Sciences (AHSS) - can hinder equitable collaboration.

Freeth and Caniglia's (2020) five-dimensional framework offers a helpful lens for analysing these challenges. They distinguish between *epistemic* (differences in assumptions about what constitutes valid knowledge), *symbolic* (status and power inequalities between disciplines or actors), *social* (interpersonal and team dynamics), *spatial* (physical and institutional location), and *temporal* (mismatched timeframes and work rhythms) dimensions of collaboration[2]. Their framework highlights that failure to navigate these dimensions can lead to what they term 'additive multidisciplinarity' - where disciplines operate in parallel with minimal integration - despite claims to the contrary. This was one of the key insights from the Mandala consortium's own evaluation of its ways of working, where initial aspirations for integrative collaboration were, at times, undermined by disciplinary dominance, logistical constraints, and shifting team compositions (Sawyer et al. 2025).

Sonnino et al. (2016) similarly observe that food systems research often privileges technical and scientific perspectives at the expense of social and cultural approaches, with arts, humanities and social science contributions either marginalised or instrumentalised to serve pre-defined agendas. Petersen's (2008) critique further adds that interdisciplinarity can become a 'myth of deliverance', invoked as a rhetorical fix for wicked problems without sufficient engagement with the structural and epistemological challenges it entails. In this view, interdisciplinary rhetoric can sometimes reproduce academic hierarchies, create unrealistic expectations, or obscure persistent disciplinary gatekeeping. Related concerns were echoed in the Rural Economy and Land Use (RELU) programme evaluation, which highlighted how qualitative and participatory methods remained undervalued in many interdisciplinary environmental research settings (RELU 2011). The outcome of ESRC's Nexus Network+ also offers valuable lessons for interdisciplinary research, based on the experience of trying to integrate the study of energy, food and water systems (Cairns et al. 2017).

These critiques do not suggest that interdisciplinary research should be abandoned, but rather that it requires critical reflexivity, institutional support, and robust frameworks to be carried out effectively. Particular attention must be paid to how partnerships are structured, how disciplinary boundaries are negotiated, how effective peer review is achieved, and whose knowledge(s) are legitimised and amplified in the shaping of research agendas and outputs.

Frameworks and tools for supporting interdisciplinary projects

In light of these challenges, several frameworks and tools have been developed to support interdisciplinary and transdisciplinary research. Three, in particular, stand out as useful reference points for the Synergy project.

The first is Freeth and Caniglia's (2020) five-dimensional model, already discussed, which not only diagnoses the friction points in collaborative work but also

[2] The temporal dimensions of collaboration could also include the additional time that interdisciplinary research requires and that is not always acknowledged.

offers a language for reflecting on how they are experienced by researchers and stakeholders. This framework is particularly well-suited to the analysis of qualitative survey responses and workshop discussions, where narratives of collaboration can be unpacked in relation to each dimension.

The second is Lang et al.'s (2012) three-phase model of transdisciplinary research, which foregrounds the processual nature of collaboration . By distinguishing between co-framing, co-production, and re-integration, it becomes possible to ask not only whether integration occurred, but when, how, and with whom. This can inform both retrospective evaluations and the planning of future projects.

The third resource is the SHAPE-ID Toolkit, developed through a Horizon 2020 project to support interdisciplinary collaboration involving arts, humanities and social science disciplines. The toolkit includes self-assessment tools, reflective questions, case studies, and strategic planning aids to help teams design more inclusive and context-sensitive collaborative processes. While not developed specifically for food systems research, its relevance to cross-sectoral, challenge-led research makes it a valuable guide for projects such as those within the TUKFS programme.

Together, these frameworks and resources encourage a move away from abstract ideals of interdisciplinarity and transdisciplinarity toward a more grounded, situated, and reflexive understanding of collaborative practice.

Implications for the Synergy project

For the purposes of our Synergy project, this literature offers both cautionary insights and constructive guidance. It suggests that simply mapping whether or not projects claimed to be interdisciplinary is insufficient. Instead, we must examine how collaboration was enacted, what barriers were encountered, and how teams reflected (or failed to reflect) on their own processes. This includes asking whether interdisciplinarity was explicitly discussed at the outset of a project, whether there were spaces for negotiating different approaches, and how power dynamics - both within research teams and between researchers and stakeholders - shaped the direction and outcomes of the work.

These considerations informed the design and analysis of the Synergy survey, where questions aimed to elicit not only outcomes but also experiences and reflections on collaboration. The literature reviewed here provides a conceptual foundation for interpreting these responses and structuring our subsequent workshop discussion. It also helps identify areas where further inquiry may be needed - for instance, into the role of funder expectations, the place of early career researchers, or the specific challenges of integrating AHSS disciplines into consortia led by natural scientists or health researchers.

In this way, the review contributes to a broader aim of the Synergy project: not only to document past experiences of interdisciplinary working, but to provide grounded recommendations that can inform future programme design, funding criteria, and team composition. The integration of theoretical insight with empirical reflection will be key to this task, and the frameworks discussed here offer a useful starting point for that process.

Survey findings

A survey of TUKFS participants was undertaken in July 2025. The level of participation was encouraging with 36 responses including participants from all of the four Call 1 consortia, plus representatives from Calls 2 and 3 and from PhD students and supervisors in the Centre for Doctoral Training (CDT). Respondents were from all career stages and had held different roles within the TUKFS programme from PIs and Co-Is to postdocs and ECRs, as well as project managers and KE staff. A demographic breakdown of survey respondents is given in Table 1 and a summary of the survey findings is provided in Appendix 1.

Gender	Age
Female: 18 (50%)	25-34: 2 (6%)
Male: 12 (33%)	35-44: 10 (28%)
Non-binary: 1 (3%)	45-54: 4 (11%)
Prefer not to say: 1 (3%)	55-64: 9 (25%)
	65 and over: 6 (17%)
	Prefer not to say: 1 (3%)
Non-response 4 (11%)	Non-response 4 (11%)

Table 1: Survey respondents by gender and age

Some key findings from the survey were:

- Overwhelming agreement (27/31 responses) that some degree of interdisciplinarity is necessary for effective food system research (because of the complexity and interconnectedness of food systems).

- Agreement that supervisors and senior researchers need training, not just PhD students and ECRs. (As one participant remarked: 'I believe that PhD students and ECRs could teach more senior academics a thing or two about this way of working - so in that sense, ALL researchers should have access to training').

- Support for the idea that interdisciplinary researchers need training in a range of so-called 'soft' (collaborative) skills as well as more technical training (in systems thinking, stakeholder engagement etc). 'Soft' skills included: communication, project management, networking, humility, patience, kindness, open-mindedness, passion, commitment, tolerance, respect, sympathy and self-awareness.

- Around half felt their teams were sufficiently broad in terms of disciplinary composition. Of those who saw gaps, economics and nutrition/public health were the most commonly mentioned, followed by calls for more critical/applied social sciences.

- The most frequently mentioned challenges were about communication and language barriers.

- In terms of the inter-, multi- and/or trans-disciplinary nature of the projects, references to interdisciplinarity dominated but with significant spread across all categories. Several participants said that they had moved between categories rather than being fixed in one. About half of the projects had discussed the nature of interdisciplinarity explicitly, but often only briefly. The other half either did not discuss it at all or saw it as secondary to the practicalities of project delivery.

- Nearly everyone worked with non-academic stakeholders (which was a programme requirement), with significant value placed on co-production and impact. Stakeholder engagement often acted as a catalyst for interdisciplinary collaboration.

- It was agreed that successful interdisciplinary working requires early relationship (team) building, the development of a common framework, strong leadership and project management and the 'right mindset' (including humility, openness and curiosity). It should also include the setting of clear goals, agreed ground rules and transparent expectations.

- Interdisciplinary collaboration was described as working best when teams hold regular meetings, focus on practical issues and develop a team culture, encouraging mutual respect among members of the team. Effective collaboration should be actively curated, not left to chance.

- The majority credited interdisciplinarity with enabling richer analyses, novel outputs and more socially relevant research.

Project workshop

Building on the survey findings (a summary of which was pre-circulated to workshop participants), the purpose of the workshop was to identify common themes and experiences of TUKFS researchers and to draft some recommendations for future projects.

The workshop was attended by 21 participants, drawn from across the TUKFS programme including 11 from Call 1 projects, 3 from Call 2-3 projects and 5 from the CDT plus one external advisor and one KE Fellow. Participants were also well spread in terms of project roles and career stages (including 3 PIs, 7 co-Is, 2 PDRAs, 5 PhD students and supervisors and 2 project administrators).

Participants were divided into two groups of 10 and used a MIRO board to address two rounds of questions. In Round 1 these questions were:

- Based on your experience of the TUKFS programme, what skills and training are needed for successful interdisciplinary research?
- What challenges can you identify on the 'dark side' of interdisciplinary research for individuals, project teams or institutions?

An example of the MIRO boards produced in Round 1 is included as Fig. 1.

Fig.1: One of the MIRO boards produced in the Round 1 workshop exercise

In Round 2, the same groups were presented with a grid and asked to make recommendations to different audiences (funders, researchers, HE institutions etc) at different project stages (from the initial Call through delivery to project legacy). The key findings from the workshop are highlighted below.

Skills and training

- The workshop discussion highlighted several skills that participants felt were necessary for successful interdisciplinary research, complementing the survey results which identified a range of 'hard' and 'soft' skills. Several of these focused on the need for mutual understanding of each other's research areas and different methodological approaches.

- General training needs (not specific to food systems research) included communication skills, open-mindedness (including an openness to other perspectives), problem solving, budgeting, active listening, conflict resolution, empathy, diplomacy and facilitation, team/relationship/consensus building, boundary setting, collaboration, philosophies of science (including different epistemologies), and convening and leadership.

- Other training needs (more specific to food systems research) included exposure to creative and participatory methods (beyond the methods conventionally employed in social and environmental science), systems thinking and understanding complexity.

- More generally, workshop participants highlighted the importance of understanding power differentials within research processes, the need for academic humility and being able to accept ambiguity and admit one's own ignorance.

- Participants also emphasised the need for training at all career levels, not just among PhD students and ECRs.

The 'dark side' of interdisciplinarity

- In order to avoid focusing only on the positive aspects of working across disciplinary boundaries, workshop participants were asked about any challenges they had faced and whether there was a 'dark side' to interdisciplinary collaboration. Across the two groups, more than 60 suggestions were submitted, suggesting that this was a fruitful line of inquiry.

- Several participants focused on the additional time required for successful interdisciplinary working, stressing the need for flexibility and allowance for the demands of setting up highly bureaucratic collaboration agreements with partners. The additional demands of interdisciplinary research included the time taken to understand unfamiliar terms, creating positive working relationships, developing new methodologies, and dealing with unsupportive bureaucracy.

- The need for a shared language was a common view, including the recognition that some apparently similar terms are used differently in different disciplinary contexts.

- Some had faced specific ethical challenges (including the way research partners were abandoned once funding ended). Others, as above, felt that asymmetrical power structures inhibited their work and that academic egos sometimes got in the way of successful collaboration.

- Others had experienced criticism over their use of specific methods which other team members had felt were 'not robust enough'. This was just one aspect of a wider discussion of the role of academic hierarchies and disputes about what constitutes 'good science' or what is recognised as valid data.

- Some project participants reported feeling disconnected with the rest of the TUKFS programme. While Special Interest Groups – for example on regenerative agriculture – were encouraged, with the aim of drawing project participants together, their implementation was very uneven in practice.

- Participants also felt that universities were still structured around disciplines, that institutional infrastructure did not always suit interdisciplinary ways of working, and that interdisciplinary research may not be valued in single-subject bibliometrics.

- The 'hidden labour' involved in interdisciplinary collaboration was mentioned by one participant and the tendency for some key roles (such as project integration) to be delegated to staff who were not recognised as having academic status was mentioned by another. This suggests that the role of professional service staff, such as project managers and administrators, might be undervalued particularly in terms of the labour of brokering between disciplines.

- Others felt that bridging or integrating skills were insufficiently recognised in a mono-disciplinary culture and that researchers risked overworking or burn-out when trying to develop adequate knowledge and skills in multiple disciplines in a relatively short timeframe (a particular issue for PhD students). One participant made a plea for 'slow scholarship', allowing time to integrate and connect disparate information.

- Particular challenges were felt by those who joined a research team part way through the project, where there was pressure to get up to speed quickly, and by PhD students who were required to work across institutions which might have different administrative, training and supervisory requirements. This contributed to a wider lack of confidence in working outside disciplinary boundaries and to doubts about the benefits of interdisciplinary working.

- Some felt there was a conflict between team science and individual career progression, or between public messaging (that tends to promote a consensus view) versus the need to explain the legitimate role of differences of opinion.

Workshop participants made several suggestions in the Round 2 discussions some of which are also reflected in the Recommendations (below). They include:

- The possibility of holding pre-Call writing retreats and team-building exercises to help bridge across disciplines. This might also guard against the tendency to rely on the 'usual suspects' with encouragement to bring in new blood/ideas.

- Close attention should also be paid at the bid-writing stage to ensure that sufficient professional services support is included with particular attention to the demands of working across disciplines. Training for team members should include the opportunity for mentorship throughout the life of the project.

- Projects should plan for a range of outputs (not just academic publications) to include toolkits, policy and practice briefs, short videos and other forms of public-facing communication all of which should be valued as modes of research dissemination. Using visualisations can also help reach diverse audiences.

- Better guidance should be provided about the kind of interdisciplinarity that is being sought in programmes such as TUKFS and how to produce an effective Theory of Change, incorporating appropriate transdisciplinary links.

- Research teams should also consider governance structures and risk mitigation strategies as part of project planning including the need for shared and collectively agreed research objectives. This is particularly important in the case of interdisciplinary projects such as TUKFS.

- Consideration should be given to the best means to facilitate collaboration across work packages (WPs) to avoid silos. This could include cross-membership of WP teams, acknowledgement of interdependencies between WP teams, and achieving the right balance of subject-specific (WP) and generic (all-staff) meetings. Where, when and how will the integration of separate WPs occur?

- In order to reduce isolation among researchers and research teams, funders and programme managers should seek to facilitate regular meetings across project teams beyond one-off annual meetings.

- When appropriate, including postdoctoral researchers as Researcher Co-Investigators, recognising their input into shaping the research process rather than simply delivering research that has been designed by more senior team members.

- Providing opportunities for early career researchers (ECRs) to present at conferences and to have time to develop their own careers (as recommended in the Researcher Concordat: https://researcherdevelopmentconcordat.ac.uk/

- Non-academic stakeholders should be engaged at an early stage in the research (pre-Call) to maximise the prospects for co-production. Appropriate exit strategies should also be discussed for managing stakeholder relationships (and funding needs) after projects have ended.

- Using a MIRO board (or similar software) might enable the mapping of project findings across the whole TUKFS programme so that gaps in food system coverage can be identified.

- As well as producing specific outputs, researchers should also help to identify 'compelling narratives' about what interdisciplinarity adds and how combining disciplinary perspectives has made a tangible difference within and beyond academia.

Plenary discussion

- A final plenary (led by Isabel Fletcher and Rebecca Wells) summarised the workshop discussions and outlined next steps.

- The plenary focused on: issues of equality, diversity and inclusion (who gets invited to participate and what roles they perform); the need to encourage risk taking and new ways of working; time pressures; when and where interdisciplinarity happens within research programmes (who does the work involved in interdisciplinary research?); institutional barriers to interdisciplinary research (from the proposal stage to the actual practice of interdisciplinary research); and the need to develop different narratives of interdisciplinary research to demonstrate its practical value (with a general consensus that food systems research requires an interdisciplinary approach).

- Our independent advisor (Catherine Lyall) also contributed to the plenary discussion adding her views on the value of collective memory (what's new and different since the RELU programme which concluded in 2013); building on previous experience (such as ESRC's Nexus programme); moving from discussions about 'why' to do interdisciplinary research to 'how' to do it most effectively; the need for time and resources to integrate different forms of knowledge; the value of being part of studies in interdisciplinarity including the National Academy of Science's 'Team Science' project: https://nap. nationalacademies.org/catalog/19007/enhancing-the-effectiveness-of-team-science; the role of non-academic team members such as project managers and knowledge exchange professionals in ensuring the success of interdisciplinary research projects; and the challenges of peer review for interdisciplinary research projects.

Recommendations

Drawing on the survey findings and workshop discussion, we propose a series of recommendations, directed at different audiences and reflecting different stages in a research project. We also use a series of icons to highlight some of the common themes across the recommendations (see Fig. 2).

Concept / Theme	Relevance to Interdisciplinary	
Time	Interdisciplinary research takes longer Dedicated time to enable interdisciplinary working needs to be put aside as part of any research project	
Funding	Interdisciplinary working may require additional, or more flexible funding, given it is complex and takes longer	
Upfront Preparation	Upfront 'seed' work is needed to build interdisciplinary teams and studies, and establish ways of working, in the early phases of a funding call, and in research projects themselves	
Design	Interdisciplinarity needs to be explicitly designed in – into teams, and into projects – for example opportunities for team working – and into PhD programmes	
Interrogate	Interdisciplinarity should be interrogated and reflected on at all stages of a project, to understand if and how it is working and how it can be more effectively implemented	
Language	Different language used by different disciplines is a major barrier to collaboration. Terms should be explicitly addressed and discussed to align understanding	
Interactions/ Connections	Opportunities for meaningful interactions between different disciplines is an enabler	
Collaboration	Skills and conditions for interdisciplinary collaboration include communication, respect, openness, trust and humility	
Structures/Silos	Existing structures - funders, universities, journals – are siloed and represent a barrier to interdisciplinary working and should be acknowledged and addressed.	
Complexity and Uncertainty	Interdisciplinary working is complex and can involve more uncertainty as a result	
Skills and Training	Interdisciplinary project management, supervision, research, writing and reviewing requires particular skills, which may in turn require additional training	

Fig. 2: Key to icons

Research funders and HE Institutions

Pre-call and project design stage

Funders should acknowledge the complexity and uncertainty of inter/trans-disciplinary working and provide additional resources to achieve this and/or be more flexible with the funding they provide.

Funders should ensure that reviewers - who are often from a particular discipline - have the necessary expertise to assess interdisciplinary research proposals, acknowledging that additional training may be required to fulfil this role.

Funders should commit the time and resources necessary for effective interdisciplinary team building. This might include the provision of seed funding for pilot work, resources and infrastructure for sharing best practice and (where appropriate) rewarding/ incentivising community participation. For an example of a two-stage funding call, see: https://www.fwf.ac.at/en/funding/portfolio/connecting minds.

UKRI should consider whether its requirement to have a lead Council for each of its joint programmes (BBSRC in the case of the TUKFS programme) inhibits the development of inter-disciplinary research with participants tending to follow the conventions of the single lead funder.

Funders should recognise that transdisciplinary research (with non-academic partners) is particularly time-consuming and adequate resources (time and money) should be allocated for this. This is particularly important given that, despite the challenges involved in working with non-academic partners, this is often considered – for example by TUKFS researchers – a highly rewarding aspect of research)

Project delivery stage

Funders should provide more funding for interactions between projects within a research programme or funded under the same call. A good example of this is the TUKFS Synergy grants, which enabled cross-project working and inter-disciplinary collaboration.

Funders should provide earlier/better guidance on reporting requirements including information required about the challenges and rewards of interdisciplinary working.

Research funders should design training programmes to support interdisciplinary knowledge and practice. Two good examples of this are the UK initiative IFSTAL (Interdisciplinary Food Systems Teaching and Learning), which has trained c.1000 Masters students and the TUKFS Centre for Doctoral Training, which moves students between different disciplinary and institutional 'kernels'.

All stages

Funders and programme managers should seek to facilitate regular meetings across project teams beyond one-off annual meetings in order to encourage cross-project collaboration.

Funders and HE institutions should consider how best to develop the collaborative skills identified as necessary for successful interdisciplinary research, acknowledging that these skills may be harder to impart that technical skills. Research managers and allied professional service staff may have an important role in this.

HE institutions should provide more support for interdisciplinary collaboration (as required to meet today's 'grand challenges') including possible revisions to academic promotion criteria.

PIs, Co-Is and post-docs

Pre-call and project design stage

PIs should ensure that all relevant disciplines are included at the research design stage, including (where relevant) less frequently included disciplines such as humanities and creative arts as well as more 'standard' combinations of natural and social science. If this is not possible from the outset of a project, money could be held back to draw in these vital skills at a later stage.

PIs should design-in interdisciplinary collaboration across work packages (WPs) to avoid silos. This could include cross-membership of WP teams, acknowledgement of interdependencies between WP teams, and achieving the right balance of subject-specific (WP) and generic (all-staff) meetings.

Research teams should acknowledge that there are different publishing conventions in different disciplines and establish a publication protocol at the outset of the project.

Project delivery stage

PIs should pay upfront attention to discussing the principles and practices of interdisciplinary working with their research teams, allowing space for critical reflection as projects develop, including whether projects are working in an interdisciplinary way or reverting to additive multi-disciplinarity, and whether certain disciplines are dominating at the expense of others.

Among Co-Investigators (Co-Is) and postdoctoral researchers, particular problems were noted for those who joined research teams midway through a project. PIs and project managers need to address these concerns in order to integrate late-arrivals into the project team.

Key terms (such as 'systems thinking') should be the subject of explicit discussion at the start of a project to ensure mutual understanding, and overcome language barriers where terms have different disciplinary interpretations.

Researchers should reflect on, and be prepared to provide lay explanations of, the underpinning principles, methods, and other conventions – for example related to research ethics, or publishing – which characterise their disciplines.

Researchers should be encouraged to ask questions of colleagues from other disciplines. PIs and project managers should enable this through the creation of safe spaces.

Time should be devoted to relationship building and informal (social) interactions as well as to more practical academic tasks.

Researchers should be prepared to adapt their methods to incorporate other disciplinary approaches.

PhD programmes – supervisors and students

Project delivery stage

Supervisors should be given a clear introduction to the interdisciplinary aims of PhD programmes such as the TUKFS CDT - and provide regular peer support to students and supervisors to encourage cross-disciplinary understanding.

Regular events should be organised across the year to help reduce student isolation and encourage programme-level integration.

All stages

Supervisors should be aware that PhD students undertaking interdisciplinary projects can feel caught between different disciplines – for example feeling 'like a diplomat trying to bring different sides of the table together' – and mitigate this challenge through proactive liaison with other supervisors.

Useful Resources

Based on the survey responses and subsequent discussion, research participants identified a number of resources that may prove useful guidance for future interdisciplinary research. They include:

Toolkits and frameworks:

SHAPE-ID toolkit: https://www.shapeidtoolkit.eu/ - helps find tools and resources about trans- and inter-disciplinary research in the Arts, Humanities and Social Sciences, Science, Technology, Engineering and Maths.

Freeth & Caniglia's framework on research collaboration (see References for full citation)

Fix-Our-Food's three Horizons approach: https://fixourfood.org/what-we-do/our-activities/3-horizons-to-support-systems-change/

The IFSTAL programme (Interdisciplinary food systems teaching and learning): https://www.ifstal.ac.uk/home

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Appendix 1: summary of survey findings

As part of our Synergy project, we surveyed TUKFS researchers to explore their experiences of interdisciplinary working across the programme. Respondents included colleagues from all career stages and represented over 30 different disciplines, ranging from natural and social sciences to applied, practice-based and creative fields. This summary of the survey results was prepared for the Synergy workshop on 15 October 2025 and was used to help formulate a series of recommendations for future UKRI-funded research. The report provides details of participant responses, some illustrative quotes from their answers to open-ended questions, and some takeaway messages (which were used to inform the workshop discussion and to help in formulating our recommendations

Q1.

Which TUKFS project(s) were you involved in?

Responses came from across the programme:

Call 1 (17 responses:
FixOurFood 5, FoodSEqual 4, H3 4, Mandala 4),

Calls 2/3 (7) and the CDT (12).

The survey reached a broad and balanced set of projects, allowing insights from across the entire programme.

Q2.

What was your role?

Responses came from across the programme:

Roles spanned the spectrum of seniority and experience: PIs, Co-Is and PhD Supervisors (54%), PDRAs and PhD students (34%) and other roles (12%) such as community partners and support staff.

Q3.

Which disciplines were included on your project team?

Over **30** disciplines were named.

Most frequently mentioned:

Over 30 disciplines were named: Public health/nutrition (18), Geography (12), Environmental science (11), Policy (11), Economics (9), Business/ Management (8), Biology (7), Sociology (7), Engineering (5), Psychology (5) and Soil science (5).

Q4.

In retrospect, do you wish other disciplines had been included in your project team? If so, please explain why.

Total responses: **31**
(excluding 5 non-responses).

No / satisfied with current team: **15 responses** (48%).

Yes / additional disciplines wanted: **14 responses** (45%).

Ambivalent (not a clear yes/no): **2 responses** (6%).

Most frequently mentioned 'missing' disciplines: Economics/health economics (5); Nutrition/ public health (3); Social sciences: (3); and, other (single mentions): ethics, psychology, systems thinking, eco-feminist perspectives, historical dimension, commercial sector.

Illustrative quotes:

"Early involvement of these disciplines [social science and public health] could have helped shape the project's direction, broadened its impact, and strengthened integration between technical, economic, and societal goals."

Takeaway:
Around half of respondents felt their teams were sufficiently broad. Of those who saw gaps, economics and nutrition/ public health were the most commonly desired, followed by calls for more critical/applied social sciences.

Q5.

Would you describe your project as interdisciplinary, transdisciplinary, or multidisciplinary (or another term)? Please explain.

Total responses: **32**
(excluding 4 non-responses).

Interdisciplinary: **12 responses** (37%).

Transdisciplinary: **5 responses** (16%).

7 responses (22%).

Multidisciplinary: **6 responses** (19%).

Combinations (e.g. "all three" or "inter + trans"):

Alternative/critical terms (undisciplinary, not fussed, fruit metaphors - see below): **2 responses** (6%)

Illustrative quotes:

"Parts of the work have been transdisciplinary, in that they do not necessarily involve a particular disciplinary method but are about the researchers and delivery partners/ stakeholders using softer skills such as relationship building, collaboration, project management, group problem-solving, communication, dissemination. [...] Parts have been interdisciplinary - different disciplines have worked together to understand available data from a range of disciplinary perspectives [...] Elements of the project have been multidisciplinary - different disciplines working on their 'bit' and then bringing others in to comment or packaging up the bits but not necessarily synthesising them."

"We aimed to be fully interdisciplinary (working across disciplinary boundaries to produce a new synthesis) but some parts of the project were probably

better described as multi-disciplinary (where people from different disciplines combined without genuine integration)."

"At times … I felt the project was truly transdisciplinary in that people living in the communities most affected … were really listened to and worked with industry partners and academics."

"There was no really interdisciplinary working on this project. All WPs conducted their research in parallel with limited overlap. The problem was largely framed as a technical one so little integration between the natural and social science approaches was possible."

"Whilst I think we've aspired to be more transdisciplinary (fruit smoothie), we sometimes act in a multidisciplinary (fruit salad) way, but more often in an interdisciplinary (fruit bowl) way."

"I am not too fussed about what label you want to put on it … we have a team from a wide range of disciplines that usually worked together really well."

Takeaway: a. Interdisciplinary dominates, but there is significant spread across all categories; b. Many projects self-identify as moving between categories rather than fixed in one; and, c. There is a clear desire for more transdisciplinary practice (involving non-academic partners), but respondents acknowledged challenges in achieving it.

Q5a.

Did your use of these terms change over the life of the project (from the proposal stage to how it was delivered in practice)?

Illustrative quotes:

Responses to the question about when/if projects reflected on their use of these terms varied from **"Yes, all the time being clear which we were using when"** to **"Don't think we really thought about it - just got on with it"**.

"In hindsight it would have been better to pay more focused attention on the basic principles of interdisciplinary working, and do more interdisciplinary knowledge sharing upfront. Later in the project when we came to write up our approach we have looked more at the use of different disciplinary approaches and critically reflected on the way this has been interpreted/worked."

Several respondents say they were not involved at the proposal stage or joined after the project started so were not involved in these discussions.

Timing issues were raised by several respondents:

"Over the course of the project we recognised it was good to reflect on interdisciplinarity, not least as it was seen differently by different people/areas of the project - both in terms of what it might be and how/if it might be useful."

And another said candidly:

"I had to google these types of multidisciplinarities to find out what they meant! The project started as multi-disciplinary but has become more integrated during the course of the project as we learn from each other and could now be called transdisciplinary."

Did your team have any discussions about how interdisciplinarity, trans-disciplinarity or multidisciplinarity would be approached after you received the funding?

Total responses: **32**
(excluding 4 non-responses).

a. Yes (discussions took place): **15 responses** (47%).

Of these: Explicit/regular discussions: 7; Bid/proposal stage mainly: 4; Creative/reflexive exercises: 1; and, Some but no consensus: 3

b. No (or not aware): **13 responses** (41%).

c. Ambivalent/unclear: **4 responses** (12%).

Illustrative quotes:

"Discussions were limited and brief. The specific terms … and specifically the differences between them were not explicitly addressed. Instead, the approach developed organically."

"I designed a creative workshop using the 'exquisite corpse' drawing game … this was helpful … but I don't think anyone actually changed their view. There was still dissonance."

"Yes, we did have some discussions about what we meant by 'transdisciplinary' … I am not convinced that these discussions ever reached consensus."

"If my memory serves me well, this terminology was secondary to the practicalities of getting the work done."

Takeaway:

a. About half of the projects did discuss interdisciplinarity explicitly, but often only briefly or as embedded in initial proposals; b. Where deeper discussions happened, consensus seemed rare; and, c. The other half either did not discuss it at all or saw it as secondary to practical delivery.

We are mostly interested in your experience of working across academic disciplines but please indicate if working with different (non-academic) stakeholders also presented useful opportunities or specific challenges to the success of your project.

Total responses: **29**
(excluding 7 non-responses).

a. Balanced (opportunities + challenges acknowledged):**13 responses** (45%).

Clearly positive (benefits outweigh challenges): 12 (41%).

b. Mainly challenges/problematic: **4 responses** (14%).

Illustrative quotes:

Stakeholders most mentioned: community groups/NGOs (12), farmers/agriculture sector (6), schools (4), industry (6), government agencies (6), creative/cultural partners (3).

Opportunities: practical impact, co-production, access to new networks, creative contributions, trust-building.

Challenges: conflicting priorities, different timescales, coordination demands, power imbalances, and ECRs acting as 'diplomats'.

Illustrative quotes:

"We were working on a very contested topic … good links to the sector … made it easier to access some stakeholders but limited the scope of questions we could address."

"We had to develop relationships with delivery partners … co-design interventions … huge amount of knowledge sharing and translation."

"Working with non-academic partners (community partners with lived experience and industry partners) was by far the most rewarding, interesting, humbling and the aspect where I learned the most in this project. It brought its own challenges - i.e., different time frames (academics are too slow), and priorities (people in communities need to see tangible action)."

"As a student it is hard, you are like a diplomat trying to bring different sides to the table and hope that all sides are appeased."

"I designed a creative workshop … with community food researchers. Helpful, but dissonance remained."

"Commercial organisations … are more interested in private wealth than public good, which creates misalignment."

Takeaway:

Stakeholder engagement added huge value but also introduced tensions around power, timelines and conflicting goals.

Q8.

Please give some examples of what went well in terms of effective working across disciplinary boundaries.

Total responses: 29

(excluding 7 non-responses).

a. Clear positive examples of effective collaboration: **23 responses** (79%).

b. Mixed/limited success: **4 responses** (14%).

c. Still developing/no strong example yet: **2 responses** (7%).

Most frequently cited effective practices/ examples:

a. Regular meetings/ structures (team, leadership, writing): **8 mentions**.

b. Stakeholder-linked interdisciplinarity (schools, councils, food partnerships): **6 mentions**.

c. Specific research outputs (Delphi study, aquaponics, business models, fibre-rich meals, regenerative agriculture, video game): **6 mentions**.

d. Team culture (respect, trust, prior relationships, openness): **5 mentions**.

e. Personal growth/ disciplinary transition: **3 mentions**.

Illustrative quotes:

"Regular meetings for the research team have meant … researchers from different disciplines can contribute … writing days and sessions have helped us share writing tips and skills."

"Making a 'plain language' table of what each discipline was working on, what their aims are and what they think their outcomes will be. Asking everyone to agree that this is correct."

"By prioritizing open dialogue, mutual respect, and integrative workflows, the team navigated disciplinary boundaries with agility - producing insights and solutions that none could have achieved alone."

"Sometimes the stakeholder engagement has been the glue that has brought in several disciplines to one piece of work"

Takeaway:

Success hinged less on abstract definitions of interdisciplinarity and more on practical structures (meetings, writing, plain language) and team culture (trust, respect, leadership experience).

Q9.

What did you achieve through interdisciplinary working that would not have been possible using a single-disciplinary approach?

Total responses: **30**
(excluding 6 non-responses).

Clear positive achievements:
23 responses (77%).

b. Mainly about personal learning:
5 responses (17%).

c. Limited interdisciplinarity/ little achieved:
2 responses (6%).

Most frequently mentioned achievements:

a. Holistic/system-level analysis of trade-offs:
9 mentions.

b. New outputs/tools/ strategies (e.g. Agrifood Calculator, policy, interventions): **7 mentions**.

c. Improved community relevance and co-production:
4 mentions.

d. Personal growth/cross-disciplinary communication:
5 mentions.

e. Creative/novel contributions (arts-based, feminist, installation):**2 mentions**.

Illustrative quotes:

"**It could definitely have gone further than it did - it happened more as a side-effect of being in the same meetings etc, but could have been curated more actively.**"

"**Interdisciplinary working allowed us to combine technical, economic, social, and educational perspectives to create solutions that would not have been possible within a single discipline.**"

"**Wider thinking and different perspectives, greater energy around a topic, networks and contacts that each discipline brings with them that offers potential to widen scope and reach.**"

"**Better understanding of the real world which is interdisciplinary.**"

"**If honest, respectful working together, it really helps to get out of own bubble, learn, and get a more nuanced understanding of problems and solutions.**"

Takeaway:

Interdisciplinarity was seen as essential for tackling complexity, producing innovative outputs and ensuring community relevance. A minority felt it was underdeveloped in their projects.

Q10.

Please give examples of any challenges that arose when working across disciplinary boundaries?

Total responses: **31**
(excluding 5 non-responses).

a. Communication/language barriers:**12 mentions**.

b. Integration/silos/ methodology clashes:
9 mentions.

c. Power dynamics / dominance of PI or undervaluing social sciences:
5 mentions.

d. Practical constraints (recruitment, ethics, publishing): **4 mentions**.

e. Personal/relational (personalities, inadequacy, "jack of all trades"): **5 mentions**.

f. No challenges: **2 mentions**.

Illustrative quotes:

"The disciplinary perspective of the PI inevitably dominates, leaving other disciplines to feel less well-represented in the processes and project design... Working across boundaries takes more time, involves more meetings where you might not necessarily see the content as relevant to you... We never explicitly discussed what was meant by a systems approach or the system, or a system 'map' so everyone continued in their own bubble of understanding/ definitions/methods."

"Different 'languages' - constantly having to translate between disciplines."

"Even when people speak the same language, they may not speak the same discipline."

"Becoming familiar with different publishing protocols."

"The elephant in the room is that personalities have a lot to do with this. Some colleagues are just more open to new/different ideas than others!"

"Blending methodologies has been tricky. For example, I am undertaking a systematic review which aims to answer health and environmental research questions. However, PRISMA and other frameworks are mostly applicable to health sciences and I have had to integrate less known frameworks to answer my question on environmental impacts."

"Some disciplines were more entrenched than others and preferred more siloed working."

Takeaway:

Barriers often centred on language, entrenched silos and unequal valuation of disciplines

Q11.

How were these challenges addressed?

> ## Total responses: **30**
> (excluding 6 non-responses).
>
> a. Communication improvements (meetings, seminars, plain language):**10 mentions**.
>
> b. Informal interactions/ relationship building: **4 mentions**.
>
> c. Translation/facilitation roles: **3 mentions**.
>
> d. Flexibility/compromise/ work-arounds: **5 mentions**.
>
> e. Training/support for interdisciplinarity: **3 mentions**.
>
> f. Supervisory or leadership mediation: **2 mentions**.
>
> f. Not addressed/ongoing: **5 mentions**.

Illustrative quotes:

"I addressed this by trying to ask more probing questions: what do you mean, why do you need that, what will that result in. It involves not being shy about asking questions all along the way and feeling able to admit you don't know what someone is talking about. I don't think less experienced researchers always feel comfortable to do this - and also there often isn't time built in."

"Still working on it", "Ongoing", "Still in progress".

"Mostly treated as if they were interpersonal issues, or issues of strong ideology or lack of professionalism of those who raise issues of power."

"Re misunderstandings - once we understood who this was most likely to happen with - we started being VERY direct, following everything up carefully etc. This helped somewhat."

"I think you just have to get good at beginning from the basics and not assuming people know what you are talking about. Which ultimately I think makes us better science communicators."

Takeaway:

Interdisciplinarity was seen as essential for tackling complexity, producing innovative outputs and ensuring community relevance. A minority felt it was underdeveloped in their projects.

Is some degree of interdisciplinary working necessary for effective food systems research? Why/why not?

Total responses: **31**
(excluding 5 non-responses).

a. Yes, interdisciplinarity is necessary: **27 responses**.

b. Yes, but with nuance/conditions: **2 responses**.

(e.g., single-discipline studies can still contribute; interdisciplinarity can be counterproductive for weakly supported students).

c. Ambivalent: **2 responses**.

d. No/reject interdisciplinarity: **No responses**.

Illustrative quotes:

"Yes, because of the complexity of food systems … many problems are not just technical, but rooted in politics and value systems."

"It depends what we mean by food systems research. It is perfectly possible to do a good and useful disciplinary study of a part of the food system. But because the system is connected, if we want to look at it holistically, and have the best chance of making effective change … we need to bring the various bits together. Not necessarily all at once, but some parts of the system at least."

"Yes, some degree of interdisciplinary working is essential for effective food systems research. Food systems are complex and interconnected, involving biological, environmental, economic, social, and health dimensions that cannot be fully understood or addressed through a single disciplinary lens."

"Not absolutely necessary for all projects, can sometimes be counterproductive (for weak students) but depends on having the match of a very able motivated student with a suitable project."

Takeaway:

a. There is near-unanimous agreement that some degree of interdisciplinarity is essential for effective food systems research; b. The strongest arguments relate to complexity, interconnectedness (among food system components) and avoiding unintended consequences of siloed research; and, c. The few caveats highlight pragmatic limits (e.g. in narrow research areas or when capacity is weak).

How can researchers best prepare to undertake large-scale interdisciplinary research projects?

Total responses: **31**

(excluding 5 non-responses).

a. Early relationship/team building, shared language/ frameworks: **12 mentions**.

b. Training/education (ECR, systems thinking, philosophy of science): **9 mentions**.

c. Strong leadership/project management/strategic team design: **7 mentions**.

d. "Right" mindset (humility, openness, curiosity): **7 mentions**.

e. Practical preparation (clear goals, rules, expectations): **6 mentions**.

Illustrative quotes:

"**Set it up properly from the start!! Build relationships, discuss how language and data and contributions will all be fed into the ultimate objective equally, without hierarchy.**"

"**Research leaders need to spend time bringing a team together and giving them the opportunity to get to know each other and their work well. Members of such a team need to be open minded and listen to other perspectives, take them seriously and value the insights that they can provide. These conversations need to carry on throughout the lifetime of the project.**"

"**Researchers can best prepare for large-scale interdisciplinary projects by building a foundation of mutual understanding and respect across disciplines early on. This includes investing time in learning about the methodologies, languages, and priorities of other fields to facilitate effective communication. Establishing clear goals, roles, and shared frameworks for collaboration at the outset helps align expectations and fosters coordinated effort. Researchers should also cultivate flexibility and openness to adapt methods and approaches as the project evolves. Moreover, engaging stakeholders from outside academia early in the process can enrich the research and ensure relevance and impact. Finally, strong project management and regular, structured communication are crucial to navigate the complexities of interdisciplinary work successfully.**"

"**Build up a solid grounding in philosophy of science, develop some disciplinary humility and openness to recognising different perspectives- no one discipline has all the answers. Team building.**"

Takeaway:

Preparation requires early investment in trust and agreed frameworks, strong leadership, practical planning and a culture of openness.

What can funders do to help this process?

Total responses: **30**
(excluding 6 non-responses).

a. Time/resources for preparation & relationship building: **13 mentions**.

b. Flexible funding models & evaluation criteria:
8 mentions.

c. Training/team-building support: **7 mentions**.

d. Fair compensation for community partners):
3 mentions.

e. Critical/sceptical perspectives (avoid buzzwords, speed-dating): **3 mentions**.

Illustrative quotes:

"Some kind of seed funding is probably necessary for big interdisciplinary projects … and some kind of audit process to ensure that interdisciplinary stops being a buzzword."

"Expect to fund these foundational work packages/activities. Provide guidance on how to do it. Share best practice on how it has been done, barriers and enablers. Recognise that funding models (e.g. different research councils) and processes of reviewing etc need a rethink if the true aim is working beyond disciplines. Be flexible on deliverables, support having unknown elements of design and outputs, as true interdisciplinary projects are evolving and adaptive."

"Allocate time for relationship building at the beginning of a project ie. pump priming funding, but also effective dissemination at the end of a project to keep ties and create long lasting connections that future work can be built on."

"Run funding schemes which recognise and reward (financially and otherwise) community participants, community partners, stakeholders and VCSE contractors."

"Further, allow for extra time. The pressure of doing research can be intense anyway, but interdisciplinary research adds a new layer of stress when you are squeezed of time and are attempting to merge multiple disciplines."

Takeaway:

Funders should enable interdisciplinarity by supporting relationship-building, training and flexible models, while avoiding superficial fixes ('speed dating' exercises etc).

What training do PhD students and ECRs need in order to position themselves for undertaking successful interdisciplinary research?

Total responses: **29**
(excluding 7 non-responses).

a. Communication/soft skills, stakeholder engagement: **12 mentions**.

b.Systems thinking/interdisciplinary methods: **10 mentions**.

c.Training in other discipline's basics (quant/qual, social/natural science crossover): **7 mentions**.

d. Project management/leadership: **5 mentions**.

e. Practical exposure (projects, secondments, supervisors): **7 mentions**.

f. Networks/mentoring support: **3 mentions**.

Illustrative quotes:

"ECRs need training that develops both disciplinary expertise and interdisciplinary skills. This includes opportunities to learn how to communicate effectively across disciplines, understand different research methods, and appreciate diverse perspectives. Training in project management, teamwork, and collaborative problem-solving is also valuable, as interdisciplinary research often involves coordinating with multiple stakeholders and navigating complex challenges. Exposure to real-world case studies and hands-on interdisciplinary projects can help build practical experience. Additionally, professional development in networking, leadership, and stakeholder engagement equips ECRs to take on diverse roles within interdisciplinary teams. Mentoring and peer support programs further enhance confidence and resilience in navigating interdisciplinary careers."

"Humility. Patience. Kindness. Open mindedness and willingness to learn a lot of new things outside of your own discipline. Passion and commitment to the end goal. Ability to compromise and tolerate 'messiness'."

"I believe that PhD students and ECRs could teach more senior academics a thing or two about this way of working - so in that sense, ALL researchers should have access to training."

Takeaway:

Training should balance disciplinary grounding with interdisciplinary breadth, communication and practical exposure.

Would training also be useful for PhD supervisors and more established researchers? If so, please specify what kind of training would be most helpful.

Total responses: **29**
(excluding 7 non-responses).

a. Interdisciplinary leadership/project management: **10 mentions**.

b. Communication/conflict resolution/facilitation **8 mentions**.

c. Epistemology/ontology awareness, integration of methods: **6 mentions**.

d. Stakeholder engagement and co-production: **5 mentions**.

e. Formats (peer-learning, case studies, co-learning): **4 mentions**.

f. Cultural/mindset change (responsibility, openness): **6 mentions**.

g. No / sceptical: **No mentions**.

Illustrative quotes:

"Yes. Training that highlights their responsibility in the process - often PhDs and ECRS are left to try and figure out interdisciplinarity on their own without sufficient support. Something that highlights the extra time that needs to be built into project plans and timelines to do this work well."

"I don't think you can 'train' - it is very experiential"

"Absolutely, training is just as important for PhD supervisors and experienced researchers as it is for ECRs. As leaders of interdisciplinary projects, they need support in developing skills that go beyond disciplinary expertise."

"Exposure to case studies of successful inter-disciplinary or multi-disciplinary projects and how they have bridged the disciplinary divides."

Takeaway:

Supervisors also need training, particularly in leadership, facilitation and supporting students.

Q17.

What 'soft skills' are required for effective interdisciplinary research?

Total responses: **30**
(excluding 6 non-responses).

a. Communication/active listening/translation **15 mentions**.

b. Respect, humility, openness: **13 mentions**.

c. Patience/tolerance of messiness/ambiguity: **9 mentions**.

d. Team building/trust/collaboration: **10 mentions**.

e. Conflict resolution/facilitation **6 mentions**.

f. Empathy/self-awareness: **5 mentions**.

Illustrative quotes:

"Communication between researchers is a common barrier and requires more time to allow understanding and agreement of different approaches and may require unpacking of assumptions in terms of how to approach or define a problem and its potential solutions. Being confident to ask 'stupid questions' of each other can be difficult for 'expert' researchers who are highly skilled in their own field but do not have skills in other areas. Team building and respect are also very important."

"To me the skills that facilitate collaboration and mutual understanding across disciplines include: Communication: The ability to clearly explain ideas and listen actively to others, especially when terminology and concepts differ between disciplines; **Team building: Fostering trust, respect, and a sense of shared purpose among diverse team members; Flexibility and open-mindedness: Willingness to adapt one's approach and consider alternative perspectives; Conflict resolution: Managing disagreements constructively to maintain positive working relationships; Empathy and respect: Appreciating different disciplinary cultures, values, and methodologies without judgment; and Collaboration and negotiation: Working cooperatively to find common ground and integrate diverse expertise."**

Takeaway:

'Soft skills' are seen as the bedrock of effective interdisciplinarity, enabling trust, collaboration, respect and resilience.

Is there anything else you'd like to add?

Main points raised:

a. Interdisciplinarity is rewarding but challenging, requiring patience, openness and institutional/funder support.

b. Investing in ECRs and training across all career stages is essential.

c. Respectful co-creation with external partners is critical.

Takeaway:

Interdisciplinarity is highly valued, but achieving it requires structural change in academia, better training and stronger support.