THE NEXUS NETWORK
new connections in food, energy, water and the environment
An ESRC investment

Maps, Measures and Narratives for Transdisciplinary Research

A workshop for the ESRC Nexus Network

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Introduction

The following report summarises the activities and discussions at the workshop coordinated by the ESRC Nexus Network at the UCL Institute of Global Prosperity on 1 May 2018. It offers some conclusions and recommendations drawn from the insights provided by the participants, who were all researchers with experience of working on transdisciplinary research projects. All views and comments made by participants during the workshop have been anonymised.

Background

Since its launch in June 2014, the Nexus Network has supported transdisciplinary research at the food-water-energy-environment (WEFE) nexus, and created meaningful links between communities of researchers, policymakers, business leaders and practitioners. Part of this work has focused on developing insights into tools and methodologies for nexus thinking and practice. Over three years, the Nexus Network awarded grants totalling more than £700,000, ranging from £5,000 to £150,000, to 27 project teams across the UK. The Network also convened workshops with researchers to address issues related to this work.

Setting the scene: developing nexus capabilities

The Nexus Network hosted a workshop "Transdisciplinary Research for Developing Nexus Capabilities" at the University of Sussex on 29–30 June 2015. As well as focusing on what combinations of methods might form the basis for transformative action to address nexus challenges, this workshop considered the skills, training and capabilities needed to develop these methodologies among researchers. Professor Andy Stirling (SPRU) prepared a discussion paper which was circulated to workshop participants prior to the event.[1] A few key points made in this paper, summarised here, are relevant to this report.

Transdisciplinary nexus-related research demands methodological pluralism, harnessing a range of techniques for engagement between diverse stakeholders. The act of engagement does not simply take place within academic disciplines. The design, implementation and interpretation of the entire research or appraisal process is conducted as an equal collaborative partnership with disparate wider interests beyond the practitioners themselves. The quality of these interactions is as important as the act itself.

This leaves various implications for research. Transdisciplinary research requires practitioners interrogate and interpret evidence and data in diverse ways, paying attention to both subjective and objective dimensions of interactions. It also requires scrutiny over the conventional ways in which research projects are organised, the way peer review is conducted, academic excellence is assessed and impacts achieved.

Many at the workshop in 2015 felt more capacity was needed to be built for transdisciplinary research.[2] Suggestions for this included enabling researchers to develop boundary-crossing skills. Working in this way may be inherently uncomfortable for researchers who have come through a single-discipline background, and support mechanisms need to be improved. This is partly a matter of funding but also of mentoring, personal support, and building career routes for transdisciplinary researchers.

Transdisciplinary research on nexus problems

In 2017, five Nexus Network Partnership grants were awarded to research groups aiming to advance understanding of WEFE interactions, support actions to improve their sustainability, and to build research collaborations in locations in the UK and overseas. These projects are outlined, briefly, on page 2.

From reviewing the reports of these projects[3], it was clear that significant value in the work derived not simply from studying the qualities of the interlinked objects and domains (water, energy, food, etc.), but from taking seriously the social and subjective processes involved in doing the linking. In other words, what matters is the means by which knowledges, methods and practices are brought together. It was in light of these observations, that the theme of "maps, measures and narratives" emerged for the Nexus Network's follow-up workshop, as a means to interrogate the processes of transdisciplinary work and the capabilities required to do this work in the first place.

Why maps, measures and narratives?

Maps establish a particular view on something that illustrates various borders, boundaries, connections and linkages. The workshop held on 1 May 2018 was designed to use maps – cartographically and metaphorically – to reconstruct, reflect, learn and, to observe transdisciplinary research practices in a new way. Participants would construct their own maps: taking a plural approach to the subjects, objects and measurements required to do so; noting the narratives that emerge from this process; keeping in mind the question, "what measurements are appropriate and necessary to help us assess something that is transdisciplinary?"

[1] http://www.thenexusnetwork.org/wp-content/ uploads/2015/06/Stirling-2015-Nexus-MethodsDiscussion-Paper.pdf
[2] Cairns, R., Wilsdon, J. and O'Donovan, C. (2017). *Sustainability in Turbulent Times: Lessons from the Nexus Network for supporting transdisciplinary research*. The Nexus Network. [available at: http://www.thenexusnetwork.org/wp-content/ uploads/2017/03/sustainability-in-turbulent-times.pdf]
[3] Reports are all available from The Nexus Network website: https://thenexusnetwork.org/projects/partnership-grants/

Network of organic resource use in rural Africa
Euan Phimister, University of Aberdeen, UK (PI)
Aims: to bring together a range of Ethiopian partners (regional and local policymakers, scientists, entrepreneurs, industry and civil society) to co-design research on organic resource use in rural areas of Ethiopia.
Biomass at the Nexus
Sujatha Raman, University of Nottingham (PI)
Aims: for social scientists to lead a team of physical scientists and stakeholders to investigate how urban households and charcoal producers in Ghana experience, envision and manage the nexus between energy, food, waste and the environment, and to develop and disseminate the implications of this bottom-up understanding for national and international policies.
Unravelling complexity: understanding the land-water-food nexus in Elgeyo-Marakwet, north-west Kenya
Henrietta Moore, UCL Institute of Global Prosperity (PI)
Aims: to bring together interdisciplinary experts, policymakers, and community members to explore the land-water-food nexus in Elgeyo-Marakwet County, Kenya, examining how two communities have managed resources over time and have adapted to changing climate, water availability, deforestation, land degradation, and biodiversity loss.
Reshaping the domestic nexus
Matt Watson, University of Sheffield (PI)
Aims: to bring together new evidence and understandings of household consumption within the nexus of water-energy-food resources to the attention of key policy partners in the UK, in collaboration with the Department of Environment, Food and Rural Affairs (Defra), Department of Business, Energy and Industrial Strategy (BEIS), Food Standards Agency (FSA) and Waterwise.
The climate-energy-food security nexus
Sally Shortall, University of Newcastle (PI)
Aims: to address the potential impacts of climate change and future energy availability on food and farming in Northern Ireland, employing interviews and multi-stakeholder scenario planning workshops to explore different perceptions of food system sustainability in Northern Ireland.

Mapping diversity

One of the specific interests we had in utilising mapping techniques was to address the question of how to account for diversity in transdisciplinary research. Collaborative interactions were a significant feature of the research process with the Nexus Network's Partnership Grant projects. More generally, in transdisciplinary research, such interactions are precursors to future outputs and outcomes that stem from research activity. Despite this, it has been identified that such collaborative interactions, particularly those that bridge individuals that rarely interact, are less studied and their importance less well understood.[4]

To address this matter in the context of the Nexus Network's activities, we drew influence from the Diversity Approach for Research Evaluation (DARE), developed by a team of researchers based at the Science Policy Research Unit (SPRU). DARE offers a framework and a set of techniques to study whether and how specific initiatives help to spur the interactions between fundamental research and applied problems. It tracks key changes in the patterns of collaborative interaction and provides an opportunity to learn how diversity in the constitution of research teams affects their performance. It can yield insights into how different types of teams or units work successfully (or don't!).[5]

Taking the lead from the approach used in the DARE protocol, the question of diversity in a research initiative can be viewed from multiple perspectives to understand how the diversity of collaborative interactions may have changed over time through techniques of measurement and comparison. While the case studies for the DARE framework have to date been confined to biomedical research, we saw the potential for broadening the application of this to an analysis of diversity in transdisciplinary research on WEFE nexus research projects.

Workshop summary

The focus

The aims of the workshop were two-fold. Firstly, to reflect on participant's recent and ongoing practices with transdisciplinary research. This was to show how these practical experiences can enhance capabilities for future transdisciplinary research. Capabilities are recognised as a necessary input for research as well as an emergent output. Collaborative interactions, particularly those that bridge individuals that rarely interact, are less studied and their importance less well understood.[6] To what extent do the knowledges, methods and capabilities enhanced or created through Nexus Network research coincide with current and future calls demand for collaborative interaction in research? What

[4] http://www.sussex.ac.uk/spru/research/dare/data/DARE_User_Guide_2017.pdf
[5] ibid.
[6] ibid.

do these knowledges, methods and capabilities mean for the capacity of research councils and the funding institutions in the UK and beyond, for supporting transdisciplinary research?

Researchers from each of the Nexus Network Partnership Grants programme joined a larger group of researcher participants at this workshop to help reflect on their experiences of planning, doing and managing transdisciplinary research at the coalface. We were pleased that Frédérique Bone, Research Fellow at SPRU and DARE team member, agreed to interact with participants at the workshop, particularly during the mapping sessions.

Transdisciplinary research: experiences and insights from the Nexus Network

Henrietta Moore, director of the UCL Institute of Global Prosperity (IGP), opened the workshop with some opening remarks on transdisciplinarity and 'grand challenge' research from the perspective of the IGP. Partnership is a core element for addressing the Sustainable Development Goals (SDGs) and the work that is ongoing at the IGP is committed to this way of working, with projects that engage both academic and non-academic actors. These projects reflect the productive reach of transdisciplinary research, and help us to break down the silos between academic disciplines and challenge the way in which we think about the practice of research. Moore remarked that the Nexus Network also has been doing important work in prioritising understandings of the complex interlinkages across the key domains of food, energy, water and the environment.

Brief presentations were made by members of the research teams from all six Partnership Grant projects. The presentations reflected the different ways in which transdisciplinary research is approached and practised, and the various challenges that can occur in different contexts.

Highlights from presentations[7]

A researcher from project 1 explained how the project team members had been brought together as a result of long and well-established working relationships over decades. For this project, the research team spent a long time in the local community socialising, building social bonds and personal relationships (eating together, going on trips, etc). Therefore, before engaging in the direction of the research agendas, they already had an understanding of the dynamics of the local partners, their problems, their agendas and constraints. They understood what people needed in terms of financial assistance, in terms of working hours and flexibility, family support, school fees, advice on engaging with other actors (including NGOs and policymakers).

The UK research team allowed their research agendas to be shaped by the local communities by proposing a broad topic about which communities expressed their concerns. They co-designed the research methods with the local communities; for example, how soil and crops should be recorded, how different people should be spoken to and who should be interviewed. The communities cleaned and analysed that data with the local research team. For the interviews, they used two notebooks: one where the original interviews were recorded and another one where the local research team interpreted the data. The results were discussed with the communities and local research team and the different understandings collected.

The Co-investigator of Project 2 had some reflections on their experiences and on transdisciplinary research practice in general. In terms of capabilities, they faced several challenges. They were the only full-time researcher engaged in the project and it was the first time for them conducting research beyond the boundaries of their own disciplinary area. To work with non-academic partners and address particular issues in a practical way, they needed to develop skills such as partnership building, group facilitation, policy advocacy and project development. This stretched the established understanding of what a researcher is and does. Their previous experiences outside academia helped them to figure out ways to do transdisciplinary research, but, on reflection, having a partner with a non-academic stakeholder background would be crucial to ensuring the success of the project. They also argued that transdisciplinary projects benefit from non-academic colleagues who can provide administrative and communications support during and after the project.

The researcher described the reflexive process they went through when addressing the ethics and boundaries of the research. They asked themselves whether they were facilitating the engagement of other people's ideas, or imposing their own. They also expressed frustration by the limited timeframe placed on the project. Engaging people in research processes takes time. They argued that transdisciplinary research would benefit from a 'pre-project' stage, with additional funding allocated, whereby more preparatory work could be done and more people engaged.

The PI from Project 3 described how the disciplines involved in the project included social sciences, environmental modelling, sociology, economics and social psychology. Subsequently, the ways in which the individual academics framed the problem were varied. For example, while one colleague with a background in economics would think about 'market-failures', someone with a background in natural sciences considered the issues in terms of soil fertility. As the project leader, they appreciated that such tensions can be generative – conflict being essential to produce something that is

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[7] All accounts given from the project representatives given at the workshop have been anonymised for the purposes of this report.

interesting – but have to be managed carefully.

Further to this, the project sought to involve local stakeholders in shaping the research; to do that, they had several stakeholder meetings, workshops and focus groups. They recognised they faced a challenge over how to create a sense of team, not just across academic disciplines but also with the local communities. The PI recalled how aspects of the project design, such as data collection, were changed following consultation with stakeholders. Beyond conventional academic outputs, for the PI, the success of this project would be judged by whether, in five years' time, they still manage to work with the same people. Also, echoing Project 2's argument, if the research is to be shaped meaningfully by stakeholders, there should be sufficient time to revisit and reconsider the project process and make necessary changes.

The co-investigator of Project 4 made it clear in their presentation this was not a transdisciplinary project in the normative sense, since all the researchers shared the same epistemic background. Compared to Project 3, maintaining the research team was not a challenge. They were all epistemologically committed to the embedment of interpretive social science in driving sustainability policy in the UK.

The challenges for this project arose while working with their non-academic partners. The project team had relationships with key people in those organisations, with whom they met at different intervals during the project, but these key contacts changed in the project's lifespan. These changes had significant impact on the project, as the agendas and priorities of the organisations also changed with the shift in personnel. This impact was a double-edged sword; while the project became even more important to some organisations, for others, the new priorities and agendas set by new personnel made the project less relevant. In addition to this, partners in the policy sector would not commit to implementing the researcher's recommendations until they could see evidence of them working in practice. Subsequently, finding evidence was a big challenge for the research team to keep partners involved.

The PI explained that Project 5 benefitted from having an interdisciplinary research team that was used to working together, and all familiar with the insights that interpretative social sciences can bring. The challenge came from the fact that the team was working at a new site; they had never worked with people in that country before. The project involved not only new partners in a new country but also new partnerships

with stakeholders from civil society. The PI explained how this presented bureaucratic challenges, and that they personally acquired new negotiation skills around contracts to keep both the legal teams of the university and partners happy.

The project's transdisciplinary approach challenges data hierarchies and associated biases from within both civil society organisations and public organisations who often have their own sense of what kind of data is important. It also breaks boundaries between qualitative and quantitative research and counters the goals and challenges defined from the top-down (e.g. by the GCRF), which often run the risk of pre-defining local priorities, with bottom-up, social interpretive insights. If transdisciplinary research is to continue, the PI argued, creating a demand for these kind of interpretive insights is a must.

Mapping Transdisciplinary Research

Following the presentations and reflections on the participants' experiences, a series of mapping exercises were conduced in a World Café format. During these exercises, participants were encouraged to consider their experiences in relation to capabilities, not only of the research team but also of the other partner organisations, universities and funders. What are the capabilities of the researchers, of partners and all stakeholders to do this research and develop the appropriate methodologies?

By way of introduction, Cian O'Donovan (The Nexus Network) presented provisional results[8] of an exercise he had conducted in preparation for this workshop. Working with colleagues at SPRU and using techniques from the disciplines of scientometrics and bibliometrics, he mapped the knowledge created by the Nexus Network by using the Web of Science database across 227 knowledge categories. He used networking software developed by DARE to map them.

Core concepts from the DARE framework were operationalised in the workshop using mapping techniques (e.g. Schiffer, 2007)[9]. Based on citations collected from the Web of Science, the resulting 'Map of Science' calculated visually the distance between fields, representing how related the subjects are. It suggests a structure of science, with proximity indicating cognitive distance.[10] It graphically represents the distance between, for example, 'social sciences' and 'physical sciences'.

Cian presented knowledge maps composed from papers in academic journals with keywords related to the WEFE Nexus (see Fig. 1). The maps located and

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[8] The five project maps displayed inaccuracies, pointing to some shortcomings of using a bibliometric approach to map capacities for transdisciplinary research. Maps by their nature seek to foreground some features of reality while backgrounding or abstracting others. In this way, bibliometric techniques represent a useful starting point, opening up conversation, but cannot on their own account for a full description of the project teams.

[9] Schiffer, E. (2007) The Power Mapping Tool: A Method for the Empirical Research of Power Relations, IFPRI Discussion Paper 00703. 00703. Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.75.9011&rep=rep1&type=pdf.

[10] See Leydesdorff, L., Carley, S. and Rafols, I. (2013) 'Global maps of science based on the new Web-of-Science categories', *Scientometrics*, 94(2), pp. 589–593.
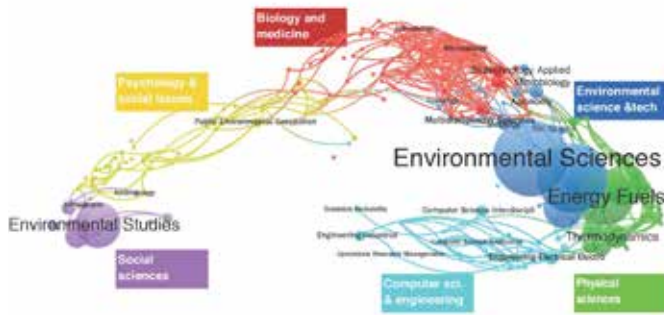
Fig. 1. A global science map of aggregate category counts and citing similarities. Based on 227 ISI Subject Categories (2015). Data: corpus of 526 journal articles returned from a Web of Science search for 'WEF nexus' and related terms.

Fig. 2. A science map of aggregate category counts based on 227 ISI Subject categories (2015). Data: bibliometric data returned from a Web of Science search for articles by researchers working on Nexus Partnership Grant projects.

visualised nexus disciplines and illustrated how they are connected around specific research problems. The map showed how, perhaps unsurprisingly, there is a great deal of knowledge mobilised from environmental and physical sciences, while the relative contribution from, and connectivity with, social sciences is significantly less.

Yet, when the bibliographic data of all the Nexus Network grantees was mapped using the bibliographies of the project researchers (e.g. see Fig. 2), the relative contribution and connectedness of social sciences was far greater. This would suggest that the research supported by the Nexus Network is bringing both new knowledge to the WEFE Nexus and new disciplinary capabilities needed to address in these challenges. Exploring these in further depth was the central task of the later sessions in this workshop.

Accounting for non-academic stakeholders

Participants recognised that it would be important to try to map these interconnections with partners outside the academia. This would result in more complex maps that would go beyond disciplinary knowledge mapping. While we might construe some information about the qualities of the interlinked objects and domains, it is limited. How do we understand the social and subjective processes involved in doing the linking? Who is doing the linking? What happens when the PI goes on holiday? What dynamics take place in the absence of the researcher(s)? What does this tell us about capabilities and capacity?

The mapping exercise is only half of the picture. These projects incorporated other knowledges that are not reflected in bibliometrics: for example, the farmers that brought a wide set of skills to one of the projects. Qualitative data could draw out details of these capabilities for doing transdisciplinary research, but how? When it comes to evaluation of the research, it was observed that the non-academic stakeholders are still prone to being on the receiving end of this conversation, rather an integral part of it. Their experiences of this process are important for understanding more about capabilities.

Transdisciplinary research is predicated on the value of co-production, working with non-academic communities. It was noted that non-academic communities are no less heterogeneous than academic equivalents, and that there is a politics that exists not only between the academic and non-academic stakeholders, but among the non-academic stakeholders on the ground. This insight emerged during the workshop, when participants shared experiences of navigating certain misrepresentations that can arise from tensions between non-academic institutions and the individuals working with or for them. Sometimes, a key contact inside an organisation can give researchers support and insights not necessarily shared by their organisation. Another concern in this area was that by relying too much on organisations, researchers miss other important points of view from the members of civil society that fall outside of these organised groups.

So, are there appropriate measures for the proximity and diversity of methods, actors, networks, power, agency, geographies, institutions, social proximity, organisational proximity? This was the prompt for the afternoon session of the workshop. Workshop participants were asked to consider a series of questions drawn from the morning's discussions: When the WEFE nexus brings together two or more areas of science, what are the issues that arise? What happens to knowledge when institutional boundaries transgress? How have encounters with citizens and other stakeholders taken place? What are the particular aspects of institutions that inform how research proceeds? Who gets to be in charge? Should any single discipline be in charge?

The World Cafe

The World Cafe consisted of three tables, or stations, around which participants circulated to discuss three topics for fifteen minutes each. Participants were provided with boards, pens and magnets to experiment with their own diversity and proximity mapping.
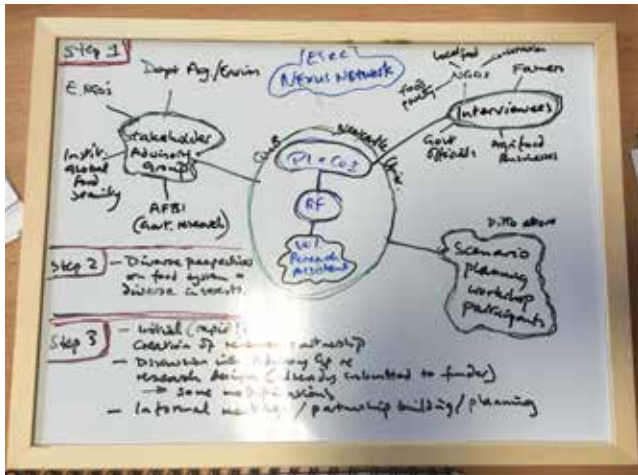
Fig. 3. Example 1 of a map produced by a participant during the World Cafe session at the workshop; mapping proximities and diversities of methods, actors, social relations, power, institutions and organisations.
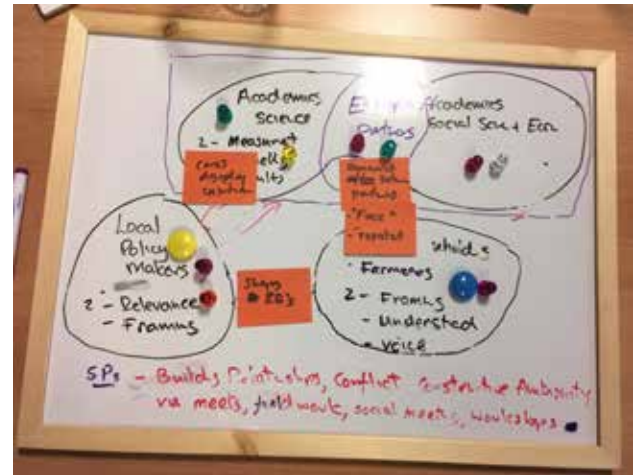

Fig. 4. Example 2 of a map produced by a participant during the World Cafe session at the workshop; mapping proximities and diversities of methods, actors, social relations, power, institutions, and organisations.

Borders and boundaries

This table was for identifying the confines researchers experienced when practising transdisciplinary research. Boundaries were perceived between government institutions, and between citizens and communities. There were groups defined within civil society, denoting boundaries between organised civil-society groups and less- (or non-) organised ones. It was also noted that the levels to which individuals within civil society groups have received education, and the nature of that education, creates boundaries.

Within universities, participants identified a wide range of boundaries, ranging from epistemological differences (positivists vs. constructivists), academic departments (which has an impact on funding options), backgrounds and research experiences. It was observed that there remains a lack of coherence between the promotion of inter- and transdisciplinary research and the teaching model in UK universities. Undergraduate teaching should encourage this type of research and train people with the soft skills needed to engage actors outside academic spheres. REF units create boundaries and also have an impact on promotion and opportunities for getting better jobs.

Who helps cross the boundaries? Who gets the money, who goes to the meetings? Who gets to be part of a project and who does not? What is the role of the partner organisation(s) in relation to these questions? Who has the power? There are bureaucratic and administrative boundaries dictating the flow of economic resources between different countries. Different institutions follow their own idiosyncratic logics. There are political powers dictating who is granted capability to travel by permitting the required visas and entry permits.

Some stakeholder groups may have suspicions or mistrust of each other, which creates boundaries. Here, the people that are crucial are those who can help researchers and research teams bridge different groups and translate the messages into a language that is understand by those actors. Some tactics and experiences of working within such boundaries follow. At the individual level, the research process may benefit from key personnel because they have a particular logic that is not necessarily shared by their entire organisation, but if teams lose those key contacts, new boundaries can be generated. Sometimes, respecting boundaries can encourage disclosure. Sometimes, researchers can use a 'common enemy' (i.e. Brexit) to break down boundaries and build alliances.

Processes of connection: towards building capacity

This linked nicely with the discussion identified by the table looking at processes of connection. It was felt that the Nexus Network and the concept of 'nexus' itself have helped to connect people and bring them together around a common goal, not least through the mobilization of funding. The role that different networking events played is crucial, since those were spaces in which people found out with whom they could work. That was influential in building the teams and shaping the projects. All the Partnership Grant projects allowed communities, policymakers and other actors to shape the research. Through the process of co-production, the key questions of the research and the priorities were collectively identified, which helped to cross boundaries, bridging communities with actors that have power (e.g. funders and international organisations).

Agency, power, methods – who has agency, who frames the problems, who selects the methods?

At this station, participants were encouraged to discuss who and what (since it's not just about agency, but also structures) decides methods, duration, frames, interpretations, approaches, participants and design. It was pointed out that there is no level of research or organisation in which power relations are not present. Who or what, then, determines project outputs? Who/what owns the narratives and accesses the impact?

It was discussed how the Nexus Network had enabled researchers to push forward an agenda for social sciences. With the acceptance of the project, the researchers achieved legitimation for social sciences methods, while stakeholders acquired new evidence-based research, which has led to mutual empowerment.

Knowledge brokering has a different dynamic depending on who is interacting with whom. The lexicon of the research requires flexibility to adapt to the jargon and terminology required for the funding call-out, and to effectively communicate with the local actors and stakeholders. This was one instance where it was felt the term 'nexus', for instance, had been a challenge. This has consequences for power dynamics and for capabilities in transdisciplinary research.

Experiences were shared over the conflicts among academic actors when deciding on matters such as remuneration for non-academic, civil-society partners. Effective interaction with focus groups requires common ground, which the academics cannot provide easily. It was considered important to take account of the process for establishing partnerships and justifying partnering with one organisation over another. Researchers risk homogenising and depoliticising social groups by generalising them as part of certain sectors of civil society, favouring expedience over complexity and accuracy.

Conclusions

How best, then, to do transdisciplinary research? Any attempted answer to this question, which arose during the workshop, would need to consider the inception of the work as a phase distinct from its duration: the capabilities required to initiate a transdisciplinary research project are not necessarily commensurate with what is required to keep it going, let alone reach a project's conclusion, considering that the maintenance of the relationships created is a significant outcome of the project in itself.

There are capabilities that are a requirement for the various types of research and methodologies proposed in the project funding applications, but there are also emergent capabilities generated along the way. It was recognised by participants that there is required capacity for managerial and academic skills. However, such skills are not necessarily compatible with academic career paths, which typically require disciplinary specialisms among other demands not linked to transdisciplinary capabilities. This is a matter of concern for many who were present at the workshop.

Transdisciplinarity sets out a way to do co-produced research. It is an ongoing process. It's not only about solving problems but thinking about new ways of understanding the problems. Integrating disciplines to co-define research problems is a challenge. Further

to this, participants believed lessons have been learnt regarding how to work with actors on the ground to co-define research questions and agendas, but there are still some challenges regarding how to confidently apply those lessons in future work.

Despite the focus on transdisciplinary research, it was discussed in the workshop how power imbalances persist and different levels of hierarchy persist in this work. From the point of view of the researcher, there needs to be an awareness of the decisions made when establishing partnerships, and the knock-on effects of these decisions. While Organisation A may be easier to work with than Organisation B because there is a history of working together, what biases, omissions or other complications might this introduce to the process? Meanwhile, working with Organisation B may require additional mediation to appreciate the context and dynamics in which the partnership will work.

It is important to be aware that terms such as co-design and co-creation can be used as normative concepts while lacking a practical dimension. We need to be aware of and discuss power relations when thinking about and doing transdisciplinary research. For example, how does the leadership work to maintain healthy team relations and allow for equitable participation? Who is invited to the meetings? Who speaks at those meetings? At stake here is the capability for understanding and developing agency.

What do funders need to know?

The projects funded by the Nexus Network Partnership Grants established links between what communities need on the ground and the kind of evidence required by policymakers and international organisations. These links illustrate how transdisciplinarity is an essential approach to research in highlighting very real social, technological and environmental issues. It appears there is a clear case to be made for supporting this kind of research. However, determining who/what is benefitting from transdisciplinary research and how is a matter for further research.

The outputs of transdisciplinary work require closer consideration, establishing what they are and how they may be construed, considering the quality of the research, the capacity for further research, the capacity of team members to lead other projects in the future, the career trajectories of team members. Approaches such as science mapping and the DARE framework offer scope for assessing and evaluating transdisciplinary research. However, much work remains to be done in providing funders and evaluators with tools by which to assess transdisciplinary research outputs. This gap represents a significant limitation for supporting the continuation of this work. Workshops like this one surely represents a contribution to this, and we suggest

attention to research capabilities and capacities offers one particularly fruitful avenue for future work.

Transdisciplinary research, it was argued by one participant, might be seen more as a means to an end: pursuing the research questions that are most meaningful for the given context is the most important goal, but using transdisciplinary research methodology helps to delimit the process of framing those questions. Not all research needs to be transdisciplinary. However, transdisciplinary methodologies give an important message that needs further promotion. The stories and qualitative data generated at this workshop supports the case for improved capacity for transdisciplinary research and indicates which capabilities might be usefully enhanced in building such capacity. These capabilities are vital not only to academic departments and universities, but also to Research Councils and other funding organisations committed to enhancing our ability to perform transdisciplinary research.

Author bios

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Acknowledgements

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This leaves various implications for research. Transdisciplinary research requires practitioners interrogate and interpret evidence and data in diverse ways, paying attention not only to seemingly objective domains of water, energy, food and the environment, but to the subjective dimensions of interactions between them. It also requires scrutiny over the conventional ways in which research projects are organised, the way peer review is conducted, academic excellence is assessed and impacts achieved.

This report summarises the activities and discussions at the workshop coordinated by the ESRC Nexus Network at the UCL Institute of Global Prosperity on 1 May 2018. Building on previous Nexus Network events including a special 2015 workshop on "Developing Nexus Capabilities", participants interrogated the processes of transdisciplinary research and the mapped some of the capabilities required to do this work in the first place. This report offers some conclusions and recommendations drawn from the insights of participants, researchers with experience of working on transdisciplinary research projects.

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