
# Holistic Approaches to Understanding Diffuse Land Management Issues: A Framework for Interdisciplinary Working

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**Summary**

Diffuse land management problems, such as diffuse pollution from agriculture, are the consequence of cumulative individual actions over a large area. These actions and their consequences are shaped by both the physical environment and the social, political and economic context. This paper presents findings from a capacity building project, funded by the Rural Economy and Land Use Programme, that sought to find new ways for natural scientists and social scientists to work together with stakeholders in tackling diffuse problems. Several workshops were held, with key stakeholder groups and scientists and the results have informed the framework presented here. This framework is not prescriptive but suggests a quite radical way of conceptualising how to conduct research into environmental problems.

**Introduction**

This document results from a project funded by the Rural Economy and Land Use programme (RELU). RELU is a joint initiative involving the Economic and Social Research Council (ESRC), the Biotechnology and Biological Sciences Research Council (BBSRC) and the Natural Environment Research Council (NERC). It has a budget of £20 million, with additional funding from the Scottish Executive Environment and Rural Affairs Department and the Department for Environment, Food and Rural Affairs. The programme's aim is to advance understanding of the social, economic, environmental and technological challenges faced by rural areas. Central to RELU's ethos is a requirement for researchers from across the natural and social sciences to collaborate in new ways.

Our project was funded by RELU as a 'capacity building' exercise, to bring researchers with very different backgrounds together with a diverse range of stakeholders and other researchers, rather than as a piece of primary research. The aim of the project was to contribute to the development of interdisciplinary approaches to broaden our understanding of the causes and consequences of diffuse agricultural pollution. The central element of the project was a series of four workshops, each designed to capture different sub-themes within the subject area. A report of these workshops, plus slides from the contributed presentations, is available at http://www.lec.lancs.ac.uk/cswm/diffuse/index.htm.

In this document we set out the need for a radical approach to interdisciplinary collaboration in research into diffuse land management issues. This need is grounded in both the physical nature and socio-spatial contexts of the problems produced through diffuse land management practices and in the wider social context of public controversies surrounding scientific and technical decision making. We believe that the main driver for interdisciplinary working from a policy perspective is the need to better understand complex 'real world' problems. This also demands greater public participation in the research and problem-solving process. Diffuse land management practices are the subject of scientific dispute and public controversy in the wake of competing efforts to locate and manage issues such as pollution events and flood risk that variously affect the livelihoods, property and concerns of different social groups.

Through our capacity building project we have gathered a range of perspectives on environmental management, public engagement and interdisciplinary collaboration that we have combined with our own conceptual framework, developed in parallel with the workshops. Therefore, this document is an early step in a new approach to *interdisciplinary environmental science* that requires social and natural scientists to work together, with non-scientific research partners, in ways that challenge respective knowledge claims and generate new understandings and competences. This approach is experimental. We would hope, however, that there are enough practical insights presented here (especially in the last main section) to provide some useful material for anyone engaging in interdisciplinary research into diffuse land management

issues. We offer this material tentatively, as a means of stimulating wider debate, both within and outside of the RELU programme.

**Context**

*Diffuse land management problems*

Diffuse problems such as agricultural pollution are the consequence of individual actions shaped by a wider political landscape: to understand the causes of diffuse problems we have to move outside traditional disciplinary boundaries in order to understand the social and environmental dynamics of those causes. Diffuse land management practices are a crucial component of the protection and enhancement of the water environment. Until recently, it appeared cheaper and less controversial for water managers to deal with the consequences of rural land management problems rather than tackle their causes because sources are difficult to pinpoint, attribute and control. The balance of evidence now contradicts this approach. For example, total costs to society of eutrophication are estimated at £58-89 million (Pretty *et al.*, 2003) while, in the UK, annual spending on adapting farm practices to reduce diffuse nutrient pollution amounts to less than £3m. The need to address this imbalance is recognised in the Government's review of diffuse agricultural pollution (Defra, 2002). Similarly, as the number of people in England at high risk from flooding is predcited to double over the next 80 years so the costs to residential and commercial properties are set to rise from £0.9 billion a year to an estimated £20 billion (Evans *et al.*, 2004). In consequence, the diffuse pollution and flood management literatures both point to the multiple (environmental, landscape and amenity) benefits of adopting land management policies that work with, rather than against, 'natural' catchment functions.

*Controversies – drivers for a radical approach*

The contested nature of scientific knowledge claims and technologies has long been recognised by sociologists and philosophers of science (*e.g.* Law, 1991; Nowotny, *et al.*, 1994; Stengers, 1997). However, in the wake of a series of public controversies (*e.g.* GM foods, mobile telephones, nanotechnology), this recognition has gathered force as the contested nature of new knowledge claims and technologies has become both more routine and more widely acknowledged. In this context, publicly funded research designed to 'settle' environmental uncertainties can itself anticipate being the subject of public dispute. Attention is now increasingly focussed on how to cope with scientific uncertainty and regain public confidence in the knowledge claims and technologies that inform public policy, as evidenced by a proliferation of reviews (*e.g.* House of Lords, 2000; May, 2002; Strategy Unit, 2002; OST, 2003; POST, 2004). Such reviews signal that a shift in attitude towards knowledge controversies is underway, from a troublesome problem to be avoided to a creative process to be harnessed (Collins & Evans, 2002). Whilst its reach is uneven, the question of how to develop a new relationship between science and democracy (Nowotny *et al.*, 2001; Latour, 2004) or, as Demos (2004) have put it, '*how to make public science more public'*, is now firmly on the national agenda. Thus, for first time, the Treasury's new Science & Innovation'

Investment Framework (2004) identifies the need to improve public confidence and engagement in science as a priority, devoting an entire chapter to 'science and society' issues.

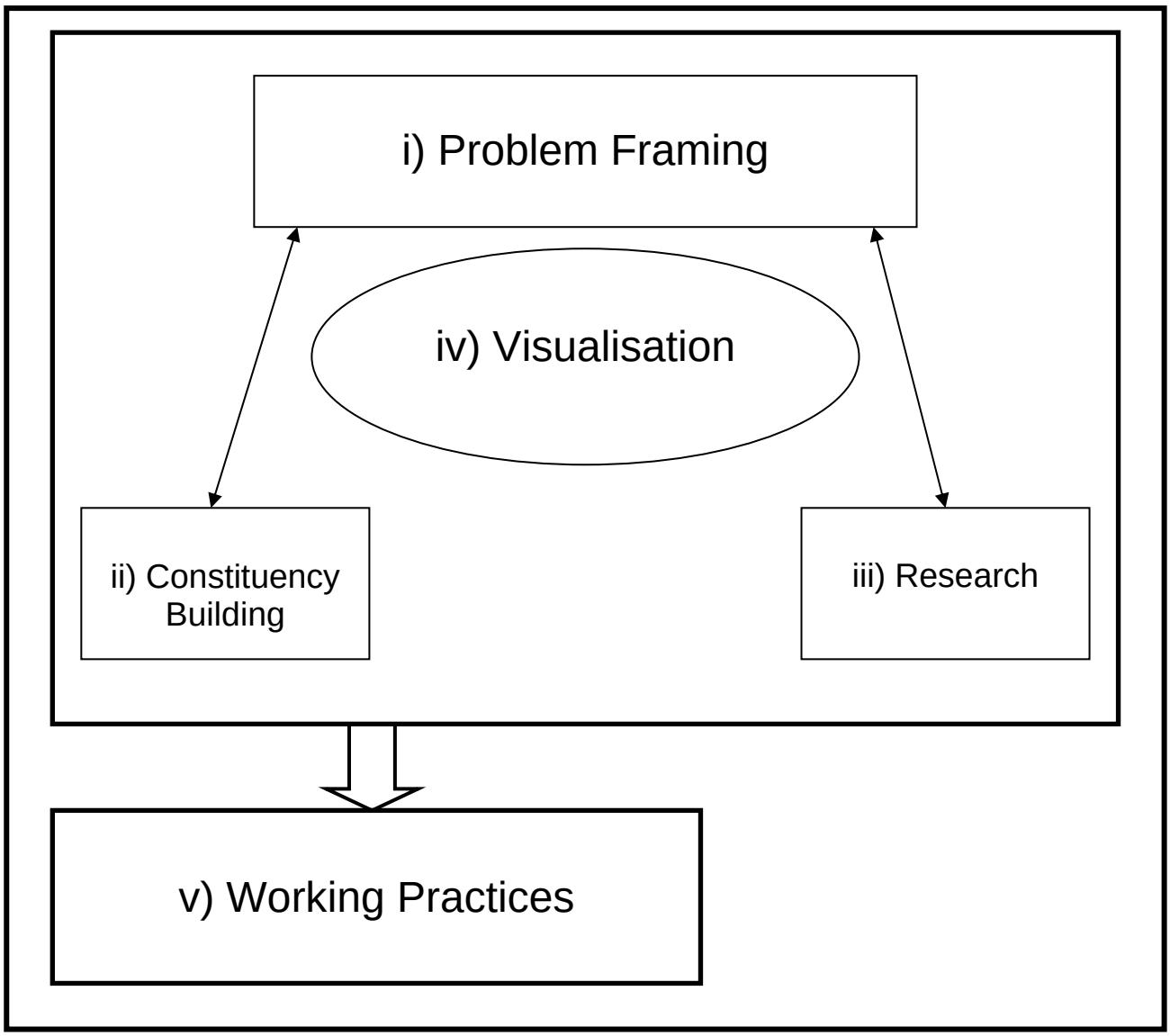
Knowledge controversies in the field of diffuse land management problems like pollution and flooding emerge in four main ways: Controversy can emerge (1) within particular epistemic communities (*i.e.* scientists or professionals sharing common knowledge claims/practices) usually over assumptions implicit in research design, sampling regime or model parameters that become exposed through peer review procedures; (2) around competing technologies derived from similar knowledge bases and practices as, for example, in the case of the commercial competition between different hydrological models; (3) between epistemic communities (*e.g.* modellers and field scientists) or institutional communities (*e.g.* commercial *vs* academic science), as different assumptions and methods are critiqued by those whose working practices and career tracks are shaped by different institutional imperatives; and (4) at the interface of scientific and non-scientific knowledge claims where disputes arise over what counts as knowledge and how different kinds of knowledge claim can be substantiated. Central to all of these controversies are the knowledge practices and technologies of measurement and modelling, both involve basic simplification (*e.g.* controlled plot experiments or the exclusion of processes deemed unimportant) in order to make the problem tractable, especially when there is a key requirement to scale-up results to large areas or long time periods. Moreover, the spatial separation of cause and effect implicit to diffuse environmental problems means that neither the source nor the management activities shaping them are readily visible to those most affected by them, placing a major burden of public trust on environmental science that has to be actively won rather than assumed.

*The practical need for a radical approach*

The spatial and temporal complications characteristic of diffuse environmental problems and practices are compounded by the extensive legacy of past interventions in river catchments and the diversity of policy goals being imposed upon catchments today, both of which complicate how 'natural' catchment functions are identified and defined. Thus, as we have observed in two of the cases studied in our Capacity Building project (the river Wharfe in North Yorkshire and Slapton Ley in Devon), river catchment management is unavoidably controversial, with the different knowledge claims and practices of multiple users, managers and scientists competing to realise different visions of what 'their' catchment should look like. What is catchment enhancement for one user group or species is as readily catchment degradation for another (*e.g.* lampreys need silted river sediments; salmonids need silt-free river sediments). It is for these reasons that we see significant potential in developing a new approach to interdisciplinary public science that harnesses the creative potential of such knowledge controversies to achieving more effectively *public* agendas and practices for sustainable water and land management in rural environments.

**A Framework for Interdisciplinary Working**

The figure below shows the relationships between 4 key elements in a framework for how interdisciplinary public science might be done. The fifth object reflects the more general working practices that frame this way of working. Below the diagram is a list of key issues and questions pertaining to each box in the process. The framework is not static or linear; it denotes a process, the key to which is an iterative approach to problem framing, as described below the diagram. It is also a way of systematically presenting the insights from our workshops. Some of these points may seem self-evident, but the pressures of interdisciplinary working require a systematic consideration of how they interrelate.




**i) Problem framing** is a formal starting point for the research process. However, if conceived of as an iterative and dynamic process in itself, which responds to research findings and inputs from the various scientific and public constituencies, problem framing can also become the central driver in

a radical and long-term approach to interdisciplinary public science. Importantly, as we use the concept here, it is possible that a problem could be 'reframed' (through iterative and collaborative research and debate) in such a way as to be considered 'solved' by those involved. However, it is equally important to consider that not only might no single solution be possible, but that there might be multiple problems resulting from the various constituencies involved. To force multiple framings of a problem into a single integrated problem could prove counterproductive. Problem framing as we see it here is about the development of multiple scenarios and the recognition of different views. Rather than aiming to bring closure to a situation, problem framing should aim to keep dialogue open. Many of the points below are phrased as questions – this is what problem framing is about.

- **What is the problem and for whom is it a problem?** This may seem like an overly obvious starting point, yet its position at the head of this framework reflects an exact reversal of the situation in one of our field-based case study workshops. After two days of discussions about decades of (natural) scientific research, reporting and public controversy and communication occurring around Slapton Ley in Devon, this question was raised during the summing up, because what seemed to be lacking from the discussion was any clear and definitive framing of what all of the activity in the catchment had been about. With the caveat that the framing should be allowed to change, this is a central question to ask throughout the research process.

- **Who is framing the problem and which problem are they framing?** This question parallels the first and, in complex situations might require some research to inform any answer. We should also be open to the notion that there might never be a single problem, that different constituents might have different views that are not easily reducible to a single problem. This also leads to another question: who *should* be framing the problem? This question has normative dimensions and relates to the issues gathered under the heading of *constituency building*, below.

- **How does the framing demand or constrain courses of action?** This question partly reflects the need to decide on the nature of research required to inform decision-making and problem reframing. Importantly, it also requires a critical examination of exactly how any given framing of a problem constrains future framings (*e.g.* can the problem-as-framed be 'solved'). These issues may affect constituents differentially.

- **Be prepared to step outside of institutional norms.** The institutions referred to here may be particular policy or regulatory regimes, academic disciplines or other socio-cultural forms such as 'community'. Each has its own ways of viewing particular problems, or deciding whether an issues is a problem at all. This point refers to a need to 'think outside the box' as

well as being forward looking, and not simply following what has gone before in terms of knowledge production. Therefore, this issue also relates to how research concerning the problem might need to be done (see *research* section below).

- **Dealing with a dynamic environment.** This is an issue that could specifically impact on the framing of problems related to diffuse land management issues that emerged during our Wharfedale case study workshop. It centres on the views of different constituents regarding how to deal with a dynamic environment in the light of ideas such as conservation and heritage. Should land management practices be used to maintain a static landscape, or should a more 'natural' ecosystems approach be adopted? What are the determinants for each approach? These are debates in wider society and policy domains that can influence the framing of problems in a local context and that will also have particular local expression.

- **Hard and soft solutions / measures.** One issue raised during our workshops concerned a tendency to require 'hard' solutions to problems, or 'hard' measures to deal with problems, with the implication that these were fixed, robust and long lasting. In comparison, a soft approach would be seen as not definitive and open to being overturned, and as such less desirable. Some participants suggested a complete reversal of these value categories, such that soft solutions were seen as flexible and able to deal with a dynamic environment and changing social context, in some sense more sustainable. This latter approach gels with a dynamic conception of problem framing.

**ii) Constituency Building** involves bringing together those groups of people with an interest in the problem – or an interest in *defining* the problem – or with knowledge or competencies that can be brought to bear on a problem. This is a broader mode of thinking than might be implied by the more commonly used notion of 'stakeholders', particularly as it does not assume that the 'stakeholders' are out there and immediately apparent. Feedback from constituents should help drive the problem framing through new iterations.

- **Some groups considered as stakeholders, might be better termed "mallet-holders".** This point was raised in our first workshop. Regulatory bodies have a different role in land management to many of those actually doing the land management. Do we need to consider the power relations amongst those who have in interest in the problem? To whom are the researchers ultimately responsible (who is the problem being framed and solved for)?

- **Which knowledge communities are important?** In other words, who needs to brought into the research to help frame the problem and to provide specialist research competence

relevant to particular framings. Forms of local knowledge are just as important as academic communities to consider here. These constituencies will be dynamic as to who is involved at different points, as problem framings are revised. For example, in our Wharfedale case study natural scientists were only brought in when the process of producing a river management solution had reached a point where all concerned felt it could not move forward without further specialist input.

- **Capture.** Common to any project involving a range of interests is the danger of the process being captured by one particular group of constituents. There may be a need to intervene and manage the number of representatives from certain groups. This will possibly require local knowledge or access to already existing local networks.

- **Stakeholder burnout.** An interesting issue raised across the workshops was the regular involvement of 'the usual suspects' in many initiatives. There is a danger that this can lead to increased capture (above), but it can also lead to stakeholders tiring of being involved and withdrawing from the process.

- **How much appeal can be made to government?** Input to our first workshop from one participant suggested that much more involvement of local government took place in working on water and land management problems in the USA. They were a key constituent in driving problem solving and being able to help sustain and impose solutions. There was a suggestion that UK local government was not strong enough to take this role. In other workshops, the UK approach to "Catchment Sensitive Farming" was revealed to be based on finding locally animated solutions that could be implemented with minimal government action.

- **The reification of farmers.** Farmers as land managers have a key role to play in diffuse land management issues, but their role can be over-emphasised too. This can lead to ignoring the long-term systemic and endemic aspects of diffuse land management problems. A constant refrain from the workshops related to a need to understand farmer attitudes and behaviour, as if this were a holy grail that would ensure sound solutions. This perhaps stems from the special position farmers have traditionally occupied in regulatory and policy frameworks. Farmers often also seem to be considered as a homogenous group. The name of DEFRA's Catchment Sensitive Farming programme marks a radical departure, placing farming within a particular environmental context and potentially opening the way for new forms of local engagement with farmers that take into account specific social contexts. Being able to identify a local intermediary to work with farmers is one avenue to engage with and build this constituency.

- **Space and scale.** The scale at which this type of research is undertaken can influence several of the other points here. At smaller scales, stakeholder burnout can increase as there are less people to be involved. At larger scales, certain constituencies might increase in number, thus increasing the danger of capture. For example, the large number of angling groups on the river Wharfe has led, at times, to an overrepresentation of that interest group in a group covering the whole river.

**iii) Research** in this context refers to the activities of both social and natural science. The role or value of research should not be predetermined on a disciplinary basis, but on the basis of who can bring the necessary knowledge competency to bear on the problem (in this sense researchers outside of any core project group might be considered as constituents, as outlined above).

- **Research is not necessarily about providing solutions.** The results of research should not be considered as a 'silver bullet' that will somehow provide the definitive solution to a problem. As our Slapton Ley case study demonstrated, the volume of research conducted at a location does not necessarily translate into solutions. What research can do is stimulate debate, facilitate problem framing and thus help in constituency building. In our Wharfedale case study, the scientific research provided not answers, but a range of options on which a community groups was able to comment and debate.

- **Who is the audience for research?** This question relates not only to the need to present research in an appropriate manner to any given audience, but also to the rationale for presenting and conducting research in the first place. Will a particular bit of research, no matter how interesting to the researcher, add anything to the process? In our Wharfedale case study, it was clear that natural science input was needed and useful in driving forward the problem framing and solving process. However, it was difficult to see what social science input could have improved the outcomes for anybody concerned.

- **Asymmetry.** Related to issues of resources, this point was raised at our final workshop and concerns the relatively larger amount resources required by natural sciences compared to social science. This can lead to a danger that social science research is overshadowed by natural science research in interdisciplinary working and that it may be deemed relatively more important by many constituents. Interdisciplinary working practices need to take this asymmetry into account.

- **A normative dimension.** In some ways the 'purity' of research is open to question in this approach. We need to move away from ideas of detached, objective outcomes and consider what the normative consequences of the research could be. Another way of thinking about this issue is not to consider what an objective optimum might be in terms of

research outcomes, but to consider what solutions could or should be put in place, given the local context of the research.

**iv) Visualisation** of a problem emerged during our workshops as a distinctive issue that connects problem framing, research and the diverse constituencies involved in both of those activities. The position of visualisation in the diagram above is an idealised one, a central and common visualisation of the problem as it is reframed by research and constituency building. As with framings of the problem, we need to consider that there might never be a single way of visualising what a problem is or where it occurs.

- **Space / scale.** A spatial framing of a problem (for example, in a 'parish' or 'catchment') can be a key way in which various constituents, from science and non-science communities can be recruited and can learn to work together. The visibility and relevance to key groups of the problem can be encompassed by placing it within a common spatial context. In our project we became concerned with the idea of the catchment and how this might relate to problem framing and visualisation. Most striking in our case studies was the case of Upper Wharfedale, with a steep sided valley and good vantage points the catchment was actually visible as a spatial entity to all concerned and the project operated "from the moor top down to the valley bottom". However, it was thought that working on a larger spatial scale (such as some of the 'river basins' considered under the Water Framework Directive) would make this kind of connection and visibility less easy. A further problem is in making the problem proximately relevant. For example, in Upper Wharfedale, it was thought that people would be far less engaged if a problem was visualised through flood impacts on the City of York, 70km away.

- **Commonality.** Some of our workshop participants suggested that when scientists from different disciplinary backgrounds were learning to work together, or learning how their different approaches could interact, a common case study was an essential component in visualising the process.

- **'Invisible' problems.** Certain problems framed from a scientific perspective, such as those concerning aquatic ecosystems or groundwater catchments, are largely invisible through any means other than specialist research techniques. It is necessary to be able to link these problems to visible indicators to inform the problem framing and constituency building processes. Such indicators might be actual events such as fish kills in relation to eutrophication or pollution events or they might be the results of research, presented and interpreted in an appropriate way.

- **Engagement.** If visualisation is thought of as key in constituency building, then a means needs to be found to take a visualisation to potential constituents. In the Wharfe case study, a large laminated floor map of the catchment was created for this purpose.

- **Use of models.** Participants in our final workshop had been experimenting with the use of computer models as tools for stakeholder engagement. It was felt that if trust had been built then models and their results and refinement could provide a useful platform for dialogue.

**v) Working practices** in the conduct of interdisciplinary public science might remain unchanged from disciplinary norms in some respects, especially when considering the specialist technical aspects of research. However, engaging in the kind of collaborative process outlined above does introduce some necessary novelty and raises a number of general issues.

- **Language.** As comments from many contributors to our four workshops underlined, it is important to note that undertaking interdisciplinary public science challenges the too easy and pejorative casting of other people's terminology as 'jargon'. Rather, such work places more than token demands on participants to engage with the vocabularies through which other people (be they from different scientific disciplines or approaches to one's own, or non-scientists) articulate knowledge, and to recognise that their own vocabularies place similar demands on others. Language affects problem framing, visualisation, constituency building and communication across the board, although differences in problem framing amongst constituents may not be reducible to comparatively simple issues of vocabulary.

- **Scope.** In an interdisciplinary project with public engagement there could be a temptation and drive to deal with every issue raised, but there are always limits to what can be dealt with in terms of resources:
    - **Time.** Interdisciplinary working and public engagement take time. It takes time to build relationships between project team members and other constituents. More significantly it takes time to build trust in those relationships. It might also take time to learn new working practices. This way of working cannot be learned from methods manuals.
    - **Money.** Perhaps obviously, the extra time that may be required of interdisciplinary projects with public engagement also requires extra funding. This may also be required to facilitate the learning of new practices

- **Management and co-ordination.** Project management and leadership have been flagged as especially important in this type of work, with more complex working practices requiring

a greater degree of co-ordination and input from key researchers than might be regarded as the norm.

- **Frameworks.** Frameworks can help in running this type of project, if only because they help focus on the fact that other groups are attempting the same type of research, or that it has been done successfully elsewhere.

- **Institutional context.** The institutional context of academic research can be constraining when it comes to radical interdisciplinary work. Participants at our final workshop raised issues around career development, which happens within disciplinary structures and may exclude young researchers from becoming involved in radical interdisciplinary enterprises. Another issue raised was the attitudes of the research funders towards radical interdisciplinarity, with even a programme such as RELU still being divided along disciplinary lines in terms of much of its structure.

- **Moving out of our comfort zones.** To get the most out of interdisciplinary public science it is necessary to open ourselves to other ways of working, other ways of talking and other ways of thinking than those we are used. This relates most strongly to issues surrounding problem framing, but also concerns how we do our research, how we communicate in response to the other researcher and constituents involved in a project. Perhaps this requires us to consider whether our normal ways of working are entirely about 'finding things out' or whether they encompass a lot more about how we consider our research in relation to that of other researchers and of non-science communities.

- **What role do academics play in a radical approach to interdisciplinary public science?** A suggestion from many workshop participants is that academics might have to start thinking of themselves as intermediaries and facilitators in wider social contexts, rather than simply as experts in their own fields.

**Final Comments**

It is worth stressing again that the ideas outlined above are not intended to be in any way prescriptive or definitive. They should not be taken as a methodology for conducting interdisciplinary research on diffuse pollution, because we have not yet conducted interdisciplinary research into diffuse pollution. Rather, we have worked conceptually and sought to scope the types of problems that might emerge as well as identifying elements of best practice from the experiences of others. These ideas are yet to be experimented with in practice by the project team as a group. They do, however, have a solid basis both in the individual experiences of the project team as we have tried to work together conceptually, and in the experiences of participants in our workshops who are engaged in similar enterprises in the UK, Europe and the USA, many of which are at more advanced stages than our own. We have also drawn on our understandings of the substantially different problematics offered by our two field-based case studies (more details about which can be found on the project website). The conceptual and working frameworks into which we have placed these ideas remains largely our own synthesis and we would not wish to implicate the workshop participants, to whom we are most grateful.

It is also important to note that this document is not (as was originally suggested within the project) intended as a *generic* framework for interdisciplinary working on diffuse pollution. With a *generic* framework there is always the risk that many situations that are otherwise quite distinct can be brought together and rendered as being the same, through the very process of being collected into a *generic* framework. This kind of approach is completely at odds with the local specificity that we have encountered during our workshops and which has informed the approach outlined above. We offer these ideas for conceptual stimulation and critical discussion.

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