

Frame alignment processes for locally useful agricultural soil research and extension: The role of farm advisors

Vaughan Higgins PhD^{1,2}  | Melanie Bryant PhD^{2,3} |
Catherine Allan PhD^{2,4}  | Geoff Cockfield PhD^{2,5} |
Peat Leith PhD^{2,6} | Penny Cooke PhD^{2,7}

¹School of Social Sciences, University of Tasmania, Hobart, Tasmania, Australia

²Cooperative Research Centre for High Performance Soils, Callaghan, New South Wales, Australia

³College of Business and Economics, University of Tasmania, Hobart, Tasmania, Australia

⁴School of Agricultural, Environmental and Veterinary Sciences, Charles Sturt University, Albury, New South Wales, Australia

⁵Centre for Sustainable Agricultural Systems, University of Southern Queensland, Toowoomba, Queensland, Australia

⁶CSIRO, Queensland Bioscience Precinct, St Lucia, Queensland, Australia

⁷College of Business and Economics, University of Tasmania, Hobart, Tasmania, Australia

Correspondence

Vaughan Higgins, Sociology and Criminology, School of Social Sciences, University of Tasmania, Hobart, Tasmania 7001, Australia.

Email: vaughan.higgins@utas.edu.au

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Abstract

Farm advisors are recognised as playing an increasingly central role in facilitating interactions between scientists and farmers to improve local implementation of sustainable soil management practices and agricultural innovations more broadly. However, there has been limited scrutiny of what farm advisors do when faced with conflicting interpretations among actors over techniques or approaches for facilitating agricultural innovation. This article advances knowledge in this area by investigating the role of farm advisors in aligning different frames on agricultural soil research and extension

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across seven Australian mixed farming regions. Drawing upon theoretical work on frame alignment, we argue that farm advisors use three types of strategies to align conflicting frames—*frame bridging*, *frame amplification* and *frame transformation*. These strategies seek to frame local soil research and extension priorities in ways that are assumed to resonate more closely with the frames of multiple constituents, such as farmers and soil scientists. Through our analysis, we argue that the application of a frame alignment approach enables greater precision in identifying which (a) interactive and social learning processes, (b) key local influencers and communities of practice and (c) resourcing and governance arrangements are most likely to be effective in facilitating soil research and extension that is locally useful and useable.

KEYWORDS

Australia, farm advisors, frame alignment processes, interpretive frames, soil research and extension

INTRODUCTION

Soils are of fundamental importance to humans and their environments, contributing to ecological sustainability, climate change mitigation, ecosystem services and food security (Dazzi & Lo Papa, 2022) as well as having a direct impact on human health (Brevik et al., 2020). Management of agricultural soils is a global priority as indicated by the high-level support of World Soil Day since 2002. Their management is also a European priority. For example, the recent introduction of the European Union (EU) soil strategy for 2030 sets out measures to ‘protect and restore soils, and ensure they are used sustainably’ (European Commission, 2023c). The EU soil strategy provides an important contribution to the European Green Deal aimed at reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels (European Commission, 2023b). Because of the fundamental importance of maintaining soils, their on-going degradation is described as a global existential challenge (McBratney et al., 2014). While there are numerous calls in Europe and elsewhere for policy, research and extension that contribute to transformations in land management approaches and practice (e.g., see Glæsner et al., 2014; Gosnell, 2022; Pulleman et al., 2022), debate persists over how and in what ways soil management knowledge can be made locally useful and useable for supporting farmers to manage agricultural soils (Ingram & Mills, 2019; Krzywoszynska, 2019; Lobry de Bruyn & Andrews, 2016). In this article, we consider, from an Australian context, the role of farm advisors in framing soil research and extension in ways that resonate with farming and ‘expert’ interpretations and that contribute to the generation of shared meaning for addressing local soil priorities.

Farm advisors, and the organisations for which they work, are widely recognised as playing a central role supporting farmers in the implementation of soil research and improved soil management practices (Bennett & Cattle, 2013; Ingram, 2008a, 2008b; Ingram & Mills, 2019). In contrast to their historical conceptualisation as a change agent ‘who disseminates technical information and policy messages as part of the tradition of top-down agricultural extension’ (Ingram, 2008a, p. 407), farm advisory services are increasingly considered as being part of a broader agricultural innovation system (e.g., Klerkx & Proctor, 2013; Nettle et al., 2017, 2018) ‘involving multi-actor processes and partnerships’ (Klerkx et al., 2012, p. 460). This is especially the case in Europe where privatisation, decentralisation and the shift from a supply-led to a demand-led system has resulted in a pluralistic advisory system characterised by ‘a diverse mix of public, private (supply chain consultants), Non-governmental organisation (NGOs), and Farmer-based organisations’, along with a range of new advisory roles such as agronomists, crop consultants and facilitators (Ingram & Mills, 2019, p. 23).

Advisory roles are also viewed as encompassing a wider ‘web of influencers on practice’ (Oreszczyn et al., 2010) that may include researchers, discussion groups and other communities of practice. These influencers are envisaged as playing an interactive and facilitative role including but not restricted to:

...organising producers ... and building their capacities; building coalitions of different stakeholders; promoting platforms for information sharing; experimenting and learning from new approaches; and acting as a ‘bridging organization’ that provides access to knowledge, skills and services from a wide range of organisations. (Rivera & Sulaiman, 2009, p. 269)

They are conceptualised variously as ‘innovation brokers’ (Klerkx & Leeuwis, 2009), ‘boundary brokers’ (Oreszczyn et al., 2010) or ‘intermediaries’ (Klerkx et al., 2012).

Similar to Europe, the soil advisory landscape in Australia has shifted towards a more multi-actor and demand-led approach characterised by a diversity of public and private organisations as well as new roles including commercial and independent agronomists, farm management consultants, farm advisors working within supply chains and advisors employed by farmer-owned and operated groups or employed within industry organisations (Nettle et al., 2018, p. 21). The states that formed the Federation of Australia in 1901 were given responsibility for managing natural resources, and they continued to support agricultural agencies that provided generally free, easily accessible agricultural information and advice throughout most of the 20th century. Top-down technology transfer was the norm for providing this advice (Cook et al., 2021), and when states created complementary soil conservation agencies to address growing land degradation issues (e.g., Breckwoldt, 1988), the same extension model was used. From the 1980s, this government-funded linear approach (research-advisor-farmer-adoption) was gradually replaced by a more complex agricultural advisory landscape. Environmental considerations were brought into mainstream agricultural management through joint arrangements between governments and farmers, such as Landcare (Lockie, 1998), and agricultural research was distanced from the government through the creation of Research Development Corporations (Hunt et al., 2014). Agency-based extension and advisory staff numbers were reduced, such that by the early 21st century, Australian farmers were seeking soil advice from industry-based advisors, private agronomists and a range of farmer groups alongside dwindling government services (Luke et al., 2021). Managing agricultural soils through multi-stakeholder collaboration remains an important government priority, evident, for example, in the recent *National Soil Strategy* that is aimed at ‘restoring and protecting soil

nationally, by driving collaborative and coordinated on-ground action, research, education, monitoring and governance' (Department of Agriculture Water and the Environment, 2021, p. 4).

The agricultural innovation systems literature provides important insights into the role of farm advisors and extension organisations in improving the governance of innovation, including how to govern interaction between different actors (Klerkx & Leeuwis, 2009; Klerkx et al., 2012; Pigford et al., 2018; Rivera & Sulaiman, 2009). For example, Klerkx and Begemann (2020) draw attention to the tools, practices and approaches through which farm advisors work with other actors to co-produce the technological, social and institutional innovations that are required to support the transition to more sustainable food systems. However, what is absent from this literature is a clear conceptualisation of what farm advisors do when faced with different or conflicting interpretations and aims among actors over approaches for facilitating agricultural innovation. Rather, emphasis is placed on processes for achieving common goals through 'the facilitation of interactive processes and social learning', with 'little recognition that the goals, interests and perspectives of interdependent actors are likely to diverge and be conflictive' (Klerkx et al., 2012, p. 473).

A comparable knowledge gap is evident in social science research on soil. For example, scholars have observed contrasting perceptions of soil understanding between farmers and 'experts', such as soil scientists, researchers and advisors (Ingram, 2008a; Ingram et al., 2010; Lobry de Bruyn & Andrews, 2016). Similar to the agricultural innovation systems literature, arguments to address differences in understanding have focused primarily on the technical processes for achieving shared goals, such as the use of participatory social learning (e.g., Crotty et al., 2019; Raymond et al., 2010; Reed et al., 2007; Stoate et al., 2019). However, this overlooks the *interpretive processes* through which advisors attempt to align divergent or conflicting understandings of soil research and extension in ways that are considered locally useful and useable. This is an issue that we address in this article through the application of theoretical work on frame alignment processes.

The concepts of frames and framing have been used widely by rural sociologists to highlight different ways in which problems, issues and debates are interpreted and/or represented amongst groups of actors. Research to date using these concepts is diverse, focusing, for example, on the control of Bovine Tuberculosis (Cassidy, 2012; Keenan et al., 2020; Naylor et al., 2015; Robinson, 2017), on-farm biosecurity (Shortall et al., 2016), technology implementation (Higgins & Bryant, 2020), food security (Mooney & Hunt, 2009), participatory catchment management (Cook et al., 2013) and the development of agricultural co-operatives (Hale & Carolan, 2018). This research draws attention to the existence of conflicting or competing frames in agricultural extension and the challenges such conflict creates for improved co-ordination, better communication between actors or clearer and/or more sustainable policy directions. It complements broader rural sociological work that highlights how conflicting interpretations, particularly between researchers or scientific 'experts' and farmers, can contribute to limited or no adoption of new technologies, management techniques or practices (e.g., Clark & Murdoch, 1997; Ingram, 2008b; Warren et al., 2016; Wynne, 1996).

Frame alignment provides a conceptually coherent approach for making sense of how advisors seek to align different, contrasting or conflicting frames. Developed by American sociologists Snow et al. (1986), frame alignment builds on an interpretive approach to frames outlined in the seminal work of Goffman (1974). From an interpretive perspective, *frames* are conceptualised as 'schemata of interpretation' (Goffman, 1974) that help to 'render events or occurrences meaningful and thereby function to organise experience and guide action' (Benford & Snow, 2000, p. 614). *Framing* involves 'the dynamic enactment and shaping of meaning in ongoing interactions (and frames are transient communication structures)' (Dewulf et al., 2009, p. 162). A frame *alignment*

approach builds on this work by recognising that while framing is interpretive, it is also strategic, being 'developed and deployed to achieve a specific purpose' to align the interests and interpretive frames of an organisation or group of actors 'with those of prospective constituents or resource providers' (Benford & Snow, 2000, p. 624). Specifically, for the purposes of this article, it enables attention to how farm advisors produce and negotiate meaning to 'span the boundaries between the farming network of practice and other communities or networks of practice in farmers' wider web of influencers' (Oreszczyn et al., 2010, p. 414).

Building on these insights, the article applies a frame alignment lens to address the following research questions: (1) How do farm advisors make sense of and seek to align divergent or conflicting interpretations around the local application of soil research and/or extension; and (2) what are the implications of this work for the role of advisors in agricultural innovation systems? We address these questions by drawing upon data from semi-structured interviews with advisors involved in supporting farmers with improved soil management practices from across seven geographically diverse mixed farming regions in Australia. Prior to discussing details of the participants, interviews and mixed farming regions that comprise the focus of our research, we first outline the frame alignment approach that provides the theoretical framework for the article.

FRAME ALIGNMENT PROCESSES

While Snow et al.'s (1986) conceptual approach is developed in the context of social movement organisations (SMOs), we argue that it is highly relevant to studying the work of farm advisors. In an environment of reduced public investment in agricultural extension and the privatisation of advisory services (Garforth et al., 2003; Hunt et al., 2012; Labarthe & Laurent, 2013; Marsh & Pannell, 2000), there are greater incentives for advisors to take on more pro-active and strategic roles, pursuing 'networks and alliances that were denied under a more rigid closed system' (Sutherland et al., 2013, p. 97). This arguably means that advisors have an increased interest in engaging with and appealing to 'actual or prospective resource providers' (Benford & Snow, 2000, p. 624), such as government agencies and research funding bodies. At the same time, under a more demand-driven and multi-actor advisory system, it is ever more essential for advisors to build institutional and relational trust with farmers (Sutherland et al., 2013, p. 103). One key way in which this is likely to occur is for advisors to link their interpretive frames with those of their constituents (Benford & Snow, 2000, p. 624), in this case, farmers/clients. As such, the frame alignment processes conceptualised by Snow et al. (1986), which we discuss in more detail below, are relevant to the role of farm advisors in an increasingly privatised and market-driven agricultural advisory system.

In their research on SMOs, Snow et al. (1986) identify four types of frame alignment processes: frame bridging, frame amplification, frame extension and frame transformation. Frame bridging refers to 'the linking of two or more ideologically congruent but structurally unconnected frames regarding an issue or problem' (Snow et al., 1986, p. 467). This can occur at an organisational or an individual level. Snow et al. (1986), argue that frame bridging involves the linking of a movement organisation with unmobilised sentiment pools or public opinion clusters and 'is effected primarily by organizational outreach and information diffusion through interpersonal or intergroup networks' (p.468). However, as Hale and Carolan (2018) observe, frame bridging can occur in a variety of ways in practice. An example of this can be found in the recent work of Keenan et al. (2020) who focus on long-running debates over how to control Bovine Tuberculosis in the UK. They identify four types of bridging frames that allow for new ways of thinking about and

communicating on Bovine Tuberculosis control: providing an alternative starting point for the issue, altering patterns of telling, changing the language and gaining local acceptability for new bridging subframes. Hale and Carolan (2018) provide a further and slightly different example of how frame bridging may be helpful to rural sociologists. They argue that as part of efforts to align different frames, ‘bridging frames’ (Hale & Carolan, 2018, p. 376) may be created or invoked that are assumed to resonate with prospective constituents. These frames can provide a crucial foundation for linking different sentiment pools, such as views on soil held by farmers and soil scientists.

Frame amplification is a second type of frame alignment process conceptualised by Snow et al. (1986). It refers broadly to the ‘idealization, embellishment, clarification, or invigoration of existing values and beliefs’ that underpin an interpretive frame (Benford & Snow, 2000, p. 624). There are two key varieties of frame amplification: value and belief amplification. Value amplification involves ‘the identification, idealization, and elevation of one or more values presumed basic to prospective constituents, but which have not inspired collective action’ (Snow et al., 1986, p. 469). This may have occurred for a range of reasons, including that the values are taken for granted, have never been challenged or that their relevance to an issue is not readily apparent or ambiguous. Belief amplification refers to ‘ideational elements that cognitively support or impede action in pursuit of desired values’ (Snow et al., 1986, pp. 469–470). These may draw upon notions of moral propriety or obligation in efforts to draw attention to an issue and to mobilise adherents around that issue. In doing so, belief amplification is often aimed at generating a sense of necessity—‘beliefs about the instrumentality of one’s own efforts’ in pursuing an objective (Snow et al., 1986, p. 471).

Frame extension occurs where the boundaries of an existing interpretive frame are extended ‘to encompass interests or points of view that are incidental to ... [a group’s]... primary objectives, but of considerable salience to potential adherents’ (Snow et al., 1986, p. 472). This is a way of mobilising a wider pool of adherents around an issue or cause. However, Benford and Snow (2000, p. 625) argue that this form of frame alignment is subject to a range of challenges including disputes over ideological purity and negotiation over how far an interpretive frame should be extended without affecting a group’s core beliefs or objectives. Therefore, it may not be as effective as other frame alignment processes.

The fourth and final frame alignment strategy is frame transformation. This involves changing or jettisoning old meanings and understandings and/or generating new meanings and is an important strategy in those contexts where values and beliefs that a group see as significant may not resonate with existing, dominant interpretive frames (Snow et al., 1986, p. 473). As such, frame transformation involves what Goffman (1974, p. 45) refers to as *keying*—a ‘systematic transformation’ of a primary framework that ‘changes what it is a participant would say is going on’. Snow et al. (1986) distinguish between two main types of frame transformation. The first of these is the transformation of domain-specific interpretive frames—what Benford and Snow (2000) also refer to as collective action frames—where ‘a domain previously taken for granted is reframed as problematic and in need of repair’ (Snow et al., 1986, p. 474), or a domain previously seen as acceptable is reframed as an injustice requiring change. This approach is used effectively by Mooney and Hunt (2009) to contrast ‘flat’ (normative, reinforces dominant institutional practices) and ‘sharp’ (oppositional, challenges dominant practices) keys associated with different food security frames. The second is the transformation of global interpretive frames, in which ‘a new primary framework gains ascendance over others and comes to function as a master frame’ (Snow et al., 1986, p. 475) and where events and experiences are interpreted in new ways.

These four frame alignment strategies highlight how actors or organisations use framing processes strategically in ways that are ‘deliberative, utilitarian and goal directed’ (Benford & Snow,

TABLE 1 Regional location for each farming group, including principal commodities produced and approximate annual median rainfall.

Region code	Region	Principal commodities	Approximate annual median rainfall
FR1	Northwest Victoria	Cereal and broadacre crops, sheep and lambs	300–400 mm
FR2	Central South Australia	Cereal and broadacre crops, sheep and lambs	300–400 mm
FR3	Northern Tasmania	Beef cattle, dairy cattle, fruit and vegetables	600–1000 mm
FR4	Western Australia Wheat Belt	Cereal and broadacre crops, sheep and lambs	300–600 mm
FR5	Western New South Wales	Cereal and broadacre crops	400–600 mm
FR6	Southeast South Australia	Cereal and broadacre crops, sheep and lambs, beef cattle	300–600 mm
FR7	Northern Victoria/Southern New South Wales	Cereal and broadacre crops, sheep and lambs, beef cattle	400–600 mm

2000, p. 624). In doing so, the strategies provide a useful framework for investigating how farm advisors make sense of and seek to align divergent or conflicting interpretations around the local application of soil research and/or extension (Research Question 1). They also provide broader insights into how frame alignment strategies are relevant in understanding the role of advisors in agricultural innovation systems (Research Question 2). Following a short discussion of the research methodology, we present our findings on how farm advisors from seven different Australian mixed farming regions align conflicting soil management frames. We then analyse these findings in light of the two research questions underpinning this article.

RESEARCH METHODOLOGY

The objective of the broader research underpinning this article was to develop an in-depth understanding of why and how farmers from across seven geographically diverse mixed farming regions in Australia adopt or do not adopt programmes, practices and technologies aimed at improving soil management. Details of the geographical location, principal commodities produced and average median rainfall of the regions in which each farming group are based are provided in Table 1.

The project was underpinned by a social constructionist approach (Patton, 2015) designed to enable the exploration of meaning and knowledge constructed by individuals and how this meaning and knowledge is shaped by specific social and cultural contexts. The first phase of the project focused on investigating the effectiveness of existing programmes, practices and techniques being trialled or used in each region to improve soil management. Exploring this from the perspective of those involved in regional soil extension and implementation was considered essential for identifying what approaches were being used, what was working well and the challenges involved in working with diverse actors including farmers, soil scientists and government agencies. It is the first phase of our project that forms the basis of the research questions underpinning this article.

TABLE 2 Participant information—Semi-structured interviews.

Participant code	Gender	Position
FR1, Int 1	M	Farmer and farming group management team
FR1, Int 2	F	Agronomist
FR1, Int 3	M	Farmer and farming group management team
FR1, Int 4	F	Farming group management team
FR1, Int 5	M	Land management extension officer
FR2, Int 1	F	Farming group management team
FR2, Int 2	M	Soil scientist
FR2, Int 3	F	Farmer and farming group management team
FR2, Int 4	M	Farmer and farming group management team
FR2, Int 5	M	Farmer and farming group management team
FR2, Int 6	M	Agricultural consultant
FR3, Int 1	M	Agronomist
FR3, Int 2	M	Agricultural consultant
FR3, Int 3	F	Agricultural consultant
FR3, Int 4	M	Agricultural consultant
FR4, Int 1	M	Farming group management team
FR4, Int 2	M	Farming group management team
FR4, Int 3	M	Research officer
FR4, Int 4	M	Farming group management team
FR5, Int 1	F	Agronomist
FR5, Int 2	F	Farmer and farming group management team
FR5, Int 3	M	Agronomist
FR5, Int 4	F	Agronomist
FR6, Int 1	M	Crop consultant
FR6, Int 2	F	Soil scientist
FR6, Int 3	F	Livestock advisor, farming group management team
FR6, Int 4	M	Senior agronomist, farming group management team
FR6, Int 5	M	Agronomist
FR7, Int 1	F	Project officer
FR7, Int 2	F	Senior land services officer
FR7, Int 3	F	Project officer

Note: Positions listed here are those nominated by participants when asked to describe their current role and how that role involved working with farmers on soil management issues.

To investigate regional soil extension and implementation approaches, we conducted three-to-six interviews in each of the seven case-study regions with farm advisors, including agronomists (retail, private/independent), farm management consultants and farming group leaders (some of whom were also farmers). A total of 31 interviews were completed. Participants were recruited through a combination of purposive and snowball sampling. Information on the participants recruited for the interviews is detailed in Table 2.

Consistent with the social constructionist approach, data collected from the individual interviews were audio-recorded then transcribed into orthographic text and analysed inductively to

enable the key themes in the data to emerge. In using this approach, open coding was first conducted to find common descriptors, followed by a second cycle of axial coding, which seeks to develop connections and relationships between codes (Miles et al., 2019).

CONFLICTING FRAMES IN SOIL RESEARCH AND EXTENSION— REDUCTIONIST SCIENCE VERSUS FARMING AS A SYSTEM

To address the research questions, it is first important to explore evidence for conflicting frames in soil management identified by participants. Based on our thematic analysis of the data, one consistent theme that emerged were reports of conflicting frames related primarily to contrasting understandings of regional soil management priorities and challenges between scientific researchers and farming communities. This is consistent with previous research documenting contrasting understandings of soil between farmers and ‘experts’ (Ingram et al., 2010; Lobry de Bruyn & Andrews, 2016). Our analysis builds on this research by focusing on how farm advisors ascribe meaning to these different understandings. Participants observed that while farmers have a concern with farming systems, scientists involved in research for improved regional soil management tend to focus on discrete parts of the system. This often results in science research aimed at addressing specific issues, which neglect how those issues are influenced by other parts of the farming system.

There’s always a need for more research, but the research needs to be—from a soils point of view—holistic research, not just based on [soil scientists] picking a particular issue and ignoring all the other factors. I think, in reduction of science that’s a difficult thing to do. (FR2, Int 2)

Further, according to this participant, the emphasis on discrete parts of the farming system results in a focus on developing new products rather than on the extension of existing research that may be far more valuable to farmers in the longer term: ‘A lot of research has been conducted to really try and find a silver bullet, and with soils it’s more about practice change rather than applying a product’ (FR2, Int 2).

This relates to a broader problem observed by some participants that the scientific emphasis on control means soil researchers may not listen to what farmers think is important. For example:

If all it is a researcher telling a farmer you do this, you do this, you do this and not listening to the farmer saying well, I can’t do that. Because when you’re asking me to do that I’m focusing on, I have to focus on my sheep, or I have to focus on my cattle or I have to focus on ... my system. (FR1, Int 5)

The neglect of farming knowledge and experience was judged to result in research that may be of interest to soil scientists, and accord with norms of scientific investigation, but not always be relevant or useful to locally defined soil priorities and challenges. For example:

... they [soil scientists] asked can we test the soil for stuff and the first question from the scientist, what would you like to know? You’re like, I just want to know if it’s good soil. Yeah, yeah, but what are you calling good soil? The farmers are just like, tell me if I’m doing the right thing and we don’t know what question—we know the answer

we want, which is yes or no, but the scientist can't run with that. That's not a study, that's not an investigation. (FR1, Int 4)

While the relevance of soil science to farmers was framed as a problem, so too was the utility of the products developed through scientific research. As noted above, the development of products to improve farmers' soil management is viewed as addressing discrete issues and not taking into account the entire farming system. A further consequence observed by participants is that the products developed from scientific research are not always useful or useable, and this has consequences for farmer adoption.

It needs to be worthwhile and useful for the farmer, not a gadget. If we promote it, then we've got a lot of members who instil that trust. . . . So, if they can get the [tool] that is very lightweight, portable, that they can just walk out, shove in the ground and they get a soil moisture reading, great, I think you'll get high adoption. But if it's something that's big and cumbersome to lug around and breaks the first time you use it, then that's it. (FR7, Int 1)

In summary, participants interpreted the work of soil scientists as largely reductionist, abstract and focused on the development and application of products that often have limited practical usefulness or useability. This framing was contrasted with a practical and localised approach towards soil management. Scientific research for improving soil management was framed as problematic for engaging farmers in addressing locally defined soil challenges and priorities. These conflicting frames are consistent with previous research conducted by Ingram et al. (2010) who argue that farmers and scientists have fundamentally different understandings of soil. While farmers' understanding of soil is broad and based on working knowledge of their farm ('know-how'), scientists' understanding is grounded in analytical knowledge and adopts a more specific focus on discrete problems ('know-why').

Having identified the conflicting frames that emerged from our analysis, we now apply the work of Snow et al. (1986) to analyse the different ways in which participants sought to align these frames. The frame alignment processes that we discuss below were drawn from two key themes that emerged from our thematic analysis—extension: farming knowledge and networks and extension: farming groups as intermediaries. It is important to note that interview participants were not necessarily aware that they were engaged in frame alignment work. Frame alignment is a theoretical construct that we have applied to our data to analyse the ways in which participants made sense of and proposed solutions to what they interpreted as key soil management challenges and priorities in their region.

ALIGNING CONFLICTING FRAMES

Frame transformation: Valuing local knowledge

It is clear from the discussion in the previous section of this article that participants report challenges in encouraging soil scientists and research organisations to appreciate the complexity of farming systems at a regional scale. As a consequence, 'reductionist science' does not seem to resonate with, and indeed devalues, the interpretive frames that underpin regional soil priorities, knowledge and experiences. Due to this lack of resonance, participants engaged in frame

transformation, seeking to frame farmers as local soil experts rather than simply as the recipients of knowledge delivered by soil scientists. This subtle reframing transforms a 'reductionist science' into a 'farmer-led science' frame where farmers are positioned as the experts whose knowledge and experience are central in determining soil science research priorities rather than the other way around. For example:

It's funny in this field. It's very rarely have I seen examples where the science comes first for the next big step. We're all looking for that next big idea, but quite often, it comes from the farmer first. Because they see the issues all day, or the problems all day. Some of these guys are probably the best engineers going around. Not all of them have got degrees in it, but their engineering knowledge and skill and invention capability is huge. (FR4, Int 4)

... we probably don't have the full science behind why we progress with things, and farmers are notorious for, and rightly so, they move faster than the science does sometimes. (FR6, Int 04)

As illustrated above, frame transformation involves advisors reframing 'reductionist science' to emphasise the significance of existing farmer expertise and experience in generating soil science knowledge. However, it also encompasses a reframing of the 'farming as a system' frame which, as we argued in the previous section, does not seem to resonate with the frames on which soil research, development and extension (R, D and E) are based. This reframing seeks to shift the emphasis from a 'farming as a system' frame into a different frame that prioritises the importance of scientists and research organisations connecting with and utilising local farmer networks as part of R, D and E. For example:

I'm going to sound a bit critical here of universities and CSIRO, but I'll go that way. We are getting those bigger R&D organisations who have these bigger projects and are a bit remote from the regions, and they come in ... and they're not connecting with those local [farmer] networks. That's a situation where you team up to get good buy-in. (FR2, Int 6)

I think that's really important because as you know, being a researcher, obviously everything that goes top-down sometimes you can have the most amazing research project, and it won't be relevant to anyone on the bottom. So, it's like, great, but what are we doing? It's got to be a nice mixture, hasn't it, where you can both collaborate well together.... There's been a lot of collaboration at this level, which is good. (FR5, Int 2)

In transforming the 'reductionist science' frame, farm advisors reframe local soil research and extension needs in ways that assert the value of farming knowledge and expertise. This reframing is important in promoting the value of local soil knowledge and experiences and connecting it to broader R, D and E practices. At the same time, advisors seek to transform the 'farming as a system' frame from a research challenge to an extension enabler where collaboration with local farming networks is emphasised in producing soil research that is useful and useable for regional

farming communities. As we argue below, this transformation is important in generating meaning on which actors and relations are important in translating soil research in ways that align with local soil research priorities.

Frame bridging—Farming groups as trusted and credible intermediaries

Based on analysis of our data, it became clear that participants positioned the local farming groups of which they were a part as key actors in bridging the ‘farming as a system’ and ‘reductionist science’ frames. The bridging work of local farming groups was elaborated by participants in two main ways. First, farming groups were judged to have access to local networks of scientific experts with the capacity to interpret soil science in ways that resonate with farmers and are applicable to local farming systems. For example:

Having people like [name suppressed] in the room to talk, and an expert who can communicate with them is really good. There are some fantastic soil scientists out there but having that middle person who can talk to the farmers in their language about their constraints and what works and what doesn’t work, and I think that’s vastly important. (FR4, Int 4)

Right throughout the southeast we are promoting—and this is by working with [name suppressed] . . . She’s a really good communicator, she’s just really vibrant and enthusiastic and just loves soils and loves working with farmers, which is great. (FR6, Int 3)

However, local experts were viewed as not just interpreting soil science for the benefit of farmers. As two participants observed, these experts are also essential in taking on board local farming knowledge and interpreting this for scientists so that future research is more applicable to local contexts.

Localised is the key I think where you bring in people who have the knowledge. But the localised bit is where you get the knowledge from the group to inform the researcher what’s actually real. (FR1, Int 4)

We see our role as to keep them [soil researchers] grounded and keep them on track and make sure they’re doing relevant research because it’s not a cheap exercise, and we don’t want to do research just for the sake of keeping people employed and doing research because there’s plenty of things here we need sorted out. (FR2, Int 5)

Through these narratives, participants seek to generate a shared sense of meaning around the significance of local farming groups in bridging the ‘farming as a system’ and ‘reductionist scientific’ frames. Farming groups are argued to be critical in accessing experts who understand local farming systems and whose knowledge is useful and useable for farmers, and in ensuring that soil research is responsive to local priorities and practices. In this way, farming groups are

framed as facilitating ‘ideological congruence’ between two frames that are otherwise conflicting and structurally unconnected (Snow et al., 1986, p. 467).

Second, farming groups were viewed as important facilitators as they were perceived as being trusted by farmers. For example:

...if we talk carbon, and there are so many experts out there, that sometimes the farmers just don't know who to believe. On a topic like that, it can be so variable. I guess having farming groups, it's one way of trying to break that link. So, in terms of adoptability, if it comes from a farming group perspective ... then it's more trusted. (FR7, Int 1)

We've [local farming group has] got that ability to try stuff that farmers might be interested in but don't really have the time or money to try themselves. So that's really important for our role. I think farming here has changed massively in the last 20 years. It really has. I think a lot is being adopted by farmers, and if it's not actually adopted, they will adopt it when they have the opportunity... Because we're not private [agronomists], we're not a business, we have no skin in the game in terms of trying to push a product or wheat variety. That's the trust issue, I guess. (FR5, Int 2)

Further, as one participant observed, farming groups are essential in working with reputable researchers and organisations to build soil science that is credible and locally legitimate.

I think the model is there with the structures we've got there now that have developed over the last 20 years with the farming groups. It's just about how we use that more effectively because you're always going to get those snake oils who are going to find those farmers and farmer networks that will be influenced, but if you have a stronger network created, strong collaboration created at that farmer group level with those key research institutions, you will start coming up with the information solutions that are quickly going to wipe those other people, less reputable people, out of the scene ... because the science will be credible because it's been developed in association with farmers and credible farmers in the area, and the word will get out. (FR2, Int 6)

These discussions reinforce previous research conducted with farmers in which trust is more likely to be placed in localised support services and those perceived as being ‘impartial’ (Sligo & Massey, 2007; Sutherland et al., 2013). Framing local farming groups as trusted facilitators is therefore a narrative likely to resonate with farmers. Our analysis builds on this research by showing how trust is used as a key authoritative claim for the validity and value of farming groups in facilitating interactions between farmers and soil researchers and thus in bridging the ‘farming as a system’ and ‘reductionist science’ frames. As such, trust is not just about identifying who is perceived as trustworthy (or not) but as a way of positioning local farming groups as the most legitimate and credible actors in linking the interests of farmers with soil researchers and research organisations.

Frame amplification—Resourcing farming groups as trusted and credible intermediaries

Integral to the bridging work described above is a second form of frame alignment—frame amplification. Participants engaged in what Snow et al. (1986) refer to as ‘value amplification’. This is evident in reports above of farming groups as locally trusted and credible conduits between scientists and farmers but whose role has not yet been effectively recognised nor utilised in the R, D and E system. Closely connected to value amplification is ‘belief amplification’. This form of frame amplification is evident in participant comments in two important ways. It can first be observed in reports of insufficient funding that restrict the capacity of farming groups to perform their role as effective conduits between farmers, soil scientists and research organisations. These reports emphasise funding as a key impediment to ‘action in pursuit of desired values’ (Snow et al., 1986, p. 470). For example:

... we don’t have a lot of funding to promote the need to monitor and address soil acidification. If soil research is so expensive or investment in any soil projects—to get good data—is so expensive, it’s very hard to focus our dollars as effectively as we could. (FR7, Int 3)

I know a few of the research funders are realising that they’re doing the research, but the message is not getting out. So that’s where we sort of come in ... but we can’t get the proper people funded to get them out on the ground. That’s where there certainly are some big gaps in research. (FR2, Int 5)

Second, it is also evident in calls by participants to change R, D and E priorities to be more favourable to the work of farming groups.

Sometimes, these big organisations think that these local organisations can exist on fresh air, whereas if they’re part of a programme or a project, they’ve got to be treated as equal partners. So they’ve got to be resourced to be involved, as well as the CSIRO or the universities. They need resources to have the researchers do the work. (FR2, Int 6)

Because we’re not for profit and a 100% grant-funded, that holds a lot of constraints around being able to deliver bottom-up projects because a lot of it is set by the funding body. Whilst the funding bodies are meant to have scoping groups that provide the research needs and the research questions that are supposed to be in the farmers’ best interest they are not always on point. (FR5, Int 1).

These calls encompass significant ‘ideational elements’ in relation to local resourcing that ‘cognitively support’ (Snow et al., 1986, pp. 469–470) farming groups in pursuit of their values as trusted and credible conduits. Advisors sought to amplify values around the trustworthiness and credibility of local farming groups as *legitimate* conduits between researchers and farmers. For advisors, this legitimacy is based largely on farming groups’ understanding of local farming systems as well

as soil challenges and priorities that are specific to these systems. It is likely that the need for amplifying values around trustworthiness and credibility is due to ‘the absence of an organizational outlet’ (McCarthy, 1986, as cited in Snow et al., 1986)—in this case the current lack of input that farming groups have into national soil R, D and E priorities—rather than a lack of trust in local farming groups (e.g., Sligo & Massey, 2007). In highlighting these impediments to action, advisors were attempting to garner broader support from resource providers—policymakers and funding agencies—for a more integral role for farming groups in soil R, D and E, as well as improved funding to support this role.

DISCUSSION

This article highlights the significance of frame alignment processes in generating a shared sense of meaning as well as purpose on local soil research and extension priorities and practices. We have focused specifically on the role of farm advisors in these processes and have used a frame alignment theoretical framework to make sociological sense of the different ways they seek to align divergent or conflicting interpretations around soil research and/or extension. This section of the article teases out how the strategies identified in the previous section of the article enable advisors to align divergent or conflicting frames (Research Question 1) and in doing so span the boundaries between farming and other networks of practice (Oreszczyn et al., 2010). It also addresses Research Question 2 by considering the implications of these frame alignment strategies for the role of advisors in soil R, D and E and multi-actor agricultural innovation systems more broadly.

In addressing Research Question 1, our analysis identifies two key frame alignment strategies—frame transformation and frame bridging—that are applicable to how farm advisors make sense of and seek to align divergent or conflicting frames around the local application of soil research and/or extension. *Frame transformation* involves re-framing ‘reductionist science’ to a ‘farmer-led science’ frame to assert the significance of farming knowledge and expertise within broader R, D and E practices. Nevertheless, this does not necessarily result in the ascendance of a ‘farmer-led science’ frame over others ‘as a kind of master frame’ (Snow et al., 1986, p. 475). As we have argued, farm advisors also re-frame the ‘farming as a system’ frame to focus on the importance of soil researchers and research organisations collaborating with local farmer networks in developing research outputs that are locally useful and useable. This is important in transforming ‘farming as a system’ from a frame that is challenging to accommodate within scientific norms and practices to one focused on collaboration that is assumed to have mutual benefits for researchers and farming communities. It is through *frame bridging* that farm advisors identify the local actors considered to be most credible for co-ordinating these collaborative efforts and in accommodating soil science research as well as farming knowledge and expertise within a revised ‘farming as a system’ frame. Frame bridging is useful in understanding how farm advisors position local farming groups as intermediaries who are trusted by farmers but who also have access to broader networks of soil expertise and who they can work with to effectively translate soil research in ways that are applicable to local priorities and practices.

Our application of frame amplification enables a deeper analysis of how farm advisors build authoritative claims for the validity and value of local farming groups in aligning the conflicting ‘farming as a system’ and ‘reductionist science’ frames. This involves first value amplification, which is crucial in the positioning of farming groups as trusted and credible intermediaries who facilitate interactions between farmers and soil researchers in ways that are assumed to resonate with the interests of both groups. Value amplification overlaps with the strategy of frame bridging

where farming groups are positioned as the most appropriate actors in generating a shared sense of purpose around local soil research and extension priorities and practices. Belief amplification builds on both frame bridging and value amplification by articulating how farming groups can be better supported in the national soil R, D and E system to perform their role as trusted and credible intermediaries. Whereas all of the frame alignment strategies drawn upon by participants are oriented towards linking their interpretive frames with those of their constituents (Benford & Snow, 2000, p. 624)—whether these be farmers, local farming groups or soil researchers—frame amplification is slightly different. It has a much more deliberative resource-focused orientation that provides what Benford and Snow (2000, p. 617) refer as a ‘call to arms’, in this case, for local farming groups to be better resourced by funding bodies and research organisations. In this way, frame amplification can be an important ‘springboard for mobilizing support’ (Snow et al., 1986, p. 469), a means by which farm advisors provide constituents—in this case, funding bodies and research organisations—with compelling accounts for engaging in action to change the current lack of resourcing for local farming groups.

In addressing Research Question 2, our research advances knowledge on the role that farm advisors play (a) as facilitators and intermediaries between farmers and soil researchers/scientists and (b) within agricultural innovation systems more broadly, in three important ways. First, it draws attention to the previously little recognised *interpretive* work of farm advisors. To date, much of the social science soil management and agricultural innovation systems literature has focused primarily on technical processes that may improve how farm advisors facilitate social learning and integration of knowledge among different actors (e.g., Crotty et al., 2019; Pigford et al., 2018; Rivera & Sulaiman, 2009; Stoate et al., 2019). As we have seen, farm advisors in our research generate meaning on (a) the different or conflicting frames that are perceived to be relevant to and impact on local soil research and extension, and (b) how different frames can be aligned in ways that are likely to resonate with the interests of both farmers and soil researchers. Studying this interpretive work arguably provides a crucial foundation for informing how the facilitation role of farm advisors can be embedded more effectively in agricultural innovation systems to enhance opportunities for ‘multi-actor interaction’ (Klerkx et al., 2012, p. 473). It can also assist in identifying which social learning and interactive processes are most likely to be suitable in aligning conflicting frames and achieving a common sense of purpose among diverse actors. Such insights are particularly important in enabling more collaborative and co-designed approaches to soil R, D and E that are a central plank of Australia’s *National Soil Strategy* as well as the recent *Soil Health Living Labs* initiative in the EU.¹

Second, the application of a frame alignment approach shows that farm advisors do not necessarily position themselves as intermediaries or facilitators within agricultural innovation systems. In our research, advisors interpreted the local farming groups with which many were affiliated, and the networks of expertise linked to these groups, as the most significant actors in aligning the conflicting ‘farming as a system’ and ‘reductionist science’ frames. This suggests that farm advisors need to be conceptualised as more than just prospective or actual intermediaries who play a largely technical role in facilitating and governing interaction between actors (Klerkx & Leeuwis, 2009; Klerkx et al., 2012). They also play an important interpretive role in *positioning* other ‘webs of influencers’ (Oreszczyn et al., 2010) and ‘communities of practice’ (Krzywoszynska, 2019) as part of efforts to make soil research useful and useable to farmers. Understanding such positioning is helpful in determining which sets of actors are interpreted as having the credibility and trust in ‘initiating, fostering and brokering farmer-centric networks’ (Ingram & Mills, 2019, p. 29) to facilitate social learning between farmers and scientific ‘experts’ for addressing local soil research and extension priorities.

Third, and finally, the use of a frame alignment perspective further expands the current conceptualisation of farm advisors as intermediaries. In our research, farm advisors used frames strategically, generating narratives that highlight the inadequacy or injustice of current arrangements, the ameliorative action required to address those inadequacies/injustices and a rationale for engaging in action (Benford & Snow, 2000, p. 624). Broadly, farm advisors diagnosed the current soil R, D and E system as problematic in being responsive to local soil priorities and practices due to the dominance of a 'reductionist science' frame. They used frame amplification strategically to rationalise the need for more resourcing from funding agencies and research institutions and to position farming groups as key actors who need to be given a more integral and meaningful role in the national soil R, D and E system. Acknowledging that farm advisors play an *interpretive-strategic role*, in addition to a technical role, is useful for soil policymakers in Europe, Australia and elsewhere in gaining an understanding of what resources and governance arrangements are likely to work best, and why, longer term for facilitating interaction and social learning between different actors (Klerkx et al., 2012). This is particularly important as part of designing initiatives aimed at building capacity in soil advisory services (Ingram & Mills, 2019) and in ensuring that soil decision-support systems—such as the SmartSOIL Toolbox in Europe—are useful and useable at a local scale.

CONCLUSION

Improved management of agricultural soils is a European and a global priority (Bouma & McBratney, 2013; Doran, 2002; European Commission, 2023c; Powlson et al., 2011). Farm advisors play a critical role in supporting farmers in the implementation of research for improved soil outcomes and in working with soil 'experts' to generate locally useful and useable soil management tools and practices (Ingram & Mills, 2019). The frame alignment approach applied in this article provides insights into the interpretive *and* strategic role played by farm advisors in aligning divergent or conflicting frames and in doing so building broader legitimacy, credibility and support for local soil research and/or extension priorities and practices. As we have argued in this article, the application of a frame alignment approach provides an important foundation in (a) identifying key frames that are at stake among stakeholders as part of efforts to facilitate co-production of knowledge between farmers and 'experts'; (b) analysing the interpretive work of farm advisors in variously accommodating, re-framing or amplifying specific frames to align different soil research and/or extension priorities; and (c) understanding how farm advisors use frames strategically as part of mobilising support among constituents for increased resourcing and a greater input into national soil R, D and E.

Our analysis advances knowledge on the role played by farm advisors in working with other actors, such as farmers and soil researchers, to co-produce knowledge for improved land and soil management outcomes. Whereas the literature to date has focused primarily on the technical role of farm advisors in facilitating interactions between different actors, and working towards common goals, our research findings draw attention to the importance of advisors' interpretive-strategic work. This involves efforts to align conflicting frames in ways that better resonate with the interests of soil researchers and R, D and E organisations, positioning particular actors as having the legitimacy and credibility to align conflicting frames, and articulating the resourcing and governance arrangements that need to be changed, which currently stand in the way of these actors performing their role effectively. We argue that this interpretive-strategic work provides a critical foundation in understanding *which* tools, practices and approaches are likely to be

most effective as part of initiatives to achieve common goals between farmers and ‘experts’, the actors positioned as having the credibility and trust to facilitate these initiatives (as we have seen, wider ‘webs of influencers’ may be important; Oreszczyn et al., 2010), and *what* resources and governance arrangements are required to enable local intermediaries to facilitate soil research and extension that is useful and useable for farmers.

ORCID

Vaughan Higgins PhD  <https://orcid.org/0000-0001-9350-1282>

Catherine Allan PhD  <https://orcid.org/0000-0003-2098-4759>

ENDNOTE

¹ENDNOTE Part of the EU Mission: Soil Deal for Europe, Soil Health Living Labs ‘will be partnerships between multiple partners and different actors, like researchers, farmers, foresters, spatial planners, land managers, and citizens who come together to co-create innovations for a jointly agreed objective’ European Commission (2023a). *EU Mission: A Soil Deal for Europe*. European Commission (https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe/soil-health-and-food_en).

AUTHOR CONTRIBUTIONS

Vaughan Higgins: Funding acquisition; project administration; conceptualisation; methodology; investigation; formal analysis; writing—original draft; writing—review and editing. **Melanie Bryant:** Funding acquisition; project administration; methodology; investigation; writing—original draft; writing—review and editing. **Catherine Allan:** Funding acquisition; project administration; investigation; writing—original draft; writing—review and editing. **Peat Leith:** Funding acquisition; project administration; investigation; writing—original draft; writing—review and editing. **Geoff Cockfield:** Funding acquisition; project administration; investigation; writing—original draft; writing—review and editing. **Penny Cooke:** Investigation; formal analysis; writing—original draft; writing—review and editing.

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The authors whose names are listed above certify that they have no affiliations with or involvement in any organisation or entity with any financial interest (such as honoraria; educational grants; participation in speakers’ bureaus; membership, employment, consultancies, stock ownership or other equity interest; and expert testimony or patent-licensing arrangements) or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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