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Communicating soil carbon science to farmers: Incorporating credibility, salience and legitimacy

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ABSTRACT

A key narrative within climate change science is that conserving and improving soil carbon through agricultural practices can contribute to agricultural productivity and is a promising option for mitigating carbon loss through sequestration. This paper examines the potential disconnect between science and practice in the context of communicating information about soil carbon management. It focuses on the information producing process and on stakeholder (adviser, farmer representative, policy maker etc) assessment of the attributes credibility, salience and legitimacy. In doing this it draws on results from consultations with stakeholders in the SmartSOIL project which aimed to provide decision support guidelines about practices that optimise carbon mitigation and crop productivity. An iterative methodology, used to engage stakeholders in developing, testing and validating a range of decision support guidelines in six case study regions across Europe, is described. This process enhanced legitimacy and revealed the importance, and the different dimensions, of stakeholder views on credibility and salience. The results also highlight the complexities and contested nature of managing soil carbon. Some insights are gained into how to achieve more effective communication about soil carbon management, including the need to provide opportunities in projects and research programmes for dialogue to engender better understanding between science and practice.

1. Introduction

Debates in rural contexts about the authoritative status and legitimacy accorded to scientific knowledge have been played out in contested arenas of conservation agriculture, diffuse pollution, GMOs, animal disease, pollinators and agri-environmental management (Blackstock et al., 2010; Fish et al., 2003; Maye et al., 2014; Maderson and Wynne-Jones, 2016; Sumberg and Thompson, 2012). More widely, recognition of science's institutionalised power and its denial of the legitimacy of other knowledges has led to a more democratic model of science and society (Wynne, 1996; Whatmore, 2009). At the same time a growing appreciation of the complexity of social-ecological systems has prompted calls for a more appropriate science that "will be based on the assumptions of unpredictability, incomplete control, and a plurality of legitimate perspectives" (Funtowicz and Ravetz, 1995 p1). A redefined position of scientific knowledge is also proposed for contributing to the negotiation processes in the context of competing claims on natural

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resources (Giller et al., 2008). This paper is situated against this theoretical backdrop. It examines the challenges of communicating information about the complex and uncertain science behind soil carbon management and draws on the notions of credibility, salience and legitimacy elaborated in the Science and Technology literature (Cash et al., 2002).

Conserving and improving soil carbon through agricultural land management provides an important opportunity to address the major global challenges of rapid climate change, degradation of soil and water quality and urgent and growing demand for food (Banwart et al., 2014). Soil organic carbon (SOC) supports essential soil functions, prominent among these is the considerable potential for land management strategies for mitigating carbon loss (Desjardins et al., 2005). A number of 'climate-smart' arable land management practices, such as cover crops, crop residues and reduced tillage, have shown potential for carbon sequestration by protecting, maintaining and increasing SOC stocks (Lal, 2003; Smith, 2004, Smith, 2012; Paustian et al., 2016). Many of these practices are also considered to improve soil productivity and profitability of farming systems (Lal, 2006). Thus soil can be managed positively to enhance the multiple benefits that SOC provides (Kahiluoto et al., 2014). As stated by OECD (2015 p.1) "soil organic matter, essentially made of carbon, is not only one of the determining factors of agricultural productivity, and a powerful support to crop resilience and adaptation to climate change, but also a promising option to sequester atmospheric CO_2 captured by photosynthesis".

These are the key narratives associated with soil carbon, they underpin international scientific and political interests in carbon sequestration, articulated for example in IPCC reports (Smith, 2012; Smith et al., 2007b), are central to initiatives such as FAO's Climate Smart Agriculture and France's "4 per 1000" proposal endorsed by the COP 21 Steering Committee in 2015 (OECD, 2015), and are the basis of voluntary and market based measures (Rochecouste et al., 2015; Dumbrell et al., 2016). This framing can be characterised as techno-scientific, based as it is on the underlying assumption that problems are of a technical nature and can be solved with agronomic interventions supported by scientific evidence (Feola et al., 2015). Understanding and removing barriers and increasing the acceptance of soil management using voluntary, compliance and economic measures is seen as a core strategy (Paustian et al., 2016). Accordingly it is assumed that the potential for agricultural practices to sequester carbon and achieve the multiple benefits described can be realised if land managers are persuaded to change practice, and that information plays a central role in this process.

Whilst this behavioural model which assumes an 'information deficit' is widely critiqued (Fleming and Vanclay, 2011; Moser, 2010), the nature and the processes involved in communicating information across the science-practice interface remain of interest. As scholars have argued the quality of the linkage between knowledge and action strongly influences the acceptance of new practices (Vogel et al., 2007). This has been demonstrated extensively in agricultural research projects which endeavour to bridge the so-called divide between scientific or technical solutions and implementation in the field (Carberry et al., 2002; McCown, 2001; Millar and Curtis, 1999). The process of knowledge development influences the substance of the knowledge developed (Jacobson, 2007; McNie, 2007; Pielke Jr., 2007) as such the need to pay attention to internal and external scientific processes and the quality of evidence produced has been highlighted (Van der Sluijs et al., 2008). The requirement for greater sensitivity to farmers' understandings of scientific knowledge when exploring management responses particularly for complex and contested issues has also been identified (Holloway, 1999).

The nature of the linkage is pertinent to the context of climate mitigation and adaptation which is difficult to communicate beyond the scientific community, due to its inherent uncertainty and complexity (Hammill and Tanner, 2011; Moser, 2010; Shackley and Wynne, 1996). This is significant given that managing carbon sequestration is a new and technically complex topic, and according to Dilling and Failey (2013) lacks sufficient supportive information for land managers.

Communicating effectively about soil carbon management presents some particular challenges. Many of the claims and promotional messages are centred on the scientific characterisation of the potential of practices to enhance carbon sequestration (Dilling and Failey, 2013). This can be problematic since soil carbon dynamics are associated with scientific uncertainty and debate concerning not only the effectiveness of practices in enhancing soil carbon but also in the role of soil carbon in mitigation (Powlson et al., 2011; Mackey et al., 2013; Stockmann et al., 2013; Sommer and Bossio, 2014; Söderström et al., 2014; Bradford et al., 2016). Furthermore, the interest in soil carbon is perceived to be driven by a political climate change agenda and not always relevant to farmer interests, priorities or aligned to their beliefs (Arbuckle et al., 2014; Wilke and Morton, 2015; Sumberg et al., 2013).

All these issues create problems with respect to scientific information being perceived as credible, relevant and considerate of everyday lives and priorities of the farming community. They also highlight that, in order to support land managers' information needs concerning soil carbon management, researchers must become more attuned to the process of producing information as well as the ultimate decision context in which information might be used (Dilling and Failey, 2013).

With this in mind this paper seeks to examine the potential disconnect between science and practice in the context of communicating information about soil carbon management. Specifically, it focuses on the information producing process and on stakeholder assessment of the attributes *credibility, salience and legitimacy,* drawing on results from consultations with representatives from the farming community in the SmartSOIL project. This interdisciplinary project aimed to provide scientifically grounded decision support to a range of beneficiaries about practices that optimise carbon mitigation and crop productivity.

2. Conceptualisation –credibility, salience and legitimacy

2.1. Farmer behaviour and communication

Farmers are the group on which the tasks of climate change adaptation and mitigation in agriculture will mainly fall (Berry et al., 2006). As the main agents undertaking these tasks their behaviour influences how and with what success scientifically derived programmes and measures are realised on the ground (Feola et al., 2015). Many studies taking a techno-scientific view have focused on technological, informational, educational, political and attitudinal barriers to implementing adaptation and mitigation practices on the farm (Smith et al., 2007a; Feliciano et al., 2014; Arbuckle et al., 2014; Cook and Ma, 2014; Burbi et al., 2013; Dumbrell et al., 2016). This follows a long tradition of behavioural studies in rural contexts in which factors explaining non-adoption of agronomic practices, innovations and agri-environmental schemes (AES) are evaluated (Feder and Umali, 1993; Knowler and Bradshaw, 2007; Siebert et al., 2006; Prokopy et al., 2008). In response to criticisms that such approaches do not accommodate farmers' diverse rationalities, there has been a shift towards understanding and influencing behaviour in wider terms of socio-cultural influences, identity and social embeddedness and social principles (Feola et al., 2015; Burton, 2004; Vanclay, 2004). Accordingly Fleming and Vanclay (2011 p16) call for social