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Understanding the influence of farmer motivations on changes to soil erosion risk on sites of former serious erosion in the South Downs National Park, UK

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ABSTRACT

Serious soil erosion occurred in the South Downs National Park, southern England in the years 1982–2006 and details of around 400 sites are contained in a database. In 2010 we revisited 85 of the most serious sites where erosion of >10 m^3 ha^{-1} y^{-1} had been recorded in order to assess land use change and any conservation measures undertaken. At 79% of the sites land use change had resulted in a reduction in the risk of erosion, most notably at 28 sites with a shift to permanent grass from winter cereals. At only 21% of sites was the risk of erosion unchanged. Twenty two farmers responsible for 66 of the sites were interviewed. Land management practices had changed on all of the fields of interest to this study since the time of the serious erosion events, to those which have the potential to lower soil erosion risk. Sixteen interviewees claimed that erosion was a motivating reason for changing their practices, due to either experiencing on or on- and off-farm impacts firsthand (12), having knowledge or suspicion of serious erosion having occurred on their land prior to their management (three), or having no knowledge of any serious erosion on their land but just wanting to reduce overall erosion risk (one). Amongst the main changes reported are changes of land use from winter cereals to grass or to overwinter stubble which have undoubtedly reduced the risk of erosion. However, some changed practices claimed by farmers, such as along-the-contour-working, earlier sowing and the use of rollers may be of little value. Furthermore, deeper analysis of farmers' motivations regarding changes in land management practices suggests a complex picture in which a range of socio-economic influences come into play over time including financial incentives offered by agri-environmental schemes which were found to be an important driver of change. Future changes in farming economics may therefore undermine the reduction in erosion risk in the longer term.

1. Introduction

Erosion is widely recognised as a threat to global soils impacting on their ability to grow crops and maintain a valuable service role such as in the control of flooding (Montgomery, 2007). Freshwater pollution and reservoir sedimentation are two important consequences of unchecked erosion. In this context, numerous publications have addressed the issue of erosion control, or soil conservation e.g. Morgan (2005) and Boardman (2002). Inextricably linked to this challenge is the problem of understanding farmers' motivations to combat erosion and therefore designing policy frameworks that are likely to yield results. These have been longstanding concerns for academics and policy makers in parts of the world where soil erosion has become an issue. In the global north most early research was undertaken in the USA from the 1950s, with Australia neglected until the 1990s (Sinden and King, 1990: 180) and Europe receiving only limited attention to date (Lahmar, 2010), with a stronger focus instead on Agri-Environment Schemes (AESs) adoption (Wauters et al., 2010). A recent review of studies from across the world of farmers' adoption of conservation agriculture by Knowler and Bradshaw (2007:25) argues, however, that there are "few if any universal variables that regularly explain" why relevant conservation agriculture practices, themselves highly context specific (Lahmar, 2010), have been taken up by farmers. This has led to further calls (Knowler and Bradshaw, 2007; Prager

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and Posthumus, 2010) for more contextualised studies of the type presented here.

The risk of erosion in the UK is particularly associated with intensive arable cultivation on lowland areas of England and Wales. A combination of erodible soils, slopes, vulnerable crops and a lack of conservation measures has led to erosion being a feature of parts of the east and west Midlands, Somerset, south Devon and chalk and greensand areas of southern England (Evans, 1996; Boardman and Evans, 1994, 2006). Two distinct examples are found within the South Downs National Park, both with a history of intensive agriculture and associated problems of runoff and erosion. The South Downs sensu stricto is underlain by chalk and typically the soils are thin rendzinas of the Andover association (Jarvis et al., 1984). The term 'South Downs' is used here in the sense adopted for the recently designated National Park in that it includes an area to the north of the chalk Downs on Lower Greensand soils around Midhurst. Post Second World War the expansion of arable farming, mainly winter wheat, led to an erosion problem on the chalk soils. In contrast, the valley of the Western Rother around the town of Midhurst is underlain by Lower Greensand with intensive arable farming of potatoes, maize, cereals and salad crops on sandy loam soils of the Fyfield 1 and 2, Frilford and the Shirrell Heath 1 associations (Jarvis et al., 1984). The chalky soils of the South Downs are regarded as at moderate risk of erosion whereas the greensand soils are at high risk (Evans, 1990).

Throughout the 1980s and 90s soil erosion was a serious threat on the South Downs, an area which has become widely regarded as a European 'hot spot' for acute events (Boardman, 2003; Verstraeten et al., 2003) (Fig. 1). In exceptional years (1982, 1987 and 1990) cases of erosion were widespread and they were accompanied by off-site damage due to muddy flooding of properties and roads (Fig. 2a and b). The most recent occurrences were in 2000 and since then there have been few instances except in the area around Midhurst in the autumn of 2006. During these three decades almost all cases occurred in the months October-December and the great majority were on land prepared for, or drilled with, winter cereals. The explanation for this pattern is the coincidence of large areas of bare, or nearly bare, ground at the wettest time of the year, with a predominance of winter cereals in the landscape. The lack of cases since 2000 suggests either that the climate has changed or that farmers have changed their land use or their practices. There is little evidence of climate change (e.g. Boardman et al., 2009) but considerable anecdotal and observational evidence of changes in land use. However questions remain as to how extensive land use and practice change has been, what has motivated such changes, and how soil erosion risk is likely to develop in the future. This paper attempts to answer these questions by examining sites of serious erosion, their current land use and the management decisions behind this. Clearly the sites selected are not representative of land use on the South Downs but of sites of serious erosion. However, it is suggested that it is at these sites that farmers could be expected to have responded most to the loss of soil and in some cases to the down-valley muddy flooding that occurred. Therefore the key questions that the paper seeks to address are:

i) How has soil erosion risk changed from 1980s to now and what are the characteristics of this changed risk (including land use change; flood defence structures; changes to farming practices)?
ii) What are the key factors motivating farmers and land managers to change or retain management practices on fields with a history of serious soil erosion and how do these relate to relevant and robust soil conservation practices?
iii) How are soil erosion risk levels likely to develop in the future?

2. Soil erosion and its management

2.1. The policy context

There is evidence to suggest that soil conservation was neglected as an issue at institutional levels both in Britain and Europe until the 1990s (Environment Agency, 2002; Evans, 2010a; Fullen, 2003). In England evidence of acute 'muddy flooding' problems in the South Downs and concerns over sediment impacts on water quality, both prominent public issues, helped prompt a concerted institutional response to soil erosion from agricultural land and other sources (Boardman, 2002). Despite the status of soil transfer as a form of 'pollution', akin in its acute forms to a water pollution incident, the dominant institutional responses to the control of soil losses from agricultural land have been through voluntary means. There is little evidence of prosecutions by the Environment Agency or its predecessor, the National Rivers Authority, in relation to acute agricultural soil erosion events and a favouring of alternative approaches (Seymour et al., 1999; Environment Agency, 2002). Likewise, while there have been a number of cases where warnings have been issued under the 1980 Highways Act in relation to mud on public roads, there are few cases of prosecutions in relation to these (Boardman, 1994; Posthumus and Morris, 2010) though Posthumus et al. (2011: 107) recommend the deployment of "prosecution based on liability" as part of a suite of incentives to promote better soil conservation. Private individuals affected by muddy flooding have had some success in pursuing incidents through the civil court system, though compensation for damage has dominated over securing future actions to reduce erosion risk (Environment Agency, 2002; Boardman, 1994; Boardman et al., 2003).

Within Defra, the government department responsible for agriculture and the environment in England, the main approaches have been to enhance advice and agri-environmental support to farmers to help them conserve soils more effectively. The first specialist *Code of Good Agricultural Practice for the Protection of Soil* was issued in 1998, followed by a series of more detailed advisory packages. However, the tendency has been to approach soil conservation through more prominent measures focused on diffuse water pollution prevention rather than on soils in situ (Posthumus et al., 2011), most notably the Catchment Sensitive Farming Delivery Initiative (CSFDI) established in 2004 primarily to address the requirements of the Water Framework Directive (Defra, 2004). This set out to raise awareness of water pollution, including that related to sediment transfer, and through the Catchment Sensitive Farming Project encouraged voluntary remedial action, in priority catchments, supported by advice and, where appropriate, 50% capital grants. Recent scheme evaluations highlight good levels of farmer engagement and positive impacts on water quality in these areas, including evidence of reduced sediment transfer (Environment Agency, 2014). Yet soil, unlike water, still has no framing EU Directive. One was proposed in 2006 but withdrawn in 2014, though the same year sustainable soil management was made a target of the Seventh Environment Action Programme (CEC, 2006; Duruiheoma et al., 2015). Soil erosion prevention has also more recently been integrated within the well-established voluntary AES tradition of England under which farmers and land managers receive payments for undertaking a range of environmentally-oriented practices. The early schemes, most notably Environmentally Sensitive Areas (ESAs) (from 1987), had a strong biodiversity and landscape orientation and did not consider issues of soil erosion. However, under the English Environmental Stewardship (ES) scheme, introduced in 2005 (and replaced by Countryside Stewardship in 2015) resource protection measures, including those specific to soils, were incorporated as one of four key priority goals and informed around 50% of options (e.g. Defra, 2005a; Boatman et al., 2008: 104). Due to the