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Short communication

A reply to panagos et al., 2016 (Environmental science & policy 59 (2016) 53–57

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ABSTRACT

We respond to the article by Panagos et al. in Environmental Science & Policy 2016, 59, 53–57. We first outline the history of assessing water erosion of cultivated land in Britain, to place in context why a model approach has not been considered the best way to assess erosion in Britain. Since 1982 a field- based approach has been consistently chosen. We then consider three particular points of contention between ourselves and Panagos et al.—1) the importance of wash erosion, 2) the cost of carrying out a field-based assessment of erosion, and 3) that the Revised Universal Soil Loss Equation should be the harmonized method to assess soil loss. Last, we respond to individual points made by Panagos et al. before drawing some conclusions. One conclusion is that a more harmonious way of assessing erosion was put forward in 2004 by Gobin et al. combining both field-based and model assessments, but unfortunately that route was not taken by researchers at the Joint Research Centre.

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1. Introduction

We respond for the second and last time to articles by Panagos et al. (2015, 2016). There appear to be three particular points of contention between ourselves and Panagos et *al.* – (1) the importance of wash erosion, (2) the cost of carrying out a field-based assessment of erosion, and (3) that the method used to assess soil loss should be a harmonized one, and as the Universal Soil Loss Equation or its variants are the most used technique, it should be based on the USLE. We then address individual points that need to be addressed. However, before we address those issues we need to outline in more detail a history of assessing and monitoring water erosion of cultivated land in Britain in order to put those points into context. This background information is given elsewhere (Evans, 1996, 2005) but we consider needs to be repeated here.

2. History of assessing erosion of cultivated land in Britain

Rill eroded fields were noted by one of us (RE) in the late 1960s and from then on a log was kept of where rill and gully erosion were recorded. We recorded what we saw on our travels, what colleagues told us and what was seen on aerial photographs. This built up a 'picture' of where and when rill erosion was found most frequently (Evans and Cook, 1986). By the late 1970s it was realised that erosion was being seen much more frequently than it had been in the recent past, and that a more systematic approach was needed to assess if water erosion of arable land was a problem. How to do this led to much discussion. Two ways were put forward to the then Ministry of Agriculture, Fisheries and Food, one based on plot experiments and one based on taking and interpreting aerial photographs to identify eroded fields and then field checking not only the interpretations but also to assess why some fields eroded and adjacent fields did not – a factor primarily controlled by the crop grown.

The field-based route was chosen as it was considered there was little point in duplicating the plot experiments which led to the Universal Soil Loss Equation (USLE) in the USA for the processes controlling erosion were already known. What needed to be known was where rill and gully erosion occurred and how often. It was considered that wash was of minor importance in transporting soil across the landscape as low velocity flow does not incise into the soil and only transports rain-splashed fine particles. Such a process leaves little evidence of movement of soil in the field apart from splashed sand grains and organic rich particles in surface depressions. In other words, particles were moved small distances and the surface remained largely unaltered except for some slaking and smoothing (crusting) of the surface. Rills and gullies were

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considered much more effective in transporting and redistributing soil within a field. As the cross-sections and lengths of rills and gullies can be measured/estimated in the field with acceptable accuracy (within 0.5–2.0 of the mean value; Evans and Boardman, 1994) and it was known that small erosion events (small rills and depositional fans) were visible on aerial photographs it was decided that was the way to go. As a result seventeen localities were selected by personnel working for the Agricultural Development and Advisory Service of the Ministry of Agriculture (now Defra) and the Soil Survey of England and Wales to be monitored over 5 years (1982–1986). Thus, the monitoring scheme to assess if water erosion of cultivated land was a problem used aerial photographs to locate eroded fields in soil landscapes where it was known erosion occurred and in other landscapes where it was considered land use change, from grass to arable, might lead to more erosion. The interpretation of aerial photographs was followed by field measurement to assess rates of erosion.

In April 1986 the Soil Survey of England and Wales was closed down but the erosion scheme continued for its fifth year. Erosion was by then acknowledged as a problem – the first advisory pamphlet was published in 1985 (MAFF, 1985). There was then much discussion as to how soil erosion should be monitored in the future. The discussion involved personnel from the Agriculture and Food Research Council, the Agricultural Development and Advisory Service, the Soil Survey and Land Research Centre and Evans (by then RE had left the Survey). At issue was not how erosion should be assessed in the field but how the fields should be chosen, i.e. the sampling scheme. By then it was also obvious that rates of erosion were so variable and so skewed that to be able to ascribe means and standard deviations that distinguished between different soil landscapes and crop types was an un-affordably large task (see below). When another monitoring scheme was initiated in the late 1980s it was based largely on the localities previously monitored and soil loss was measured in the field. A scheme considered more statistically sound was initiated in the mid-1990s. The assessments of erosion were still to be field-based. Other researchers in Britain have also considered that rill and gully erosion should be assessed rather than wash erosion, as the latter was thought of little importance. Much of this work assessed erosion following a storm or wet period, rarely was erosion monitored over a number of years, the work of Adam Watson in Scotland (Watson and Evans, 1991, 2007) and John Boardman in England (2003) being notable exceptions.

When all the field-based estimates of soil erosion in Britain were brought together (Evans et al., 2015) it was found that the results were consistent and, as found earlier, did not relate well to rainfall and topographic factors. Nor could soil landscapes be differentiated by their mean rates of erosion but could by the extent of erosion within landscapes this being related to the range of crops grown in those landscapes. In other words, for two decades field-based assessments of erosion were considered in Britain to be the best and most efficient way of assessing soil loss. To respond to one of the points raised in Panagos et al. (2016), perhaps that is why the United Kingdom has not participated in modelling exercises to assess soil loss, there seemed little point when it was known models to predict erosion did not relate to where erosion actually occurred (Evans and Brazier, 2005).

3. Wash erosion

Visual assessment of erosion in the field suggests that very small volumes of soil are transported by what we consider to be wash (see above). Other researchers also consider wash/interrill/sheetflow erosion accounts for only a small proportion of the soil transported, for example Govers and Poesen (1988) suggest 20% of total erosion is sheetflow. We have observed turbid runoff both over saturated bare soil surfaces and grassland into streams, but with very little evidence of the process imprinted on bare soil (see below) and almost none over grassland. Such wash can take place across a whole field/landscape when topsoils are saturated. In our experience, rills tend to occur in particular places within a field, on a valley-side slope below a crest or on a long slope below a convexity for instance, or in valley floors and depressions, not across the whole field or landscape. The USLE estimates wash across the field/landscape but that wash includes small rills. Both ways of assessing erosion accept that wash can occur across the field or landscape, but field assessment distinguishes between wash and rill erosion whereas the USLE appears not to. The differing interpretations of wash may well, at least partly, explain the differences in assessments. Visual assessment identifies rill eroded fields within a landscape across which wash erosion takes place. The USLE and its Revised version (RUSLE) models interrill and (small) rill erosion across the whole landscape, when in fact in our experience rilling that would lead to higher rates of erosion does not occur across the whole of a landscape, but in any year only a part of it.

4. Cost of field-based monitoring

Panagos et al. (2016) suggest the cost of field-based assessment of erosion is prohibitive. It is not. The SSEW monitoring project produced results that were later checked and the soil associations (landscapes) considered most at risk of erosion were confirmed as the ones where rill eroded fields were found most often and most extensively (Marks et al., 1997). Rates of erosion found by other researchers were very similar (Evans et al., 2015). In other words, as the history of erosion assessment in Britain shows, field-based assessment was accepted as a satisfactory way of assessing erosion. What was argued about, and presumably is the basis of Panagos et al.'s comments, was the number of fields that would have to be sampled to give a statistically valid answer to distinguish rate of erosion on different soil and crop types. That was because the range of rates of erosion within a soil landscape is large and skewed (Boardman, 1990; Evans, 1990a, 1998), similar to the distribution of values recorded in plot experiments (Evans, 1995; Boardman and Favis-Mortlock, 1999), with a larger range of values in more erodible landscapes or in years when more rill erosion occurs. Rates of erosion in those years have higher mean values, but median values in all years are similar. Hence the cost of assessing rates of erosion to identify which soils or crops eroded most within England and Wales, if not done on some kind of stratified (e.g. soil landscape) basis, was too great because the number of fields which would have to be assessed to give a statistically sound answer was too large.

The time taken to carry out the SSEW monitoring scheme over its 5 year period, is partly described in Evans (1992, pp. 85) and the number of days analysing the data for the full 5 years (1982–1986) is updated here. Thus, "Over the five year period from 1982 to 1986, the number of fields examined each year ranged from 135 in 1984–560 in 1983. On average it took 5.2 (range 4–7) working days to interpret the aerial photographs and 23.3 days (16–32.25) days to carry out the fieldwork." One person did all the interpretations, and 65% of the field work, but a further seven people were involved over the five year period. It took a further 263 days for one person to analyse the data; write-up time and cost of taking aerial photographs are not included. As noted above, the field-based monitoring scheme showed which landscapes suffered most erosion, that erosion was a problem in some landscapes and the results were confirmed by later work. In view of the time and costs taken to set up experimental plots and to build models on the data obtained from those experiments the costs of the field-based

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