ASC analysis to support a long-term plan for the Somerset Levels and Moors

The Adaptation Sub-Committee (ASC) of the Committee on Climate Change is due to present its first statutory report to Parliament in the summer of 2015. This will assess the progress being made in preparing the UK for climate change. In advance of this we are gathering a range of evidence to help understand the country's exposure and resilience to the expected impacts of climate change. The ASC has considered the drivers and impacts of flooding in some detail, as this was identified as the most significant risk facing the UK by the Climate Change Risk Assessment. Much of this evidence will be directly relevant for planning the long-term resilience of the Somerset Levels and Moors ("the Levels").

Land management in the upper catchment

The way that land is used and managed in the upper catchment will have a strong influence on downstream flood risk. This is particularly the case with the Somerset Levels, given its flat, basin-like topography that is bisected by higher ground, notably the Mendips and the Polden Hills. For this reason, it will be important that the long-term plan accounts for land use in the upper catchment.

The Environment Agency's Parrett Catchment Flood Management Plan[1] notes that flooding been strongly driven by local surface water problems, exacerbated by some farming practices. A survey of over 3,000 sites in south-west England[2] found that the soil structure of three-quarters of sites under maize cultivation were damaged to the extent that rainfall is unable penetrate the upper soil layers, resulting in muddy, silt-laden runoff. The authors estimate that every 10-hectare block of damaged land under maize produces the equivalent of 15 Olympic swimming pools of runoff (more than 375 million litres) during a 12-hour rainfall event.

Analysis for our 2013 report noted that there has been a 50% increase in the area of land under maize in the UK, from 976,000 hectares in 2000 to just under 1.5 million hectares in 2010. Nearly one-third (31%) of UK maize production is in the south west region, where there has been a noticeable increase in the cultivation of maize, as well as crops like oil seed rape, while more traditional crops (wheat and barley) have declined in recent years. Maize covered nearly 15% of cultivated land in the south-west in 2010, up from 8% in 2000.[3]

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[1] Environment Agency (2012). The contribution of farming practices to flood risk is highlighted in the following sub-compartments: Upper Yeo and Cary, Upper and North West Parrett and Upper Isle, Upper Tone.
[2] Palmer (2013). *Soil structural degradation in SW England and its impact on surface-water runoff generation.* **Soil Use and Management** Vol. 29 Issue 4
[3] The proportion of cultivated land in South West England under winter cereals declined from 35% in 2000 to 33% in 2010 and the proportion under barley from 50% to 42% over the same time period. The proportion under oil seed rape increased from 3% to 9%. See Environmental Change Institute et al (2013) for the ASC.

The long-term plan for the Levels should include measures to ensure that land managers in the upper catchment are not inadvertently increasing flood risk downstream. This could be, in part, through ensuring implementation of the cross-compliance requirements under the Common Agricultural Policy,[4] as well as incentivising soil conservation through agri-environment schemes. Detailed mapping of land use in the upper catchment along with hydrological surveys would help to better quantify whether and to what extent current cultivation practices are increasing siltation of river systems in the Levels.

There is some evidence to suggest that targeted tree planting in upland areas can be effective in helping to reduce, or delay, surface runoff volumes and so help mitigate downstream flood risk. For example, recent field trials in Wales reported a 78% decrease in surface runoff from tree-planted plots compared to grazed plots.[5] Again, detailed mapping of current levels of woodland cover in the upper catchment would be useful for identifying where further targeted tree planting is likely to help mitigate flood risk in the Levels. Consideration should also be given in the long-term plan to putting in place large field-scale experiments of tree planting in targeted parts of the upper catchment to monitor the effect this has on downstream flood risk.

Condition of floodplain peatlands in the Levels

The Somerset Levels and Moors contain some of the most significant lowland peat soils in the country. Natural England has estimated that deep peat soils in the Levels and Moors cover an area of 16,000 hectares.[6] These peatlands have formed over thousands of years and are some of the deepest in England, storing an estimated 25-30 million tonnes of carbon.

Peatlands in good condition provide a number of important services, including carbon storage and water purification. However, degraded peatlands are particularly prone to erosion meaning that their carbon-rich soils can silt up rivers and emit CO_2 to the atmosphere.

Extensive drainage of the Levels since the 1600s has resulted in the shrinkage of peaty soils. The resulting subsidence is likely to have contributed to the observed changes in maximum high tide levels in the Bristol Channel, which are estimated to be at least one metre higher than 400 years ago.[7]

Our 2013 progress report[8] referred to Natural England's analysis that over 90% of deep peat

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[4] Particularly the Soil Protection Review component

[5] Marshall et al. (2014). *The impact of rural land management changes on soil hydraulic properties and runoff processes: results from experimental plots in upland UK.* **Hydrological Processes** Vol. 28 Issue 4

[6] Natural England (2010). *England's Peatlands – Carbon storage and greenhouse gases*

[7] See Risk Management Solutions (2007*) 1607 Bristol Channel Floods: 400-Year Retrospective*. This notes that the observed increase in maximum tidal heights is due to a combination of postglacial rebound (0.6m), global sea level rise (0.2m) and other factors including localised peat shrinkage (0.2m).

[8] ASC (2013) *Managing the Land in a Changing Climate*

soils in England have been damaged from a combination of historic air pollution and on-going land management practices. Using Natural England's deep peat mapping, we have estimated that around 70% of deep peat in the Somerset Levels and Moors is likely to be losing carbon due to intensive livestock grazing, cultivation and direct extraction. A further 23% is likely to be in a stable condition, but less than 1% is classed as being pristine and therefore still actively forming peat.

More positively, we found that 7% of peat in the Levels (over 1,100 hectares) has been restored at some point over the last decade or so. Further restoration of the remaining area of degraded peat would help to improve water management, primarily by reducing carbon-rich soil losses to the rivers. Restoration would also help to increase the resilience of vulnerable peat soils to the increasing frequent and severe extreme weather events we can expect in the future with climate change.

Our analysis in 2013 demonstrated that if a value is placed on the benefits from restoration they will, in most cases, outweigh any costs. However, a major barrier to wider uptake is the lack of financial incentives for landowners, both to provide any capital outlay and to help address any reduced revenue. In this regard, we suggest that the long-term plan considers mechanisms that could be used to stimulate further restoration by fully valuing the services from well-managed peatlands.

On-going development in high flood risk areas

Our 2012 report[9] assessed the annual rate of development in areas of significant flood risk[10] in England between 2001 and 2011. These are areas that have a low level of flood protection, or do not have any defences at all.

We found that nearly 40,000 properties had been developed in significant risk areas in that time, which amounted to around one-fifth of total floodplain development. It is possible that strict conditions have been applied to much of this development to minimise risk,[11] although we cannot be certain due to the lack of nationally available data to assess uptake of flood resilience measures in buildings. However, property-level flood protection measures can generally only go so far in reducing risk and are not likely to be effective in the case of major flood incidents, particularly in coastal areas. Furthermore, continuing to develop in the areas at highest risk will place increasing reliance on building and maintaining flood defences, as well as potentially resulting in the displacement of flood water and increasing the area of hard (impermeable) surfaces. Defences can also be over-topped, putting increased pressure on local responders including the emergency services in such cases.

[9] ASC (2012). *Climate change – is the UK preparing for flooding and water scarcity?*
[10] Assessed as having a 1 in 75 annual chance of flooding or greater, after taking account of any defences in place.
[11] Measures might include ensuring dry escape routes, requiring design that minimises flood damages, such as raised floors and/or requiring sustainable drainage so that flood risk is not increased downstream.

The district councils that cover the Somerset Levels all have some properties located in high-risk areas. Sedgemoor District had by far the highest number and proportion of properties in significant flood risk areas in 2011 (at 5,400) of the four local district council areas. 11% of all properties in the Sedgemoor District are at a significant flood risk, compared to 1-2% for the other three Districts and 1% nationally. Furthermore, the annual rate of development in significant flood risk areas in Sedgemoor District increased from 1.2% a year between 2001 and 2008 to 3.2% a year between 2008 and 2011. This was more than double the average annual rate for England (1.2%), resulting in almost 900 new properties being built in areas of significant flood risk in Sedgemoor District over the decade to 2011.

Adaptation Sub-Committee Secretariat

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