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Addy, J. W. G., Ellis, R. H., MacLaren, C., Macdonald, A. J., Semenov, M. A. and Mead, A. 2022. A heteroskedastic model of park grass spring hay yields in response to weather suggests continuing yield decline with climate change in future decades. *Journal of the Royal Society Interface*. 19, p. 20220361. <https://doi.org/10.1098/rsif.2022.0361>

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RRes Press Release 24 Aug 2022 **Climate change impact on hay yields will leave farmers short of feed**

New analysis points to spring hay decline in southern England of up to 50% by 2080

A new study of long-term data from a Hertfordshire pasture suggests that spring hay yields in southern England have already been reduced by more than a third due to changes to our climate and further declines are forecast as global heating accelerates.

The analysis by Rothamsted Research and the University of Reading is published today in the Journal of the Royal Society Interface. This research has revealed that yields of animal fodder from grassland have fallen by around 35% over the last century. The data were collected between 1902 and 2016 from the Park Grass long-term experiment at Rothamsted's main site in Harpenden, Hertfordshire. The study forecasts that climate change will reduce spring hay yield by a further 20-50% between 2020 and 2080.

An innovative statistical modelling approach was used to analyse the data. This takes into account unusual patterns of yield variability, but the wide forecast range for loss in yield is primarily due to uncertainty over future global greenhouse gas emissions. The model confirmed that warmer and drier autumns, winters and, within limits, springs in the twentieth and twenty-first centuries reduced yield. The optimum spring weather is colder and wetter than the conditions that we are generally seeing now and those we are expecting to see in the future.

Dr John Addy, a statistician at Rothamsted Research and the study's lead author said, "The precise response of spring hay yield to temperature and rainfall varied during the year but there is an optimum "Goldilocks" spring rainfall and temperature associated with the maximum level of yield. Changes in autumn and winter temperature had more of an effect on yield than autumn and winter rainfall."

Managed grassland (rough grazing and pasture) is the UK's largest crop by area at over 12 million hectares; it underpins a livestock sector worth over 13 billion GBP each year. Spring hay and silage is fed to livestock throughout the winter and in also in times of summer drought, as is the case this year.

Professor Richard Ellis of the School of Agriculture, Policy and Development at the University of Reading added "The one hundred and fifteen years of results from the Park Grass experiment allow us to analyse the consequences of the previous year's weather on yield. There is a substantial legacy effect in this perennial crop: if the weather in one year is poor for hay yield, then yield in the following year is also reduced to some extent and vice versa. This is highly relevant to the resilience of farming businesses."

These projections are specific to the Park Grass site, but the design of the long-term experiment means that a range of grassland systems are studied. Plots on the site range from those with high fertilizer inputs, plots with only additions of farmyard manure and some plots with no additional inputs. The relative effect of climate change on yield was remarkably similar across all these contrasting treatments.

"Many livestock farmers in the region have already responded to change - the increase in the area of forage maize over the past half century being but one example, but future investments in milk production from grass are more likely to favour the wetter and cooler regions of the UK" concludes Professor Ellis

Publication- A heteroskedastic model of Park Grass spring hay yields in response to weather suggests continuing yield decline with climate change in future decades. Journal of the royal Society Interface 2022, Addy, J.W.G
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