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PERSPECTIVE

US agricultural policy, land use change, and biofuels: are we driving our way to the next dust bowl?

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Abstract

Lark *et al* (2015 *Environ. Res. Lett.* **10** 044003), analyze recent shifts in US agricultural land use (2008–2012) using newly-available, high-resolution geospatial information, the Cropland Data Layer. Cropland expansion documented by Lark *et al* suggests the need to reform national agricultural policies in the wake of an emerging, new era of US agriculture characterized by rapid land cover/land use change.

The US Department of Agriculture (USDA) has compiled standardized agricultural statistics (area planted, area harvested, crop yield, etc) at the county level (10^4–10^6 km^2 scale) since 1945 (US Department of Agriculture (USDA) 1969). Only recently, beginning in 2008, has USDA distributed nation-wide, agricultural land use information at high spatial resolution (30–56 m) via the National Agricultural Statistics Service (NASS) Cropland Data Layer (CDL) (Boryan *et al* 2011).

The new paper by Lark *et al* (2015) makes an original contribution to our understanding of the current state of US agriculture through the first application of the CDL for purposes of a nation-wide assessment of agricultural land cover/land use change (LCLUC). Importantly, their period of study, 2008–2012, spans an era of rapidly increasing commodity prices and the implementation of new agricultural policies; namely, the acceleration of corn ethanol production under the Renewable Fuel Standard version 2 (RFS2) and a shift from commodity price supports to subsidized crop insurance.

Lark *et al* focus their study on agricultural extensification, i.e., the conversion of non-cropland to cropland. To minimize false-positive results in their analysis, Lark *et al* implement a number of quality-control measures derived through testing against published benchmark data and direct consultation with NASS personnel producing the CDL. These measures included a straightforward, but original, temporal-filtering approach taking into account the full trajectories of the CDL time series at a given location; as opposed to simply comparing baseline (2008) and final (2012) endpoints, as others have done in previous applications of the CDL (Wright and Wimberly 2013).

Lark *et al* also developed an original method for addressing a critical knowledge gap in US LCLUC studies; the identification of undisturbed grassland. Here they used the 1992, 2001, and 2006 versions of the National Land Cover Database (Fry *et al* 2011) to identify grassland that had not been plowed, used for hay production, or improved in other ways for at least 20 years prior to agricultural conversion. From this data, Lark *et al* calculate a back-of-the-envelope estimate of the carbon footprint of recent corn and soy expansion, 94-186 MMT CO2e.

Put simply, Lark *et al* provide a broad glimpse at a new era of US agriculture. One characterized by: (1) rapid expansion of the corn belt onto marginal lands (e.g., figure 1); (2) replacement of wheat by corn and soybeans in climates formerly unsuited for corn/soy cultivation (too arid and/or too short a growing season), made possible by the development of better-adapted corn/soy cultivars and thereby forcing wheat production to expand onto other grasslands in order to meet global demand; and (3) homogenization of mixed-use landscapes (annual crops, pasture, hay, and non-cropland) to landscapes increasingly dominated by annual crops; with likely negative impacts on native biodiversity (Meehan *et al* 2010).

Paradoxically, Lark *et al* find high rates of cropland expansion often co-occurring with high rates of cropland abandonment. This suggests that US agricultural policies targeted at soil and wildlife conservation, e.g.,

Figure 1. Conversion of marginal grassland to cropland—Grant County, South Dakota. Photo credit: Peter Bauman.

the Conservation Reserve Program which takes marginal cropland out of production and into perennial grass cover, are operating at cross-purposes with other national policies that: (1) mitigate the risk of farming marginal land through crop insurance subsidies (Feng *et al* 2013, US Government Accountability Office (GAO) 2015) and (2) increase market demand for corn, e.g., corn ethanol production standards under RFS2; thereby incentivizing both direct and indirect LCLUC (Feng and Babcock 2010, Ahlgren and Di Lucia 2014, Fatal and Thurman 2014) and crop switching, e.g., wheat to corn.

A salient point made by Lark *et al* is that the challenge of matching policy responses to accelerated LCLUC may be more one of reforming existing US agricultural policies rather than a need for wholesale change. For example, the 2014 Farm Bill (the most recent enabling legislation for US agricultural policy) contains a 'Sodsaver' provision that sharply reduces crop insurance subsidies on land converted from undisturbed grassland, albeit with a scope limited to six mid-Western states (Montana, the Dakotas, Nebraska, Minnesota, and Iowa). Lark *et al* find that these states account for only 36% of cropland expansion on previously uncultivated lands, nationwide, revealing a sizable gap in Sodsaver's coverage. In another example, the Energy Independence and Security Act of 2007 specifies that lands eligible for biofuel feedstock production must have been 'cleared or cultivated' prior to enactment in December 2007 (US Environmental Protection Agency (EPA) 2010). Under this provision, much of the cropland expansion found by Lark *et al* is likely ineligible for production of corn ethanol and soy biodiesel feedstock. However, the mechanism for monitoring feedstock eligibility, so-called 'aggregate compliance', is based on an evaluation of net annual change in US cropland area as estimated from traditional USDA statistics. By contrast, Lark *et al* show in their analysis—made possible only by recent availability of the CDL—that substantial gross change in the form of cropland expansion is often offset by cropland abandonment and, thus, hidden in aggregate measures of net change. Accordingly, they recommend reform in the enforcement of existing biofuel supply-chain standards through a CDL-based or other spatially-explicit regulatory framework.

Climate change can be expected to magnify negative impacts of recent cropland expansion. For example, Swain and Hayhoe (2015) recently analyzed an ensemble of Global Climate Model projections for the US Great Plains, finding a 50–200% increase in summer drought risk across much of the US corn- and wheat belts corresponding to +1 to +4 °C increase in global mean temperature. This risk, in combination with cropland expansion onto marginal lands already vulnerable to erosion, introduces the potential for catastrophic soil erosion.

US biofuel policy is intended to reduce net greenhouse gas emissions by the US transportation sector. However, the extent of cropland expansion found by Lark *et al.* suggests that measures like RFS2 are actually accruing an unintended, but substantial, carbon debt. Lastly, given the very real possibility of a failure to align biofuel development with other national policies intended to de-incentivize cropland expansion onto marginal lands, we run the risk of inadvertently driving our way to the next Dust Bowl.

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