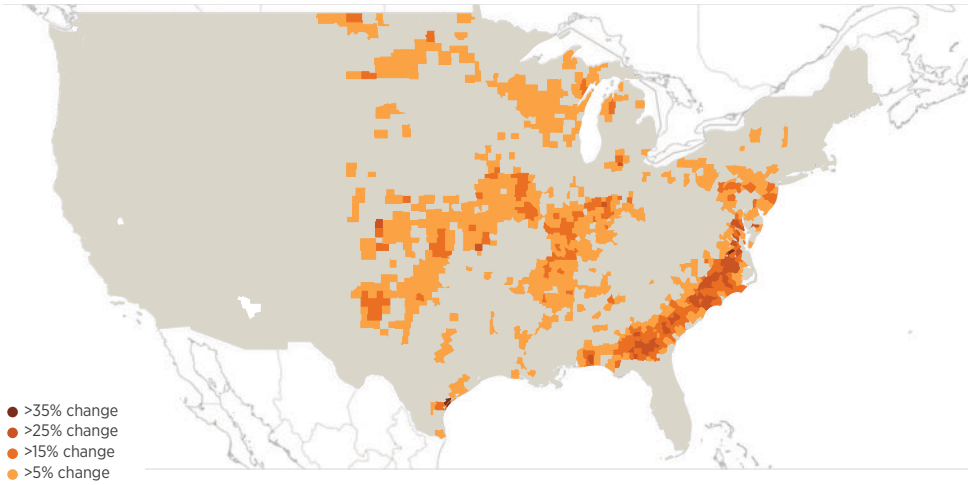
Land-Use Change Implications under *BT16* Scenarios

The *2016 Billion-Ton Report (BT16) Volume 2: Environmental Sustainability Effects of Select Scenarios from Volume 1* is a pioneering effort to analyze a range of potential environmental effects associated with illustrative near-term and long-term biomass-production scenarios.[1] Among other key environmental indicators, *BT16* volume 2 aims to clarify land-use change (LUC) implications of the select BT16 scenarios.[2]



Change in perennial cover by county is the difference between (1) the percentage of total agricultural acres (cropland + pasture + idle land) managed as perennial cover in the 2040 base case (BC1) and (2) the percentage managed as perennial cover in the 2040 agricultural baseline without new biomass production. The maximum county-level increase in perennial cover in BC1 was 38%. The light grey shading over the majority of counties indicates that change was below 5% (either an increase or decrease in perennial cover). Larger increases in percentage of perennial cover occur in areas where simulated returns from conventional crops are not as competitive with energy crops under the conditions defined in BC1.

Summary

LUC can refer to changes in land management, cover, or a combination of the two. The primary type of LUC associated with *BT16* supply scenarios involves changes in agricultural land-management practices. For example, the area that would be managed as perennial cover in 2040 is 24 million and 45 million acres greater under base-case (BC1) and high-yield (HH3) scenarios,[3] respectively, than the area of perennial cover simulated in the agricultural baseline in 2017 or 2040. Perennial cover does not change significantly over time in the agricultural baseline but increases over time in tandem with higher biomass supplies in *BT16* scenarios. The geospatial distribution of the net change from annual to perennial cover in BC1 is illustrated in the figure above.

Additional changes in management occur on pasture: 37–39 million acres, or about 8% of total pasture area in the agricultural baseline in 2015, would undergo changes in management for energy crops by 2040. Fencing and pasture rotation are management practices that are assumed to intensify production on another 60 million acres of pasture, equivalent to 13% of total pastureland in the 2015 baseline.

Under *BT16* BC1 2040 and HH3 2040 scenarios, changes in land management are significant in terms of land area (up to 45 million acres of annual cropland shifting to perennial management) but modest relative to the total U.S. agricultural land. For example, a 24 million-acre transition from annual to perennial cover simulated in BC1 affects only 3% of total agricultural land in the agricultural baseline in 2015.

Insights and Implications

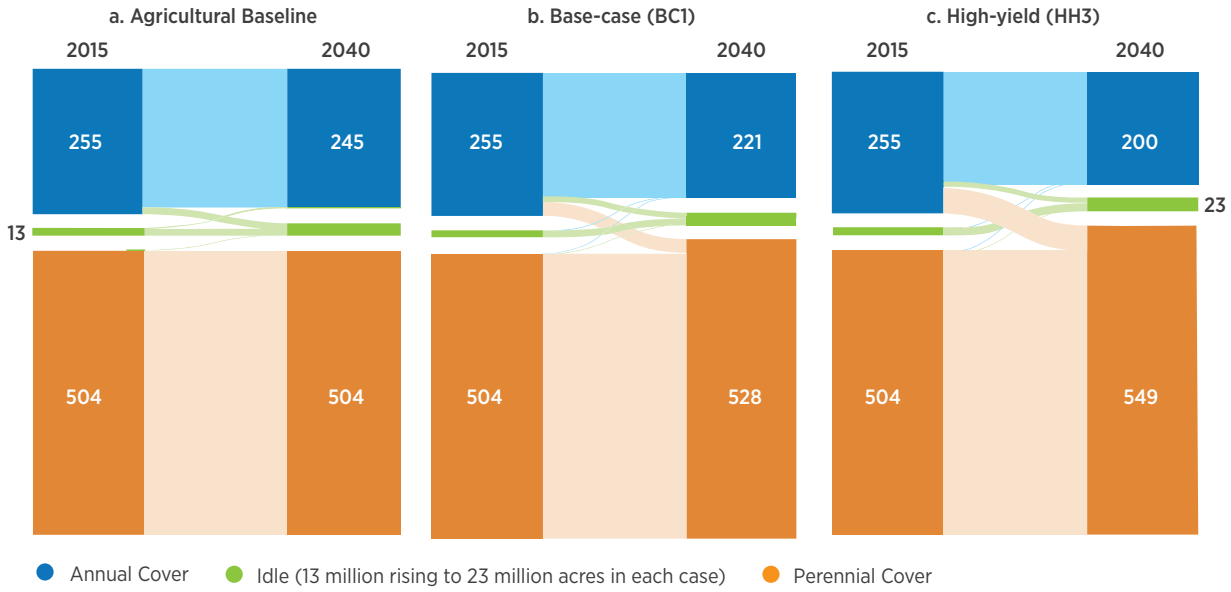
A literature review led the team to conclude that clear definitions of land parameters and effects are essential to improve LUC analyses. The large variability in results from previous LUC analyses associated with increased biomass production underscores the need for more consistent and transparent approaches.

Other areas for future work include (1) linking the *BT16* assumptions and outputs from BC1 and HH3 scenarios with global models to estimate potential indirect LUC effects; gathering better data on crop rotations and modern management practices that influence assumptions underlying assumed LUC effects; and improving monitoring to provide spatially and temporally explicit data on environmental conditions, land cover, and the application of land-management practices.

[1] Scenarios are specific to *BT16* and further elaborated in chapter 2.

[2] The information in this fact sheet is further discussed in chapter 3.

[3] Base case refers to a 1% annual yield increase. High yield refers to a 3% annual yield increase.



The above graphic depicts agricultural land (millions of acres) managed as annual crops, perennial cover, or idle cropland in 2015 and 2040 as estimated under the (a) agricultural baseline; (b) base-case scenario (BC1); and (c) high-yield scenario.

Background

As estimated in *BT16* volume 1, 0.8 billion dry tons or 1.2 billion dry tons of biomass are potentially available annually by 2040 at $60 per dry ton or less,[4] under base-case and high-yield production scenarios, respectively. Scenarios from 2017 and 2040 were selected to examine effects of a large increase in biomass production with an emphasis on cellulosic biomass, as well as effects of increasing biomass yield.

For the purposes of this report, LUC refers to the effects on land that are caused or implied by the biomass production systems simulated in *BT16*. *BT16* volume 2 chapter 3 describes where, how much, and what type of LUC is associated with the simulations.

Unlike most LUC studies, *BT16* volume 2 does not analyze the LUC effects of a policy. *BT16* assumptions hold the forestland and agricultural land base constant throughout the 2017–2040 simulation periods. Supply constraints limit the total land available for energy crops in *BT16* based on rainfall, rates of transition, and caps on total area allowed to transition to new crops.

The potential for the most significant LUC drivers associated with forestry biomass (e.g., loss of natural forest) is excluded from *BT16* by design because the Forest Sustainable and Economic Analysis Model (1) aims to ensure that demands for conventional wood products are met in addition to those for biomass; (2) assumes no changes in areas for total timberland, plantations, and natural forest-management lands; and (3) incorporates supply constraints to mitigate common LUC concerns, such as no new road building, and limits or exclusions for biomass removals on steep-sloped terrain. The supply estimates of biomass from agriculture and forestry sectors are meant to be conservative and avoid significant LUC concerns.

[4] This price is at farmgate or roadside, marginal cost.

This fact sheet refers to the following documents:

U.S. Department of Energy. 2017. *2016 Billion-Ton Report: Advancing Domestic Resources for a Thriving Bioeconomy, Volume 2: Environmental Sustainability Effects of Select Scenarios from Volume 1*. R. A. Efroymson, M. H. Langholtz, K.E. Johnson, and B. J. Stokes (Eds.), ORNL/TM-2016/727. Oak Ridge National Laboratory, Oak Ridge, TN. 640p.

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