Executive Summary

Field to Market: The Alliance for Sustainable Agriculture brings together a diverse group of grower organizations; agribusinesses; food, beverage, restaurant, and retail companies; conservation groups; universities; and public sector partners to create opportunities across the agricultural supply chain for continuous improvement in productivity, environmental quality, and human well-being. Field to Market offers America’s food and agriculture industries an essential tool for unlocking shared value for all stakeholders—a common framework for sustainability measurement that farmers and the supply chain can use to better understand and assess performance at the field, local, state, and national levels.

By linking the entire agricultural value chain together to collaborate pre-competitively, Field to Market helps drive continuous improvement in the sustainability of commodity crop production. Our Supply Chain Sustainability Program provides an unparalleled platform that helps the food and agricultural supply chain benchmark sustainability performance, catalyze continuous improvement, and enable brands and retailers to characterize the sustainability of key sourcing regions as well as measure and report on progress against environmental goals.

This, the third edition of our National Indicators Report, analyzes sustainability trends over time at the national scale for commodity crops, utilizing the eight environmental indicators in Field to Market’s Supply Chain Sustainability Program and five additional social and economic sustainability indicators. Utilizing publicly available data, published government reports, and scientific literature, we take stock of long-term trends from 1980 to 2015 to assess the sustainability performance of commodity crop agriculture against these indicators.

This edition updates the national level indicators presented in the previous reports for Land Use, Soil Conservation, Irrigation Water Use, Energy Use, and Greenhouse Gas Emissions. In addition, we include the six crops previously assessed: corn for grain, cotton, potatoes, rice, soybeans, and wheat, as well as four new crops: barley, corn for silage, peanuts, and sugar beets. This edition also includes three environmental indicators not considered in the previous report—Biodiversity, Soil Carbon, and Water Quality. Without sufficient quantitative data for these three indicators, we are unable to evaluate crop-specific national trends. However, extensive research and evaluation of national level government reports and scientific literature have enabled us to explore what sustainability trends can be evaluated for each of these three important sustainability issues for commodity crop production as a whole. While we present and discuss trends and drivers, it is important to note that a full statistical analysis for attribution to specific drivers and establishing significance is beyond the scope of the report.

This edition updates the same six social and environmental indicators evaluated in the second edition, utilizing publicly available data to establish a national trend for five indicators, which are Farm Financial Health, Farm Profitability, Generation of Economic Value, Worker Safety, and Labor Productivity.
What We Learned: Report Findings

- All primary environmental indicators for Land Use, Soil Conservation, Irrigation Water Use, Energy Use, and Greenhouse Gas Emissions, with the exception of Soil Conservation for peanuts, show improved environmental performance in 2015 when compared directly to 1980.

- In many cases, improvement in environmental performance was largely driven by increases in crop yield when evaluating per unit of production. The results are more variable when environmental performance per acre is assessed or when total resource use is considered.

- Confidence in trends is highest in cases where the trend lines for both per-unit production and per-acre production illustrate consistent improvement.

- In a number of crops, according to both environmental and economic indicators, there is a clear trend toward a plateau, or flattening, of the long-term trend line over the past five to 10 years, presenting both a challenge and opportunity for technological innovation combined with expanded adoption of conservation practices.

- National trends assessed for Biodiversity, Soil Carbon, and Water Quality highlight the complexity of assessing indicators that result from complex human interactions with the environment; while some limited trends can be discerned from available information, clear long-term signals would require additional data and advances in scientific research.

- The socioeconomic indicators for Farm Financial Health and Worker Safety improved over their respective time periods, while the Labor Productivity indicator indicated improved efficiency of production. The Farm Profitability and Generation of Economic Value indicators illustrate that the agricultural sector’s contribution to national GDP has increased over the time period evaluated.

Environmental Indicators by Crop

**BARLEY**

Total production and area planted of barley have declined significantly over the study period, while yields have increased. The Land Use, Soil Conservation, and Irrigation Water Use indicators improved consistently over time, while Energy Use and Greenhouse Gas Emissions improved slightly on a per-bushel basis and increased slightly on a per-acre basis.

**CORN FOR GRAIN**

Area planted and total production of corn continued to increase through the study period, and the Land Use indicator also continued to improve. For the other four primary indicators, the declining (improving) trend transitioned to a flat trend in the early to mid-2000s, indicating that the improvements in environmental outcomes on a per-bushel basis have plateaued.

**COTTON**

There is variation but no consistent trend in the total production and area planted for cotton. The Land Use, Energy Use, and Greenhouse Gas Emissions indicators have all improved over time on a per-pound-of-lint basis, while Irrigation Water Use has increased (declined) steadily on both a per-pound and per-acre basis.

**PEANUTS**

Total production of peanuts has increased over time, with a slight decline in planted area. All indicators, with the exception of Soil Conservation, improved over time on a per-pound basis. Soil Conservation increased until around 2007, when it began to decline (improve).
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POTATOES
Total production of potatoes has increased, while planted area has declined; however, the Land Use indicator has remained relatively flat since 2000. While all four of the other indicators have improved over time on a per-hundredweight (cwt.) basis, Energy Use and Greenhouse Gas Emissions have increased on a per-acre basis. Irrigation Water Use has declined consistently both per cwt. and per acre. These indicators all continue trends past the year 2000, indicating that the trends are driven by factors other than yield.

RICE
Total production of rice has increased slightly, while planted area has remained steady. The Land Use indicator has improved over time but remained steady for the past four years. This coincides also with a plateauing of the Energy Use, Irrigation Water Use, and Greenhouse Gas Emissions indicators, signaling that improvements over time have been driven in large part by yield improvements. Soil Conservation declined (improved) after the early 2000s.

SOYBEANS
Both total production and planted area of soybeans have increased from 1980 to 2015. Yield improvement, illustrated in the Land Use indicator, has driven improvements in Irrigation Water Use, Energy Use, and Greenhouse Gas Emissions on a per-bushel basis, and these indicators have increased slightly on a per-acre basis. For these indicators as well as Soil Conservation, the improvement trends have become flat trends in recent years.

SUGAR BEETS
Total production of sugar beets has increased as planted area has remained relatively steady. The Land Use indicator has improved over time, along with the Irrigation Water Use, Energy Use, and Greenhouse Gas Emissions indicators on both a per-ton and a per-acre basis. Soil Conservation has not followed a consistent trend over time but rather shows variation, with a slight improvement in the past five to 10 years.

WHEAT
Both total production and area planted have declined over time, while the Land Use indicator illustrates improvements in yield. The Irrigation Water Use, Energy Use, and Greenhouse Gas Emissions indicators have all improved on a per-bushel basis, with either steady or increasing per-acre trends. The Soil Conservation indicator shows consistent declines (improvement) over time.

National Trends in Environmental Indicators

In Part Two of this report we include, for the first time, a discussion of three environmental sustainability outcomes for which calculating a national trend line by crop is not possible given both available data and the nature of the environmental outcome.

BIODIVERSITY
Assessing suitable land available for habitat to support a diverse ecosystem, we evaluated long-term trends in land cover change. From 1980 to 2000, agricultural lands (for all crops) decreased in area as they were converted to grasslands (including those grasslands in USDA's Conservation Reserve Program, or CRP), urban land, and forest land, according to comprehensive national analyses using satellite remote sensing data. While no comprehensive national land cover change analysis is available after 2000, recent remote sensing studies have found increasing cropland area in some regions, reflecting expansion of row crops into previously set-aside CRP lands and grasslands.

New technologies and scientific advances show promise for future assessments of land cover change that are ecosystem- and land management system-specific.

SOIL CARBON
We have assessed trends in soil carbon, which indicate a negative change between 1990 and 2007 on aggregate (more carbon was lost than gained) for commodity crop systems using data from national modeling studies conducted for government assessments. The exception is land that is in complex rotations, or perennial grass (hay or CRP land). When these are considered, the overall national trend is consistently positive (increasing carbon in soils).

WATER QUALITY
While an aggregate nationwide measure or assessment of water quality trends is not available, we analyzed government reports on water quality in major watersheds from in-stream measurement.
programs and from a simulation modeling scenario of conservation practice adoption to assess the state of water quality and agriculture nationally. While conservation practice adoption has likely helped to avoid substantial nutrient, sediment, and pesticide loss to waterways, in-stream water quality measurements have not notably improved in recent years. We find encouragement in recent research that has found that continued adoption of conservation practices holds promise to improve water quality outcomes over the long term.

**Socioeconomic Indicators**

We continue to explore socioeconomic indicators in Part Three of the report in order to gain a better understanding of the long-term trends in economic sustainability and social well-being associated with commodity crop production in the United States.

**GENERATION OF ECONOMIC VALUE**

Measured by the contribution of all agriculture to the national gross domestic product, commodity crop production has increased the generation of economic value over the period of 1997–2015.

**FARM FINANCIAL HEALTH**

Measured by the debt-to-asset ratio for general cash grain farms, Farm Financial Health has improved over the period of 1996–2015, driven by strength of land value and relatively low farm debt.

**FARM PROFITABILITY**

Crop-specific Farm Profitability represents the financial returns to a farmer above the variable costs of their operation. No clear national trends can be drawn, as substantial variation exists between crops as well as over time due to numerous cost factors and crop price trends.

**WORKER SAFETY**

Improvements in all measures of the Worker Safety indicator—workplace injury, time lost from work due to illness, and workplace fatalities—improved (decreased) over the period analyzed.

**LABOR PRODUCTIVITY**

Improvement over time in the Labor Productivity indicator is seen for most crops as a decline in the number of hours per acre and per unit of production; for most crops, this improvement has plateaued in the last five to 10 years.

**Conclusions**

The findings in this report highlight both the opportunities and the challenges of achieving continuous improvement in environmental outcomes of agricultural land. On the whole, the crops assessed have produced more yield on less land with improved environmental outcomes on a per-unit-of-production basis. This continued improvement has also contributed to reduction in loss of soil carbon. This significant progress toward more sustainable food, feed, fiber, and fuel production is a result of many different technological advancements and greater adoption of conservation practices.

However, this report identifies that improvements are plateauing for a number of crops and indicators. Moreover, recent studies indicate an increase in crop land area in certain regions of the country at the expense of grasslands and other ecosystems and highlight continued water quality challenges in many river basins. To continue to improve on these very challenging and pressing sustainability concerns will require not just concerted action from farmers but collective action from the agricultural agencies, communities, and supply chains that support them. Identifying important technology improvements that can address these environmental sustainability outcomes is one area to target. Another is further research on effective conservation practices and the necessary infrastructure, training, and knowledge transfer to increase their adoption by farmers across the country.

In some areas, achieving continuous improvement is also limited by knowledge gaps that require redoubling efforts on scientific research. In particular, better understanding of the fate of nutrients and the most effective practices for ensuring efficient use and minimal loss of nutrients to the environment is critical. While studies indicate the potential for water quality improvement due to conservation practice adoption is substantial, this improvement has not been observed in the nation’s waterways.
These limitations also present opportunities for supply chain partners to advance sustainable agriculture through communicating the importance of this data and research to the private sector. Downstream companies and retailers can provide a consistent signal to the supply chain and farmers that improvement in these sustainability trends over time is important to customers. Similarly, it is essential that this demand signal be consistently sent regardless of end use, whether for food, feed, fiber, or fuel.

In the same way, the agriculture community can provide support to farmers in the form of knowledge and guidance for specific farming operations by coordinating and sharing knowledge among commodity organizations, agricultural retailers, crop advisors, and university extension personnel. Field to Market is working with organizations along this spectrum of opportunities to support development of education and outreach guidance for both farmers and supply chain partners to advance opportunities for continuous improvement.

At the core of all the trends and improvements illustrated by the indicators presented are the millions of individual decisions made by farmers and land managers every day. Analyzing the aggregate impact of these decisions underscores the critical importance of individual actions in achieving improvements and delivering sustainable outcomes for agriculture and the environment. The field-scale metrics and benchmarking available in the Fieldprint® Platform—the analytic engine that drives the metrics in both the Fieldprint® Calculator and the integration into associated farm management software—provide a way for farmers and the supply chain to characterize their sustainability and identify opportunities for improvements at the field and landscape levels. By catalyzing continuous improvements at the field level, Field to Market’s members are working together to drive significant and broad-scale progress nationally toward creating a more sustainable food system.