SOY SUSTAINABILITY

Examining U.S. Soy's Carbon Footprint

Data Shows Lower Carbon Footprint for U.S. Soy vs. Other Countries Producing Soy

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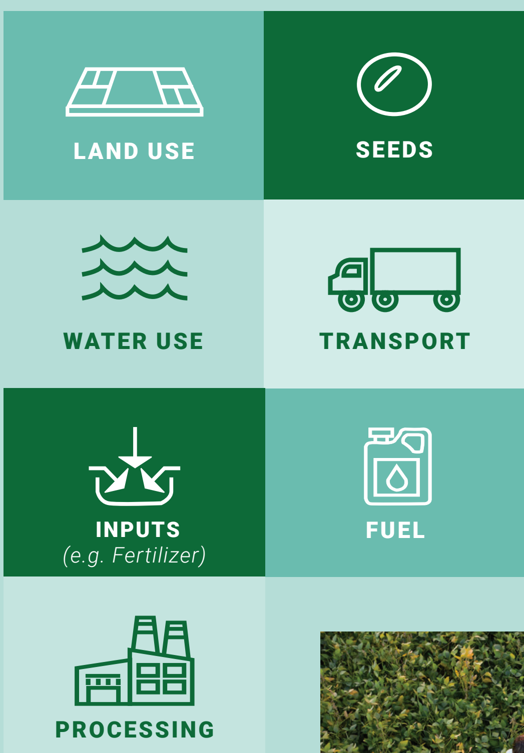
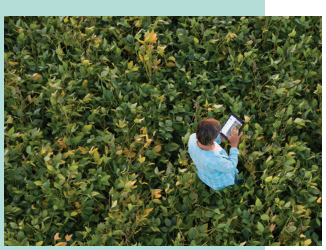
USSEC U.S. SOYBEAN EXPORT COUNCIL | US SOY

You care about the impact you leave on the world, and so do the farmers and business owners that bring you U.S. Soy.

Figure 1.

CONTRIBUTORS TO SOY'S CARBON FOOTPRINT





What Goes into a Carbon Footprint?

Determining a product's carbon footprint involves many factors. For soy—a crop grown for protein and oil—it begins at the farm with the natural resources needed to grow the crop, such as soil and water. The carbon footprint also includes the inputs required, like seeds, crop protection products, fertilizer manufacturing, and even the diesel fuel used to operate farm equipment. Additionally, it accounts for the journey soybeans take from the farm to reach you, as well as the manufacturing processes that turn soy into the products you use today. The combined impact of all these processes and products constitutes the carbon footprint.

While this is a simplified explanation, scientific studies provide a more accurate understanding of the environmental impact of the products we use in our daily lives.

> **The impact created by all the processes and products associated with producing soy and getting it to you makes up the carbon footprint.**

The carbon footprint is the result of all the processes and products involved in producing soy and delivering it to you. Science allows us to compare the environmental impact of different products. In this piece, we examine the carbon footprint of soybeans produced in the U.S. and other countries around the world. These footprints vary because the environments in which we operate differ, as do the natural resources available to us. Additionally, there are nuances in how we produce our crops and bring them to market, leading to differences in our carbon footprints.

What Drives Differences in the Carbon Footprints?

A key factor in the varying carbon footprints of soybeans produced in the U.S. versus other countries is land use change. Specifically, differences arise from how land is altered to grow soybeans and the resulting environmental impact.

For example, over the past 20 years, the amount of land used for soybean cultivation in the U.S. has decreased, while forestland has increased. In contrast, in many tropical areas, recent expansions in cropland have come at the expense of forests, leading to the release of carbon into the atmosphere.

Why Do Carbon Footprints Matter?

Soy is used in a wide range of applications, from livestock, poultry, and fish feed to protein and oil in human diets, and even industrial uses like biofuels. Because of this, many industries are eager to understand soy's carbon footprint and how it varies across different producing countries.

Additionally, non-governmental organizations (NGOs), manufacturers, retailers, and consumers who use soy want to reduce their environmental impact by choosing products with a lower carbon footprint. They need reliable data on soy's carbon footprint to make informed decisions.

Figure 2.

LAND USE CHANGE

Land use change refers to the conversion of natural lands (such as grasslands, wetlands, savannas, or forests) into cropland which can result in carbon emissions, land degradation, and biodiversity loss.

Measuring Soy's Carbon Footprint

To evaluate the environmental footprint of soy from the U.S. and other countries, Mérieux NutriSciences | Blonk used its Agri-footprint™ database, which calculates the footprint of specific products.

This database employs Life Cycle Assessment (LCA) methodology, incorporating Land Use Change (LUC) impacts in accordance with the Product Environmental Footprint (PEF) standard set by the European Commission.

By calculating the carbon footprint based on science-based and factual data, actionable insights and benchmarks are provided for manufacturers and others across the value chain, enabling them to measure and reduce greenhouse gas emissions in their operations.

Initially, Mérieux NutriSciences | Blonk assessed the carbon footprint of soy cultivation in different countries, excluding land use change. This analysis focused on the impact of farming practices and transportation. In the next step, land use change was factored into the calculations, which refers to the conversion of natural land—such as forests, savannas, wetlands, and grasslands—into cropland. Including land use change accounts for the impact of deforestation and other land conversions on soy's carbon footprint.

In the Agri-footprint database, all calculations are based on country averages, though specific supply chains may yield different carbon footprint results.

Mérieux NutriSciences | Blonk

Mérieux NutriSciences | Blonk is a leading international expert in food system sustainability, inspiring and enabling the agri-food sector to give shape to sustainability.

Carbon footprint of whole soybeans

EXCLUDES LAND USE + PEAT

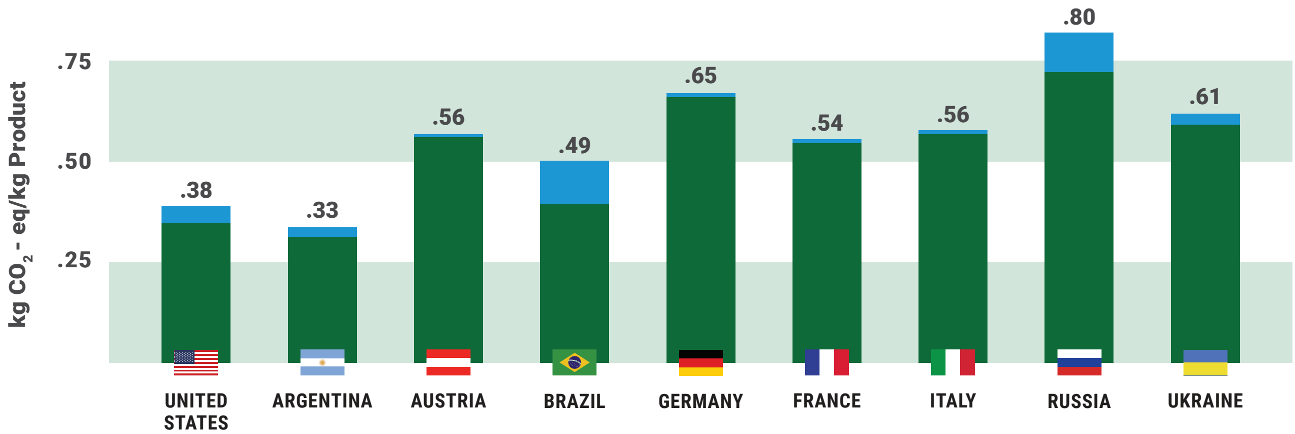


Figure 3. Illustrates the carbon footprint of whole soybeans imported from various countries.

INCLUDES LAND USE + PEAT

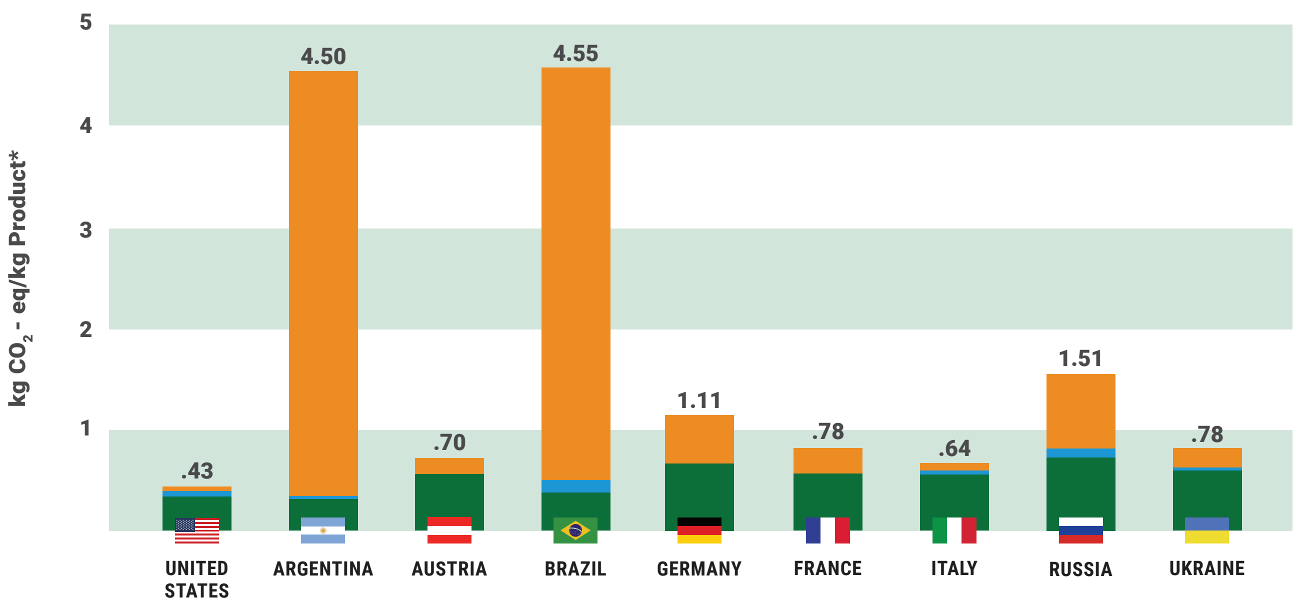


Figure 4. Shows the carbon footprint of whole soybeans, including land use change, across various sourcing countries.

Mérieux NutriSciences | Blonk, Agri-footprint *Results based on default emission modelling, including land use change emissions, according to the rules of the PEFCR-Feed guidance document (European Commission, 2018) as implemented in the Agri-Footprint 6.3 database. Input data rely on country average FAO statistics and other secondary sources. Supplier specific information would improve data quality and may provide differing results. Comparisons have not been reviewed in the context of ISO 14040/14044 compliance.

The Impact of Cultivation

The cultivation process—or growing the soybeans—is the primary contributor to the global warming impact of whole soybeans (excluding land use change).

The majority of cultivation emissions come from energy use for machinery and irrigation, fertilizer production and emissions of nitrous oxide (a potent greenhouse gas) resulting from application of nitrogen fertilizers, and crop residue emissions. Countries with relatively low environmental impact typically have higher yields, lower fertilizer use, and reduced energy consumption for machinery.

For U.S. Soy, several factors help minimize emissions related to cultivation, including the use of technology and precision farming techniques by U.S. farmers. Conservation practices like cover crops and no-till or reduced tillage—although not included in the applied emission model for this carbon footprint analysis—also reduce emissions while benefiting soil health and biodiversity. Additionally, U.S. farmers participate in the Conservation Reserve Program, which provides incentives to leave land plots unfarmed for at least 15 years.

The Impact of Land Use Change (LUC)

Including land use change in the analysis of soy production and handling across different countries significantly alters the results.

The data clearly indicates that land use change in Argentina and Brazil—primarily due to deforestation—accounts for the majority of these countries' carbon footprints for soy. When forests are cleared for farming, the carbon stored in the trees and soil is released into the atmosphere as carbon dioxide.

These emissions from land use change are included in the life cycle analysis. Mérieux NutriSciences | Blonk used the PAS 2050-1 standard, which includes a 20 year look back and is the most widely applied method for calculating the impact of land use change on the carbon footprint.

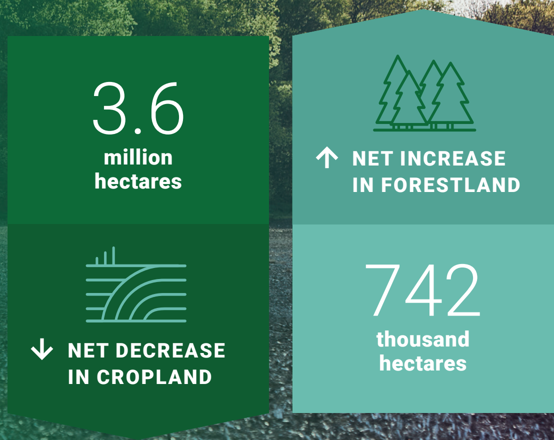
Based on country-level statistics on the expansion or regression of cropland and forest areas, deforestation is attributed to crops with significant relative expansion. In contrast, land use change has a minimal impact on the carbon footprint of U.S. soybean cultivation. Compared to South America, deforestation and land conversion are much less of an issue in the U.S.

Figure 5.

U.S. CROPLAND DECREASED WHILE FORESTLAND INCREASED

CROPLAND CHANGE 1997-2017

> Compared to South America, deforestation and land conversion **in the past two decades are much less of an issue in the U.S.**



"U.S. Cropland Decreased While Forestland Increased." Please see Natural Resources Conservation Service Results for more information.
Source: 2017 National Resources Inventory Summary Report

Background Information on LCA Methodology

CALCULATING THE ENVIRONMENTAL FOOTPRINT OF A PRODUCT

Life Cycle Assessment (LCA) is a research method used to evaluate the environmental impact of a product throughout its entire life cycle. An LCA examines all stages of a product's production, processing, and use—from raw materials, packaging, and transport to retail, consumption, and waste processing (cradle-to-grave). It captures multiple environmental impact categories, including climate change, eutrophication, acidification, water use, and land use. An LCA identifies the environmental impacts and pinpoints where they occur within a product's life cycle (hot spots).

CARBON FOOTPRINT OF U.S. SOY

Mérieux NutriSciences | Blonk used its Agri-footprint™ database—the most extensive LCA database on agricultural and food products—to compare the carbon footprint of U.S. soybeans and soybean meal with those from other countries. The study's scope was cradle-to-market, meaning it considered emissions from cultivation, processing (crushing), and transport to the market.

INPUT DATA FOR SOYBEAN CULTIVATION

For a detailed explanation of the input data used for soybean cultivation by country, refer to chapter 3.2 of the Agri-footprint™ 6.3 methodology report.

LAND USE CHANGE

Land Use Change data was obtained in November 2018 from the Food & Agriculture Organization of the United Nations.

Climate Change Impact Due to Land Use Change

When forests are cleared for farming, the carbon stored in the trees is released into the atmosphere as carbon dioxide. These emissions from Land Use Change (LUC) must be accounted for in LCA. This is not a straightforward process, as appropriate data are often lacking. Ideally, satellite imagery or other sources would be used to determine the exact historic land use of a specific area over the past 20 years. However, such data are often unavailable, necessitating the use of alternative methods. The PAS 2050-1 standard is the most commonly applied method for calculating the impact of land use change on the carbon footprint. Based on country-level statistics on the expansion or regression of cropland and forest areas, deforestation is attributed to crops with significant relative expansion. Mérieux NutriSciences | Blonk has developed a tool that calculates LUC for each country–crop combination. This LUC data is also integrated into Mérieux NutriSciences | Blonk's Agri-footprint™ database.

SOME CONSIDERATIONS: STRENGTHS AND WEAKNESSES OF LCA OF SOY

It is important to note that LCA can only approximate the environmental impact. The results presented in this factsheet are based on country averages, but data from specific regions within a country or even specific farms could yield different results. While many impact categories are included in this study, not all environmental issues, such as soil degradation, are currently covered by LCA methodology.

Reduced inputs of mineral or organic fertilizers would lower the cultivation footprint, but the calculations would not account for the resulting depletion of soil nutrients.

Tropical regions generally have favorable climate conditions for soybean cultivation. The high carbon footprint of soy production in these regions could lead to the expansion of soy cultivation into areas less suitable for soy or to the cultivation of alternative crops that are less efficient.

Agri-footprint™ is a high-quality Life Cycle Inventory database for the agriculture and food sector. It covers data on agricultural products such as feed, food, and biomass. The aim of the database is to facilitate transparency and a more rapid transformation to sustainable food supply chains. Since its release in 2014, Agri-footprint™ has been critically reviewed and is widely accepted by the food industry, LCA community, scientific community, and governments worldwide. It should be kept in mind that LCA can only provide an approximation of the environmental impact. Results presented in this factsheet are based on country averages. Data of specific regions within a country or even specific farms could provide other results. While many impact categories are included in this study, not all environmental issues, such as soil degradation, are yet covered by LCA methodology.

The Life Cycle Assessment helps buyers to better understand the impact of their purchase of soy. Agri-footprint™ 6.3 was released in 2023, contains approximately 5,000 products and processes, and is available in LCA software SimaPro. Besides Agri-footprint™, Mérieux NutriSciences | Blonk also developed other major feed databases like GFLI and the EC feed database for the European Commission. More information can be found on **www.agri-footprint.com**.

SOY SUSTAINABILITY

Know the Carbon Footprint Impact Before You Purchase

U.S. Soy provides a sustainability advantage through it's carbon footprint. U.S. soybean farmers are implementing practices and techniques to minimize emissions, while U.S. forestland has remained stable for nearly 40 years. When making your purchasing decisions, be sure to evaluate the carbon footprint of soy.

Sourcing verified U.S. Sustainable Soy is simple with the U.S. Soy Sustainability Assurance Protocol (SSAP)

Indicate to your soy supplier that you require an SSAP certificate for your U.S. Soy purchase. The SSAP certificate offers an origin-specific, sustainability verification of U.S. Soy.

For more information about the sustainability of U.S. Soy, *visit*

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