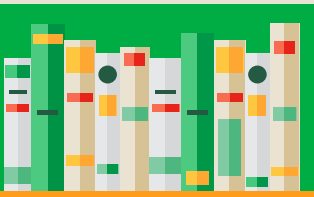
Are GMOs SAFE?

YES. The National Academies of Sciences, Engineering, and Medicine 2016 report reaffirms

Over **900** studies and publications were examined



20+ scientists, researchers and agricultural and industry experts **over a 2 year period** reviewed animal studies, allergenicity testing, North American and European health data, and more

years of data since GMO crops were introduced

SAFE.

"No substantiated evidence of a difference in risks to human health between current commercially available genetically engineered [GMO] crops and conventionally bred crops."

The National Academies of SCIENCES • ENGINEERING • MEDICINE

Full report available at **http://nas-sites.org/ge-crops/**

gmo answers

Can GMOs HELP PROTECT THE ENVIRONMENT?

THEY ALREADY DO.

Contrary to myths about GMOs hurting the environment, GMOs allow farmers to preserve the land while doing more with less resources.

The Environmental CHALLENGE:

30% POPULATION INCREASE BY 2050[1]

HIGHER DEMAND FOR

FOOD and FIBER FUEL

2 POTENTIAL PATHS

1. Convert more land, like forests and prairies, into agricultural production
2. Use agricultural technologies like GMOs to increase crop yields on existing farmland

GMOS are ONE SOLUTION

In 2016, GMOs allowed farmers to use

55.4 MILLION less acres of land

to produce the same amount of food, fuel and fiber crops[2]

That's nearly equal to all the farmland in Iowa and Missouri.[3]

Without access to GMOs, farmers would have needed to plant an additional:

20.3 MILLION acres of corn	26.7 MILLION acres of soybeans	7.2 MILLION acres of cotton	1.2 MILLION acres of canola

to keep up with global production levels in 2016[4]

[1] World population projected to reach 9.7 billion by 2050 (2015). Retrieved from: http://www.un.org/en/development/desa/news/population/2015-report.html.
[2,4] Brookes, G. and Barfoot, P. (2018). Environmental impacts of genetically modified (GM) crop use 1996-2016: Impacts on pesticide use and carbon emissions. http://www.tandfonline.com.
[3] Brookes, G. and Barfoot, P. (2016). GM crops: global socio-economic and environmental impacts 1996-2014. Retrieved from http://www.pgeconomics.co.uk/pdf/Grow_More_on_Less.pdf.

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gmo answers

HOW DO WE PRESERVE OUR HABITAT?

GMOs ARE ONE TOOL THAT CAN IMPROVE

crop yields by allowing fewer acres to produce the same amount of food. This can help save critical animal and plant ecosystems including

FORESTS PARKS PASTURES

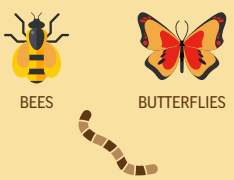
11% In 2015, GMO crops helped preserve the equivalent of 15% of the arable land in the United States.[1,2]

That's nearly two thirds of all the land in America's national parks!

IMPROVED ECOLOGY THROUGH GMOs

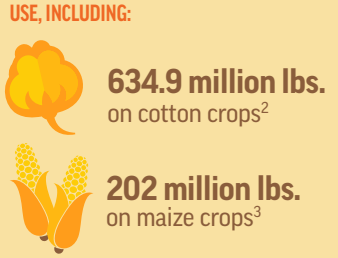
DECREASES INSECTICIDE USE

Bt crops are designed to allow important, beneficial bugs to thrive, including:



BEES BUTTERFLIES EARTHWORMS LADYBUGS

SINCE 1996, GM INSECT-RESISTANT CROPS HAVE LED TO A REDUCTION OF INSECTICIDE USE, INCLUDING:



634.9 million lbs. on cotton crops[2]

202 million lbs. on maize crops[3]

[1,3] Brookes, G. and Barfoot, P. (2018). Environmental impacts of genetically modified (GM) crop use 1996-2016: Impacts on pesticide use and carbon emissions. http://www.tandfonline.com
[2] https://tradingeconomics.com/united-states/arable-land-hectares-wb-data.html

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gmo answers

What Does GMO Stand For?

GENETICALLY MODIFIED ORGANISM.

A GMO crop is the product of a precise crop improvement technique that enables us to take a beneficial trait (like insect resistance or drought tolerance) & transfer it into a crop plant.

GMO also stands for BENEFITS:

ENVIRONMENT

1. GMOs help us preserve the land while doing more with fewer resources (e.g., drought tolerant and fertilizer use efficient products).[1]
2. GMOs help us reduce food waste (e.g., non-browning GMO apples and GMO potatoes that are less prone to bruising and black spots).[2,3]

YOU

1. **LOWER FOOD COSTS** GMOs help us reduce the cost of food.
2. **GROW MORE FOOD, SAFELY & SUSTAINABLY** GMOs have been proven safe[5], and over the last 20 years, GMOs have allowed farmers to increase crop yields by 22% and reduce pesticide applications by 18.4%.[1,6]
3. **INCREASED NUTRITIONAL BENEFITS** Scientists are working on biofortified GMO crops to help address nutrition deficiency and food security issues around the world.[7]

GMO stands for food that's **safe to eat** and **sustainable to grow.**

[1] Brookes, G. and Barfoot, P. (2018). GM crops: global socio-economic and environmental impacts 1996 - 2015. Retrieved from http://www.pgeconomics.co.uk.
[2] Artic Apple Benefits. Retrieved from https://www.arcticapples.com/arctic-apples-r/arctic-apples-benefits/
[3] Halterman, D., Guenthner, J., Collinge, S. et al. Biotech Potatoes in the 21st Century: 20 Years Since the First Biotech Potato (2016). Retrieved from: http://link.springer.com/article/10.1007/s12230-015-9485-1
[4] Goodwin, B., Marra, M., and Piggott, N. (2016) The cost of a GMO-free market basket of food in the United States. Retrieved fromhttp://www.agbioforum.org/v19n1/v19n1a03-marra.htm
[5] The National Academies of Sciences, Engineering, and Medicine. Genetically Engineered Crops: Experiences and Prospects. (2016) http://nas-sites.org/ge-crops/
[6] Klumper, W. and Qaim, M. A Meta-Analysis of the Impacts of Genetically Modified Crops (2014). Retrieved from http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0111629
[7] Gearing, M. (2015). Good as Gold: Can Golden Rice and Other Biofortified Crops Prevent Malnutrition? Retrieved from: http://sitn.hms.harvard.edu/flash/2015/good-as-gold-can-golden-rice-and-other-biofortified-crops-prevent-malnutrition/

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HOW DO GMOs HELP PRESERVE H_2O?

According to the Environmental Protection Agency, drought and water scarcity has been rising steadily since the 1970s and the agency is predicting a significant increase in areas of high drought risk worldwide by the end of the century.[1] To combat this, GMOs are helping agriculture by protecting crops yields during drought and our waterways.

GMOS CAN REDUCE IMPACTS OF DROUGHT ON CROPS

Studies have shown drought tolerant GM corn reduced transpiration by 17.5% under stress conditions, which allows for better moisture retention to endure drought conditions without additional irrigation.[2]

...AND CLEANER WATERWAYS

6,400 = Bodies of water affected by soil erosion that can benefit from adopting no-till agriculture with help from herbicide tolerant crops and similar technologies.[3] That's an average of 128 lakes, streams and rivers per state in the US!

Future nitrogen use efficient (NUE) GM crops also will help reduce runoff into waterways while potentially increasing yield by 15% more per acre.[4,5] Applied to rice production, that's an estimated increase of **118 MILLION METRIC TONS OF RICE**—19 times heavier than the pyramid of Giza!

The public-private partnership Water Efficient Maize for Africa is developing GM drought tolerant and insect resistant maize for smallholder farmers in Sub-Saharan Africa.[6]

Have a question about GMOs? Visit **http://GMOAnswers.com**

[1] (2016). More Droughts. Retrieved from https://www3.epa.gov/climatechange/kids/impacts/signs/droughts.html
[2] Nemali, K.S.; Bonin, C.; et al (2015). Physiological responses related to increased grain yield under drought in the first biotechnology-derived drought-tolerant maize. Plant Cell Environ, 38: 1866-1880. doi:10.1111/pce.12446
[3] (2016). Summaries of EPA Water Pollution Reporting Categories Used in the ATTAINS Data System. Retrieved from https://www.epa.gov/sites/production/files/2016-02/documents/160112parcat_plain_english_descriptions_finalattainonames.pdf
[4] Grooms, Lynn (2012) Seed companies developing hybrids that use nitrogen more efficiently. Retrieved from http://farmindustrynews.com/biotech-traits/seed-companies-developing-hybrids-use-nitrogen-more-efficiently
[5] Pocket K No. 46: Nitrogen Use Efficient Biotech Crops. Retrieved from http://www.isaaa.org/resources/publications/pocketk/46/default.asp
[6] African Agricultural Technology Foundation (AATF-Africa). Retrieved from http://wema.aatf-africa.org/about-wema-project

gmo answers

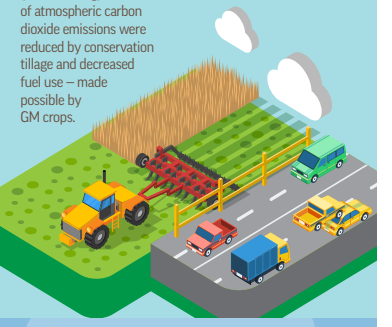
How GMOs and Sustainable Farming Practices CAN IMPROVE AIR QUALITY

GMOs have reduced greenhouse gas emissions on farms globally and can help farmers adapt to and mitigate climate change.

With conservation tillage[1], less carbon dioxide is released from the soil.

In 2016, **58.9 billion pounds** **(27.1 billion kg)** of atmospheric carbon dioxide emissions were reduced by conservation tillage and decreased fuel use – made possible by GM crops.

= Nearly **16.7 million** **fewer cars** on the road for one year.[2]



According to the USDA, adopting conservation tillage can save at least **3.5 gallons** **(13.2 liters) of fuel per acre** for farmers because they're spending less time on tractors.[3]

If all of the corn (GM and non-GM) planted in the U.S. in 2015 was grown with conservation tillage methods, nearly **308 million gallons** **(1.2 billion liters) of fuel** would be saved.

= **6.9 billion pounds** **(3.1 billion kg) of carbon dioxide** emissions prevented.[4] Globally, the benefits could be even greater.

RICE is a staple food for **more than half** of the world's population.[5]

Research shows that **nitrogen-use-efficient rice** which requires 50% or less the amount of normal fertilizer applications, **reduces nitrogen emissions** (a greenhouse gas) and has shown a **30% average yield increase** across four years of field trials.[6]

[1] Conservation tillage is any method of soil cultivation that leaves the previous year's crop residue (such as corn stalks or wheat stubble) on fields before and after planting the next crop, to reduce soil erosion and runoff. Conservation Practices | Minnesota Conservation Funding Guide, (2016). Retrieved from http://www.mda.state.mn.us/protecting/conservationpractices/constillage.aspx
[2] Brookes, G. and Barfoot, P. (2017). GM crops' global socio-economic and environmental impacts 1996 - 2015. Retrieved from http://www.pgeconomics.co.uk
[3] Conservation Practices that Save: Crop Residue Management (2005). http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/energy/conservation/?cid=nrcs143_023637
[4] Crop Production 2015 Summary (2016). http://www.usda.gov/nass/PUBS/TODAYRPT/cropan16.pdf
[5] The global staple. http://ricepedia.org/rice-as-food/the-global-staple-rice-consumers
[6] Nitrogen Use Efficient Rice Demonstrates an Average Yield Increase of 30 Percent in Four Years of Field Trials (2015). http://www.arcadiabio.com/news/press-release/nitrogen-use-efficient-rice-demonstrates-average-yield-increase-30-percent-four

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gmo answers

How GMOs Help Reduce FOOD WASTE & LOSS

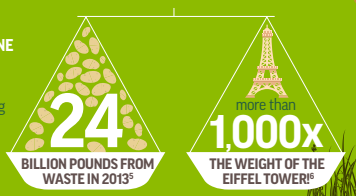
In the United States, approximately **133 BILLION POUNDS** of food is **WASTED** annually, contributing to **18% of the total U.S. landfill methane (greenhouse gas) emissions.**[1]

GMOs help farmers minimize these losses and grow more food using less land. In 2016, GMOs enabled farmers to use 55.4 million less acres of land to produce the same amount of crops[7]—equivalent to an area larger than the state of Idaho.

GM APPLES ARE NON-BROWNING, ELIMINATING THOSE SUPERFICIAL ISSUES that cause people to unnecessarily throw them away.[2]

In 2010, each American on average **THREW AWAY** **17 APPLES**[3] totaling 1.7 billion pounds of food waste.[4]

GM POTATOES ARE LESS PRONE TO BRUISING AND BLACK SPOTS, meaning fewer potatoes will end up in landfills.



20 – 25% **of all crop yields in the U.S. are LOST to pests, crop diseases, or post-harvest losses.** *In the developing world, it's as high as 40 – 50%.*[8]

[1] America's Food Waste Problem (2016). Retrieved from https://www.epa.gov/sciencematters/americas-food-waste-problem
[2] Artic Apple Benefits. Retrieved from http://www.arcticapples.com/artic-apples-r/artic-apples-benefits/
[3] Smithsonian: This Is How Much Water You Waste When You Throw Away Food (2015). Retrieved from http://www.smithsonianmag.com/science-nature/how-trashing-food-wastes-water-too-180957239/?no-ist
[4] U.S. Census Bureau Announces 2010 Census Population Counts – Apportionment Counts Delivered to President. Retrieved from https://web.archive.org/web/20101224044247/http://2010.census.gov/news/releases/operations/cb10-cn83.html
[5] Halterman, D., Guenthner, J., Collinge, S. et al. Biotech Potatoes in the 21st Century: 20 Years Since the First Biotech Potato (2016). Retrieved from: http://link.springer.com/article/10.1007/s12230-015-9485-1
[6] All You Need to Know about the Eiffel Tower. Retrieved from http://www.tourdeffel.paris/images/PDF/all_you_need_to_know_about_the_eiffel_tower.pdf
[7] Brookes, G. and Barfoot, P. (2017). GM crops: global socio-economic and environmental impacts 1996 - 2015. Retrieved from http://www.pgeconomics.co.uk
[8] Global Scientists Meet for Integrated Pest Management Idea Sharing (2015). Retrieved from https://info.usda.gov/blog/global-scientists-meet-integrated-pest-management-idea-sharing

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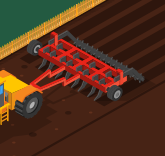
GMOs Improve SOIL HEALTH

Healthy soil is fundamental for **CROP GROWTH & FOOD PRODUCTION.**[1]



Over the last **20 YEARS,** GMOs **HAVE:**

↓8.2% **REDUCED PESTICIDE APPLICATIONS**[2]

&

↑22% **INCREASED CROP YIELDS**[3]

Herbicide-tolerant GM crops enable farmers to till – or turn over and break up the soil – less often. This has **increased nutrient-rich organic matter up to 1,800 pounds per acre per year.**[4]

LESS TILLING[5] =

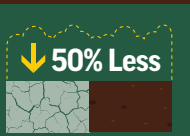
↑ Soil Moisture

↓ Greenhouse Gas Emissions

↓ Soil Erosion

In the last 150 years, half of the planet's topsoil has been lost, largely as the result of erosion. Erosion clogs streams and rivers, hurting fish and other species, and can worsen flooding.[6]

GMOs are part of sustainable farming that preserves topsoil, preventing erosion and desertification.[7]



LESS EROSION AND HEALTHIER SOIL, THANKS TO GMOs.

[1] Unlock the Secrets in the Soil: Soil Health. Retrieved from http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/soils/health/
[2] Brookes, G. and Barfoot, P. (2018) Environmental impacts of genetically modified (GM) crop use 1996-2016: Impacts on pesticide use and carbon emissions. http://www.tandfonline.com
[3] Klumper, W. and Qaim, M. A Meta-Analysis of the Impacts of Genetically Modified Crops (2014). Retrieved from http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0111629
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