Climate Project

We must transform agriculture to feed a growing population while sustaining the planet—producing more food with fewer inputs, lower emissions, healthier soils, and greater resilience for farmers and ecosystems.

Reinventing Agriculture

Agriculture is defined by a paradox of too much and not enough. Too much of what goes into agriculture—nitrogen, carbon, pesticides, energy—leaks into the environment, while not enough remains where it supports crops, soils, and farmers.

Without today's industrial farming methods, we could not feed billions of people. Yet modern food systems are energy-intensive, emissions-heavy, and locked in a damaging cycle with climate change: agriculture contributes to warming, and warming, in turn, places growing stress on agriculture. Amid these challenges, our food system is reaching its limits as the global population is expected to grow.

Feeding the world while protecting the planet requires a fundamental redesign of agricultural systems. This opportunity exists because of advances in modern biology, bioengineering, sensing, computation, and materials—capabilities that MIT has developed over decades. Tools designed to work in complex living systems for human health now make it possible to do the same for agriculture, beginning with plants and soils and extending to entire ecosystems.

Support our work to reinvent agriculture

We invite endowed and expendable support to advance research and pilot solutions that redesign agricultural systems.

A NEW APPROACH TO AGRICULTURE, FROM THE GROUND UP

Reinventing agriculture is one of the MIT Climate Project's frontiers – priority areas where the Institute is uniquely positioned to deliver integrated, scalable impact by redesigning systems from the ground up. The goal is agriculture designed for this century, an integrated system that works with natural processes rather than against them and works across diverse contexts and communities.

A starting point, and a distinctive strength of MIT, is the application of the tools of modern biology and bioengineering to understand and guide interactions among microbes, roots, plants, soils, water, and climate. Making sense of these complex systems will deliver insight into how to grow more food with fewer inputs, lower emissions, greater nutrition and yield, and healthier ecosystems.

At the scientific core of this transformation are microbial and plant-based innovations – engineered microbes, enhanced biological fixation, targeted nutrient release, and soil microbiome health. These advances combine with next-generation sensing, AI-driven decision tools, and novel materials that allow farmers to precisely shape the conditions their crops need, when and where they are needed.

The Role for MIT

MIT's distinctive contribution is its ability to connect such deep biological insight with engineering, data, and systems design. Where agricultural research often tackles isolated challenges – fertilizer efficiency, crop traits, soil health – MIT brings these elements together, linking molecular-scale processes to field performance, regional impacts, and global outcomes.

And we are not starting from scratch. Building on a strong foundation of agricultural research that spans bioengineering, synthetic biology, materials science, AI, sensing, robotics, economics, and systems modeling, MIT brings a uniquely powerful mix of expertise to design and deploy agricultural systems that are efficient, resilient, and responsive to local conditions. By harnessing these capabilities together, MIT will help lead the new era of agriculture – one that aligns food production with climate, energy, and ecosystem goals while supporting farmers and communities worldwide.

Crucially, this redesign cannot be abstract or one-size-fits-all. Agricultural systems are shaped by local climates, soils, crops, cultures, and economies, and solutions must be tested and refined under real-world conditions. Progress will depend on working with farmers, regions, and communities to pilot new approaches, learn what works in practice, and adapt innovations to diverse contexts – from smallholder systems to industrial agriculture.

AGRICULTURE REALITIES

2–3 billion

people are fed today by industrial agriculture systems that are reaching environmental and climate limits

~25%

of global greenhouse gas emissions come from agriculture, forestry, and land use

70%

of human-caused nitrous oxide – a greenhouse gas 273× more potent than CO_2 – comes from agriculture

Up to 50%

of applied nitrogen fertilizer is lost to the environment, driving pollution, emissions, and ecosystem damage

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