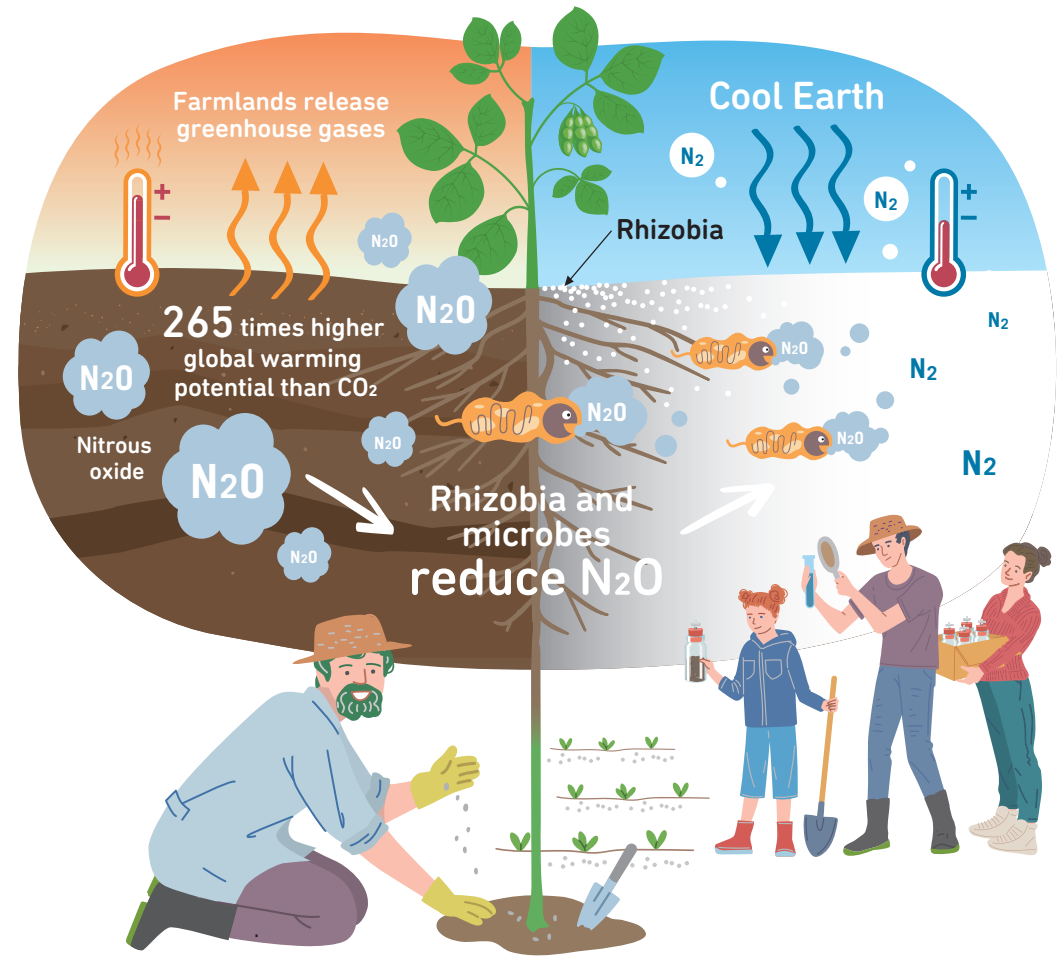


# 08 PROJECT

## Microbes Hiding in the Soil Help Curb Greenhouse Gases

### Mitigation of Greenhouse Gas Emission from Agricultural Lands by Optimizing Nitrogen and Carbon Cycles

You probably know that CO<sub>2</sub> is a greenhouse gas, but have you heard of N<sub>2</sub>O? Nitrous oxide exists in the atmosphere in lower concentrations than carbon dioxide, but its greenhouse effect is 265 times higher! The largest source of human-caused N<sub>2</sub>O emissions is agriculture, and approximately 60 percent of that comes from cultivated soil. As Earth's population continues to grow, more food is needed. If the use of chemical fertilizers increases proportionately, we will generate greater amounts of N<sub>2</sub>O as well. Ways to reduce agricultural N<sub>2</sub>O emissions without affecting food production are urgently needed to protect the global environment.



### Soil Samples Collected by the Citizens Lead to New Possibilities

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Our citizen science subproject was launched to raise awareness among the general public about N<sub>2</sub>O and its connection to global warming. We asked people to collect soil and air samples that we used in our search for microbes that decompose N<sub>2</sub>O. Inspired by the microorganisms we discovered and the soil aggregate structure in which these microorganisms live, we have developed [artificial soil aggregates](#). We have also partially succeeded in reducing N<sub>2</sub>O from nitrogen fertilizers. Our goal is to contribute to a Cool Earth by reducing N<sub>2</sub>O emissions from agriculture.

**Microbes Hiding in the Soil  
Help Curb Greenhouse Gases**

>> **Beans and Bacteria  
Make the Strongest Tag Team**

Fertilizers used to improve crop growth contain nitrogen compounds. These are broken down by microbes and fungi in the soil and released into the atmosphere as N<sub>2</sub>O. Rhizobia, which live on the roots of legumes, are one such type of microbe. We were the first in the world to identify a specific strain that has a high capacity for decomposing N<sub>2</sub>O. When this strain of rhizobia was used on actual farmland, the result was a 30 percent reduction in N<sub>2</sub>O emissions. We call these N<sub>2</sub>O-reducing microbes “Global Cooling Microbes.”

>> **Exploring Global Cooling Microbes**

Rhizobia are amazing, but they can only reduce N<sub>2</sub>O on the roots of leguminous plants. Reducing all types of agricultural N<sub>2</sub>O means finding microbes that are not dependent on legumes.



This is why we launched our citizen science project. We have found several Global Cooling Microbe candidates from the soil samples submitted thus far, and we feel that our research is making progress. We hope to reduce agricultural N<sub>2</sub>O through the application of these Global Cooling Microbes in agriculture.

**KEYWORD**

**Artificial Aggregates**

These ball-shaped clods of synthetic soil are designed to be a favorable habitat for N<sub>2</sub>O-reducing microbes. Applying these aggregates like fertilizer can help create soil that does not release N<sub>2</sub>O.

**FUTURE VISION**

2025

**Collection of Data for Real-World Use**

We aim to obtain data that will serve as the foundation for the development of rhizobial technology in Japan and internationally. We will continue research on rhizobia, artificial aggregates, and artificial carriers with the aim of deploying them in agriculture.

2027

**Rapid Adoption of Rhizobia and Artificial Aggregates**

Our objective is to commercialize the rhizobia, starting with domestic and then international application.

2029

**The Dream Is a Society With Half the Nitrogen**

With full-scale rhizobia deployment domestically and internationally, and the use of artificial aggregates and carriers underway, we aim to reduce N<sub>2</sub>O emissions by about 50 percent. We will achieve results in our core research, clarifying the functions of soil microbes, and demonstrate both technological and academic progress.

