Agriculture and Biotechnology Business

To contribute to solving global problems such as global warming, energy issues and food shortages, Toyota believes in the need for new businesses that contribute to the environment, in addition to the automotive business. Therefore, we are establishing a structure to carry out R&D in a variety of fields and start new businesses.

Biomass Utilization

To support fuel diversification for automobiles in the future and spread environment-friendly cars, Toyota is promoting the development of technologies for producing bioethanol that uses biomass, which does not compete with food or feed crops to realize a low-cost, stable bioethanol supply. Currently, demonstration trials are underway, primarily in Southeast Asia, using a high-ethanol-production yeast developed by Toyota. Toyota is focusing on Napier grass, a perennial grass in the Poaceae family that thrives on poor land unsuitable for cultivation, as a biomass resource. We have established a production and purchasing system for low-cost Napier grass in Indonesia.

Furthermore, in Southeast Asia, we are breeding high-productivity varieties of sugarcane using DNA markers. We are also conducting research on innovative core biotechnologies utilizing artificial intelligence (AI).

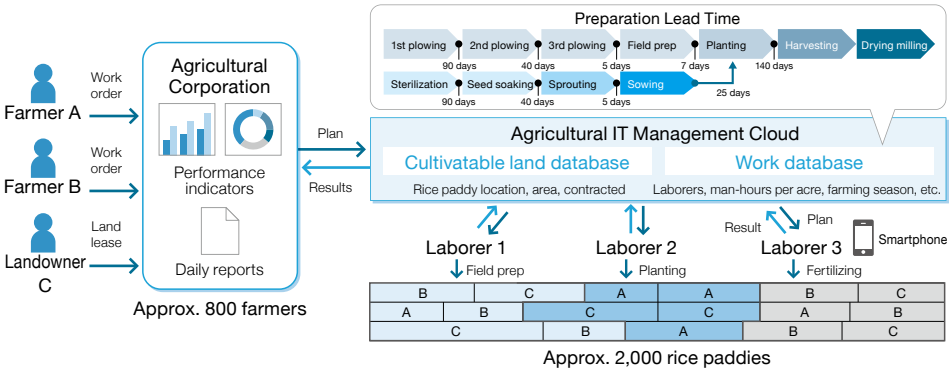
For details on an Indonesian case example that uses Napier grass, please see Environmental Initiatives on page 119.

Support to Agricultural and Food Production Industries

Toyota used the production control methods and process of *kaizen* (continuous improvement) established in the automotive business to develop *Housaku Keikaku*, an agricultural IT management tool, in order to raise productivity in agriculture. *Housaku Keikaku* has been provided to rice-growing agricultural corporations since 2014. Since April 2014, Toyota has participated in the Advanced Model Agricultural Business Formation Trials conducted by the Ministry of Agriculture, Forestry and Fisheries, and has established the Rice Production *Kaizen* Network in collaboration with Ishikawa Prefecture, as well as nine rice-growing agricultural corporations in Aichi and Ishikawa Prefectures. With the collaboration of *Housaku Keikaku* and onsite *kaizen*, we have conducted verification tests to raise efficiency and quality even further and built foundations for development of human resources.

Toyota announced collaboration with Hokkaido and Nagano Prefectures in 2017. The number of agricultural corporations implementing *Housaku Keikaku* based on collaboration with local governments was 65, as of May 2018. Since April 2018, through business collaboration with two agricultural corporations in Aichi Prefecture, we have been working on developing a large-scale, diversified, cutting-edge agricultural model having the following three characteristics: Smart farming that links big data with advanced technologies; improved distribution and sales processes; and application to multiple kinds of crops. Toyota plans to continue contributing to agriculture by further enhancing the functions of *Housaku Keikaku* and developing new products and services.

***Housaku Keikaku* System Overview**



GRAS-Di® New DNA Analysis Technology

On October 30, 2017, Toyota signed a licensing agreement with Kazusa DNA Research Institute, Eurofins Genomics, and GeneBay for Toyota's GRAS-Di®* DNA analysis technology (announced in September 2016), which can dramatically accelerate selective breeding. This technology can substantially simplify the process of identifying and selecting specimens with useful genetic information, and can be expected to cut cost down to approximately one-third and man-hours by one-tenth, both of which have been major hurdles in previous technologies.

Since November 2017, the technology has been put to practical use in contract-based analysis businesses in Japan and abroad, confirming that currently more than 60 species can be analyzed. GRAS-Di® can be applied to selective breeding in general, not only in agriculture, but for wide-ranging development in other areas.

* GRAS-Di®: Genotyping by Random Amplicon Sequencing-Direct

Building a Sustainable Environment

Since 2001, in order to help solve environmental issues, including the warming of cities, Toyota has been developing reforestation technologies that take advantage of functions of plants, as well as conducting research that contributes to people and society.

Toyota Roof Garden Co., Ltd. sells the reforestation products developed by Toyota: TM9 Zoysia grass (low maintenance); specialized green construction and material of rooftops, walls and parking areas; and year-round irrigation control systems.