

# Sustainability in Three Areas

---



Technology



Manufacturing



Society

---

## Contributing to Sustainable Development of Society and the Earth

---

Since its establishment, Toyota's fundamental philosophy has been to contribute to the creation of a prosperous society by manufacturing automobiles. Today, given the critical risk that the automotive industry faces unless global environment and energy issues are resolved, we are dedicated to the development of vehicles that can coexist in harmony with the Earth.

We believe that the key words to contribute to the sustainable development of society and the Earth are "Sustainability in Three Areas": "research and development," "manufacturing," and "nurturing society." We are working to satisfy the needs of both environmental preservation and economic growth. Eventually, we hope to contribute to the realization of a prosperous, low-carbon society.



## Technology

# Achieving Sustainable Mobility

Technological innovations hold the key to the environmental preservation and economic growth that are essential for us to contribute to a prosperous society and the Earth. Accordingly, Toyota is conducting research and development aimed at the realization of an automotive society that can coexist with the Earth, or Sustainable Mobility.

### Automotive Society Issues and Toyota's Vision for Future

Based on the vision of "Zeronize & Maximize," Toyota aims to minimize the negative impact that vehicles have on the environment, while maximizing their positive aspects, such as convenience, comfort, enjoyment, and excitement. Under the above concept, we are conducting research and development focused on the themes of the "environment," "energy," "safety," and "excitement."

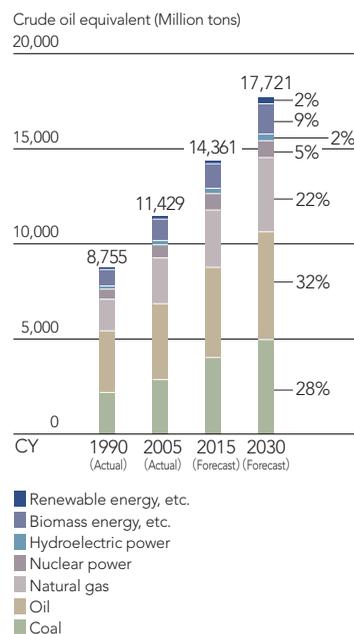
Considering the themes of the environment and energy, we believe that these are the three major issues that must be addressed simultaneously with respect to automobiles:

1. Supporting alternative energy sources;
2. Reducing CO<sub>2</sub> emissions (as a measure to counter global warming); and
3. Improving air quality.

Since fossil fuels are finite resources, it is imperative we use various alternative energy sources. Accordingly, we need to determine the appropriate energy sources for vehicles' practical use as well as develop power trains that are compatible with them, while also reducing CO<sub>2</sub> emissions and ensuring cleaner exhaust emissions.

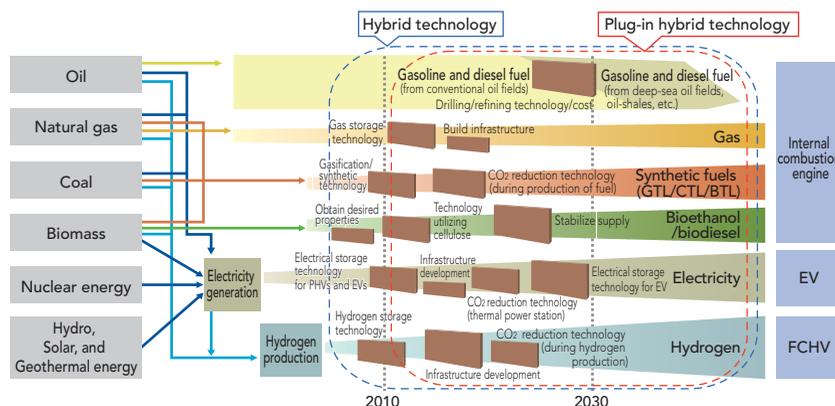
Targeting the realization of an ultimate eco-car, Toyota has long pursued research and development of conventional gasoline and diesel engines, as well as power trains that are compatible with such various energy as biofuel, electricity, and hydrogen. Of these technologies, since hybrid technology can be applied to all types of power trains, we have positioned it as a core technology and are aggressively pursuing its development. Introducing these R&D results in products, we are taking a multifaceted approach to providing "the right vehicle, at the right time, in the right place."

### Trends and Forecast of World Energy Demand by Fuel



Source: Agency for Natural Resources and Energy (Japan)

### Scenarios for Response to Environmental and Energy Issues



Improving Environmental Performance

» Improving Fuel Efficiency and Reducing CO<sub>2</sub> Emissions

With respect to power trains, by 2010 we will have installed in all our vehicles a new series of gasoline and diesel engines and transmissions to boost fuel efficiency. In addition, we are currently increasing efforts to further evolve hybrid technology and expand our hybrid lineup.

Improving fuel efficiency and reducing CO<sub>2</sub> emissions requires smaller and lighter vehicles. One response to smaller vehicles is the iQ ultra-efficient package vehicle, scheduled to launch in 2008 in Japan and Europe. The iQ offers a spacious cabin capable of seating four passengers, yet the body of the vehicle is less than three meters long. At the 2007 Tokyo Motor Show, we also demonstrated our future vision for weight reduction vehicles in the 1/X concept car. This concept car embodies all of the weight-saving and environmentally friendly technologies that we believe need to be incorporated into all future vehicles.



iQ, ultra-efficient packaging like no other



1/X, a redefinition of "environmentally considerate"

Gasoline Engines

With respect to gasoline engines, we have incorporated cutting-edge electronic control and other technologies, lowered fuel consumption and exhaust emissions for cleaner operation, and improved combustion efficiency to ensure superior engine performance. In 2008, we will complete the renewal of our gasoline engine lineup with the introduction of new 1.3-liter and 2.5-liter engines. The new 1.3-liter engine features the newly developed Toyota Stop & Start System, an improved version of the Toyota Intelligent Idling Stop System applied to the Vitz launched in 2003. This innovative system contributes to improving fuel efficiency and reducing CO<sub>2</sub> output by automatic stalling the engine when the car is stopped.



New 2.5-liter gasoline engine

Diesel Engines

Regarding diesel engines, providing a wide lineup from 1.4-liter to 4.5-liter, Toyota's cumulative production of diesel engines reached 20 million in February 2008, while it has been promoting clean diesel engines particularly in the European market. In addition, we have made a significant contribution to cleaner exhaust gas through the development of the world's first Diesel Particulate—NO<sub>x</sub> Reduction System (DPNR). This system features technology that simultaneously reduces the emissions level of specific particulate matter (PM) and nitrogen oxide (NO<sub>x</sub>) in exhaust gas. The application of such advanced technologies reduces CO<sub>2</sub> emissions and ensures cleaner exhaust gas.



Diesel engine with a DPNR

Toyota is Contributing to the Realization of a Sustainable Mobility Society



Masatami Takimoto

Executive Vice President

Currently, almost all vehicles run on gasoline or diesel oil because petroleum is readily available and is an economical energy source with an exceptionally high energy density. Sustainable alternative energy sources to petroleum that can help alleviate the problems of CO<sub>2</sub> emissions include biofuels, electricity, and hydrogen. There are, however, many issues that need to be addressed before these energy sources can be utilized for vehicles. This is why, I believe, there is a need to take advantage of the strengths of each energy source, and create the framework for a new sustainable transportation system, or Sustainable Mobility society.

A Sustainable Mobility society could consist of new types of personal mobility systems as a means of transportation, and a new public transportation system, in addition to small EVs, biofuel PHVs, FCHVs, and so on. Each system and vehicle has its own pros and cons. I, however, believe that each will have a role to play according to its respective characteristics. Toyota is committed to continuing to devote its full resources to realize a Sustainable Mobility society.

## Toyota Hybrid Technologies

Over the 10 years since we first launched the Prius in 1997, the fuel efficiency of all Toyota vehicles sold in Japan has improved by an average of approximately 28%. This is the result of improved fuel efficiency in both gasoline and diesel vehicles, and increased hybridization.

### Hybrid Vehicles

Toyota's core technology, its hybrid system, contributes to everything from cleaner emissions and lower CO<sub>2</sub> emissions to increased fuel efficiency. As such, we are implementing it in an expanded range of vehicles. In April 2008, cumulative global Prius sales reached one million. In June 2008, cumulative global hybrid sales reached 1.5 million. We are targeting one million hybrid vehicle sales per year by the earliest possible time in

the 2010s. Achieving this goal requires a drastic improvement in hybrid system performance and fuel efficiency. We will continue to develop high-performance electric motors, inverters, batteries, and other devices while working on ways to reduce the weight, size, and cost. Our current goal is to develop a hybrid system that is one quarter the size, weight, and the cost of the original Prius.



Crown Hybrid

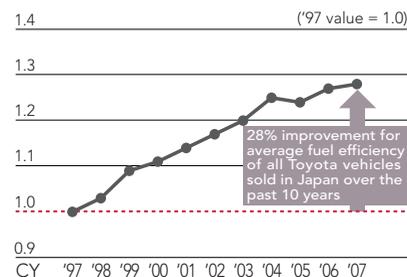


Harrier Hybrid



Lexus LS600hL

### Progress in Average Fuel Efficiency for all Toyota Vehicles (passenger cars)



## Approach to Diversification of Energy Sources

Since fossil fuels are finite resources, we continue to develop technologies that enable vehicles to use energy sources other than petroleum. Although the situation of these energy sources differs depending on the country and region, we believe that the primary sources of sustainable energy are biofuels, electricity, and hydrogen.

### Bioenergy (Flexible-Fuel Vehicles or FFVs\*)

Since 2006, Toyota has worked to ensure that all of its models are compatible with E10 fuel (gasoline with 10% ethanol). Furthermore, we have introduced an E100 (100% ethanol) compatible Corolla Flex in 2007, in Brazil, where bioethanol has become a mainstream fuel. Also in 2008, in Thailand we introduced a Corolla and three other models that are compatible with E20 fuel (20% ethanol). We also plan to offer E85 (85% ethanol) compatible Tundra FFVs and Sequoia FFVs in North America, and are working toward the introduction of other FFVs with

specifications that satisfy specific regional requirements.

\* FFV: A vehicle capable of running on fuels that consist of any percentage of ethanol mixed with gasoline or on ethanol alone.



Corolla Flex

## Electricity (PHVs / EVs)

Although electricity supply is easily accessible and electric vehicles (EVs) can run cleanly with no exhaust gas, current EVs require extremely large batteries. Therefore, they face such issues as cost, charging time, and driving range. For the foreseeable future EVs are likely to remain a realistic solution only for short-range commuting. We have been engaged in compact EV development for some time and will accelerate our efforts aimed at their eventual mass production.

Using our own hybrid technology, Toyota has developed Plug-In Hybrid Vehicles (PHVs) boasting significantly extended range using the electric motor alone, with the additional capability of being charged using regular household electricity. Although the vehicle runs on electricity alone for a short drive in urban areas, the gasoline engine provides support at high speeds when required. There is no issue concerning range limitations since PHVs can be operated as normal hybrid vehicles in long-distance drives. Supplying photovoltaically generated electricity to a biofuel PHV that also uses a next-generation biofuel, such as cellulosic ethanol, can in effect reduce CO<sub>2</sub> emissions from driving to near zero.

Economic benefits, including charging at night when electricity prices are low, are expected. In addition, lower CO<sub>2</sub> emissions and decreased fuel consumption will result in minimal atmospheric pollution. Currently, PHVs are considered the most realistic approach using electricity, and tests have already proven the effects of improved fuel consumption. Toyota is accelerating development with the aim of making PHVs popular, and plans to introduce PHVs equipped with lithium-ion batteries (LIBs) to fleet customers by 2010.

Since batteries hold the key to the future development of PHVs and EVs, we have also created a new Battery Research Department to research and develop a next-generation battery that considerably outperforms conventional LIBs. Additionally, we are developing batteries for use in vehicles at Panasonic EV Energy Co., Ltd., a joint venture between Toyota and the Matsushita Group. They are scheduled to commence limited production of LIBs in 2009 and move into full-scale production in 2010.



Plug-in Hybrid Vehicle

## Hydrogen (Fuel Cell Hybrid Vehicles or FCHVs)

In June 2008, Toyota introduced the TOYOTA FCHV-adv, installed with newly designed, high-performance fuel cells, Toyota FC Stacks, which were certified by Japan's Ministry of Land, Infrastructure and Transport. Featuring a 25% improvement in fuel efficiency and internally developed high-pressure hydrogen tanks, the vehicles have a cruising range of approximately 830km (in the 10–15 Japan test cycle; 760km in

the Jc08 test cycle; as measured by Toyota) on a single fill up of hydrogen. This is over twice the cruising range of its predecessor, the TOYOTA FCHV. Toyota is making every effort to meet the challenges of maintaining reliability, lowering costs, and other issues, having overcome such FCHV technical problems as starting and driving in temperatures as low as -30°C.



TOYOTA FCHV-adv

### Various Alternative Fuel Issues

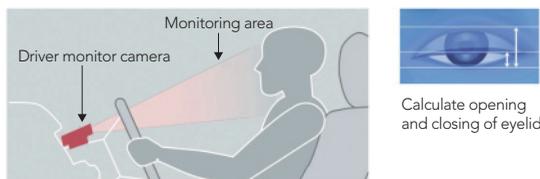
Toyota is working to address other various alternative fuel issues. We are using yeast technologies incubated in Japan to develop ethanol production capability based on cellulose, an abundant resource in inedible plant material, to avoid competing against food resources. In the area of biofuel alternatives to diesel, we are collaborating with Nippon Oil Corporation to research biohydrofined diesel oil (BHD), which offers a drastic improvement in oxidative stability, as well as equivalent performance to that of regular diesel oil. In addition, we are researching biomass-to-liquid (BTL) biofuels synthesized from gasified cellulose and other biomass materials.

## Approaches to Safety

Toyota is committed to technological developments based on the Integrated Safety Management Concept. We are working not only to improve preventive safety and collision safety but also to offer optimum driver support for every aspect of driving. These efforts include sensors that detect vehicle movements, traffic conditions, and even the state of the driver. Computers are then used to determine the necessary driver support and activate safety systems. For example, the Pre-Crash Safety System uses a millimeter-wave radar to detect obstacles such as vehicles ahead and alerts the driver by sounding a warning buzzer if the system determines that there is a high risk of collision. If the system determines that a collision is unavoidable, it automatically activates Pre-Crash Brake to reduce the vehicle's speed and Pre-Crash Seatbelt to minimize injuries.

The fully remodeled Crown launched in 2008 integrates the Pre-Crash Safety System with an eye monitor that detects whether a driver's eyes are properly open.

A camera installed on steering measures facial angle and how wide open the driver's eyes are, and if it judges that a collision



may occur, it alerts the driver at an early stage, via a warning buzzer and illuminated display. If the probability of a collision increases and the driver's conditions do not improve, the system applies a warning brake to physically alert the driver.

Through the developments of these and other safety technologies, Toyota is working to create an even safer automotive society.

## Traffic Environment Research

Toyota views people, vehicles, and the traffic environment, and aims to attain the ultimate goal of zero fatalities or injuries in traffic accidents. With respect to the traffic environment, we are pursuing research and testing of a Safety Driving Assistance System. We conducted public road tests of this system in Toyota City, Aichi Prefecture, for the six-month period beginning December 2006. Using 100 vehicles equipped with drive recorders, we collected and analyzed data on drivers' behavior under various driving situations on public roads. The results are being applied to research aimed at reducing traffic accidents through the development of infrastructure cooperative systems that support safe driving by communicating information on road conditions, traffic signals, and other factors with vehicles.

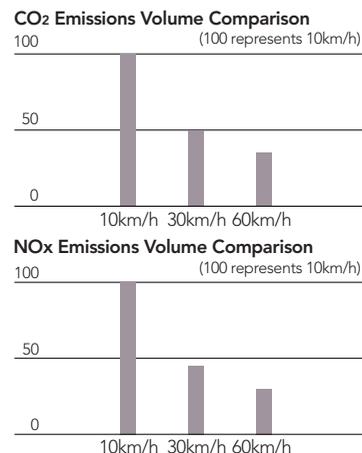
In addition, we are actively participating in the development of the Probe Traffic Information System, which can provide drivers with information ranging from estimated travel time to routes to avoid traffic congestion. This helps smooth traffic flow and consequently reduces CO<sub>2</sub> emissions.



### Driving Simulator

Toyota developed and installed the new "Driving Simulator" at the Higashifuji Technical Center in November 2007, with the goal of reducing traffic accidents and promoting the development of active safety systems. The simulator analyzes driver characteristics during vehicle operation and develops and confirms the efficacy of accident-reduction technologies. The simulator also offers a driving experience that is as real as possible. It is expected to lead to the development of advanced safety technologies and vehicle designs while boosting the speed of development and lowering development costs.

### Comparison of Gas Emissions Volume Depending on Average Speed



Source: Japan Automobile Research Institute



## Manufacturing

# Implementing “Sustainable Plant” Activities

Sustainability is also being pursued at the plants that drive Toyota’s manufacturing operations. In July 2007, Toyota initiated “Sustainable Plant” activities with the goal of creating production sites that are in harmony with their natural surroundings.

### CO2 Emission Reduction Results and Targets

The Toyota Environmental Committee was established in 1992. In 1993, it announced the Toyota Environmental Action Plan, which defined specific measures and targets for environmental action. Since then, we have continued to implement environmental and energy-related initiatives, including measures to reduce CO2 emissions. We are currently conducting activities in line with the 4th Toyota Environmental Action Plan to meet targets set for the year ending March 31, 2011. In fact, we have already achieved the CO2 emissions reduction target outlined in the plan and are now working to meet a new, even higher target for the year ending March 31, 2011.

### CO2 Emission Reduction Targets, Results and New Targets

Region	CO2 Emissions	2010 Target	2007 Results	New 2010 Target
Worldwide*	Volume per sales unit	20% reduction from 2001	32% reduction from 2001	35% reduction from 2001
TMC (Japan)	Volume per sales unit	35% reduction from 1990	55% reduction from 1990	60% reduction from 1990
	Volume	20% reduction from 1990	25% reduction from 1990	30% reduction from 1990

\* The roughly 120 Toyota Group companies both in Japan and overseas subject to consolidated environmental management

Note: The years mentioned are from April 1 to March 31.

### “Sustainable Plant” Activities

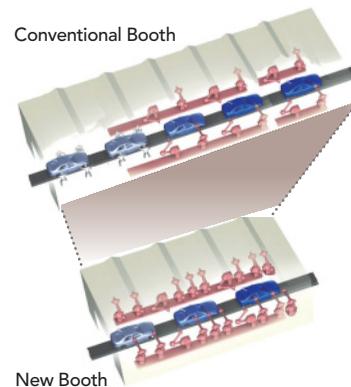
Toyota conducts its “Sustainable Plant” activities globally on three broad fronts. The first is energy reduction through the development and introduction of low CO2-emitting production technologies and daily *Kaizen* (continuous improvement) activities. The second is energy conversion utilizing photovoltaic and other renewable energy sources. The third is tree-planting to foster involvement with local communities and ecological preservation.

### Development and Introduction of Low CO2-Emitting Production Technologies

Toyota’s Takaoka Plant is one example of how “simple & slim” thinking can streamline manufacturing operations. We have been working to shorten our assembly lines and dramatically reduce their energy use by taking advantage of innovative production technologies. The new Takaoka Plant Line No. 1 began operations in August 2007. Here, we have

achieved CO2 reductions of approximately 15% by shortening the length of the painting equipment and eliminating the need for the primer-drying oven. We continue to improve these innovative assembly lines to further reduce CO2 emissions and costs as we introduce the improvements at all Toyota plants worldwide.

### Example of Reducing CO2 Emissions in Painting Process



Through the development and introduction of slim robots, Toyota has shortened the length of the painting process. This has helped to lower CO2 emissions by reducing energy use.

### Utilization of Renewable Energy

At the Tsutsumi Plant, a photovoltaic generation system has been installed with a rated output of 2,000kW, equivalent in the area to approximately 500 houses, and the system is among the largest for any automobile plant in the world\*. This system is expected to reduce annual CO<sub>2</sub> emissions an estimated 740 tons, an amount equivalent to that generated by burning 1,500 barrels of crude oil.



Photovoltaic generation system at the Tsutsumi Plant

\* As surveyed by Toyota

### Tree-Planting Activities

Toyota's goal is to protect ecosystems by planting trees that are indigenous to the given region, thereby helping to support the original local biodiversity. At the Tsutsumi Plant, in May 2008 almost 5,000 local residents and employees and their families participated in planting approximately 50,000 trees. In the future, we will continue to expand these activities on a global scale to meet the challenge of tree-planting and forest growth worldwide.



Tree-planting event at the Tsutsumi Plant

### Model Plants Overseas

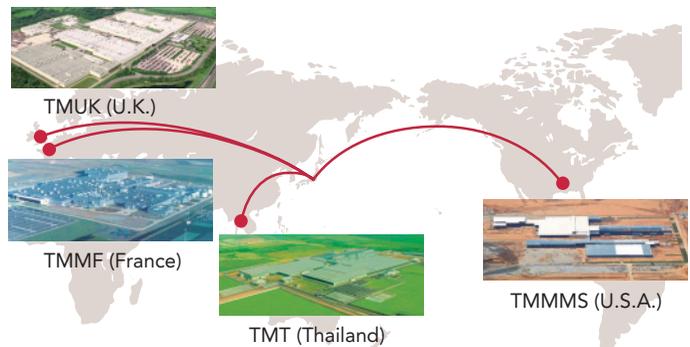
In the United States, Toyota has designated its Toyota Motor Manufacturing, Mississippi, Inc. (TMMMS) plant (currently scheduled to begin production in 2010) as a model "Sustainable Plant." In addition to incorporating innovative production line technology, it is also actively promoting tree-planting activities as part of its efforts to achieve a harmonious balance between the local community and the environment.



Photovoltaic generation system at the Ban Pho Plant in Thailand

In Europe, Toyota Motor Manufacturing (UK) Ltd. (TMUK) and Toyota Motor Manufacturing France S.A.S. (TMMF) have both been designated model plants, and in Asia, the Ban Pho Plant operated by Toyota Motor Thailand Co., Ltd. (TMT) has been selected as a model plant. The Ban Pho Plant already utilizes a cogeneration system, solar panels, a wastewater recycling system, and waterborne metallic paints at vehicle body paint lines. The plant has maintained zero landfill waste since the beginning of its operations. As part of its plant "greening" activities, an event in August 2008 drew an estimated 10,000 people to plant approximately 100,000 trees in what was Thailand's largest tree-planting event ever.

### Worldwide Model Plants for "Sustainable Plant"



Toyota is pursuing "Sustainable Plant" activities worldwide using the Tsutsumi Plant and four overseas plants as models.

### Spreading Toyota's Effective Measures and Environmental Awareness Worldwide



Takeshi Uchiyamada

Executive Vice President

From the standpoint of reducing CO<sub>2</sub> emissions, there are numerous examples of the effectiveness of Toyota's "Sustainable Plant." They require less energy to operate, utilize natural energy sources, and, through tree-planting, can contribute to the absorption of CO<sub>2</sub>. Participation in tree-planting projects also helps employees develop a deeper appreciation for the environment and spread environmental awareness in the local community.

As soon as we announced the concept of "Sustainable Plant" activities, we began receiving requests to participate from our plants around the world. Certain plants have been designated as model plants, but other plants have begun tree-planting and environmental projects voluntarily and the practice is rapidly spreading. We will continue to expand our "Sustainable Plant" activities to ensure that both Toyota products and the plants that manufacture them are gentle to the environment.



## Society

# Environmental Activities for a Sustainable Future

Toyota engages in a wide range of nurturing society activities at home and abroad as it seeks to become a trusted global corporate citizen and to contribute to the sustainable development of a prosperous society.

### Toward a Sustainable Environment

Toyota implements measures on a national and international level in its efforts to achieve a sustainable level of global environmental preservation. Recognizing the importance of ongoing efforts deeply rooted in local communities, we proactively contribute to society in each country and region through our development programs for forestry, human resources and the local community.

#### The Forest of Toyota

In 1997, Toyota established the “The Forest of Toyota” in Toyoda City, Aichi Prefecture, to serve as a model for other mountain forest restoration efforts. At the forest, communities are invited to participate in nature experience programs, forest management activities and mountain forest studies.



Elementary students participate in the nature experience program

#### TOYOTA Shirakawa-Go Eco-Institute

In 2005, Toyota established the “TOYOTA Shirakawa-Go Eco-Institute” in Shirakawa Village, Gifu Prefecture, which works to increase environmental awareness through forest preservation projects and nature experience programs.



TOYOTA Shirakawa-Go Eco-Institute

#### The Anti-Desertification Initiative in China

Since 2001, Toyota has been involved with afforestation activities in Fengning Man Autonomous County, Hebei Province, China, where significant desertification has occurred. By planting some 2,600 hectares with trees, we made a major contribution to environmental conservation in Fengning Man County, which is an important source of water for Beijing and Tianjin. By taking measures against overgrazing, which causes desertification, and by afforesting with fruit trees, we are conducting the compatibility of community life and environmental conservation. In May 2008, we established the Afforestation Center in order to help foster afforestation experts, disseminate information on greening technology, and enhance the localization of our afforestation activities.



Before afforestation



After afforestation

#### Rain Forest Restoration Initiatives

Since September 2007, Toyota has been engaged in an afforestation project in the northern region of Luzon, the Philippines, that calls for approximately 1,772 hectares to be planted with trees over a three-year period. Toyota has been implementing measures that include establishing a forest for harvesting fuel wood and planting such fruit trees as mango to encourage those living there to not log in the forest for fuel wood, in hopes of limiting natural forest deforestation. Sharing our afforestation expertise and technologies, we are achieving sustainable afforestation so that local communities and forest restoration can coexist.

#### Toyota Environmental Activities Grant Program

Started in fiscal 2000, the Toyota Environmental Activities Grant Program supports projects that nurture environment-friendly people and technologies. Now in its eighth year, the program has supported 140 projects in 42 countries worldwide.

In research and development, manufacturing, and nurturing society, Toyota is committed to sustainability. We will continue to contribute to the sustainable development of society and the Earth as we strive for “Sustainability in Three Areas” and share a keen awareness of environmental issues with people around the world.