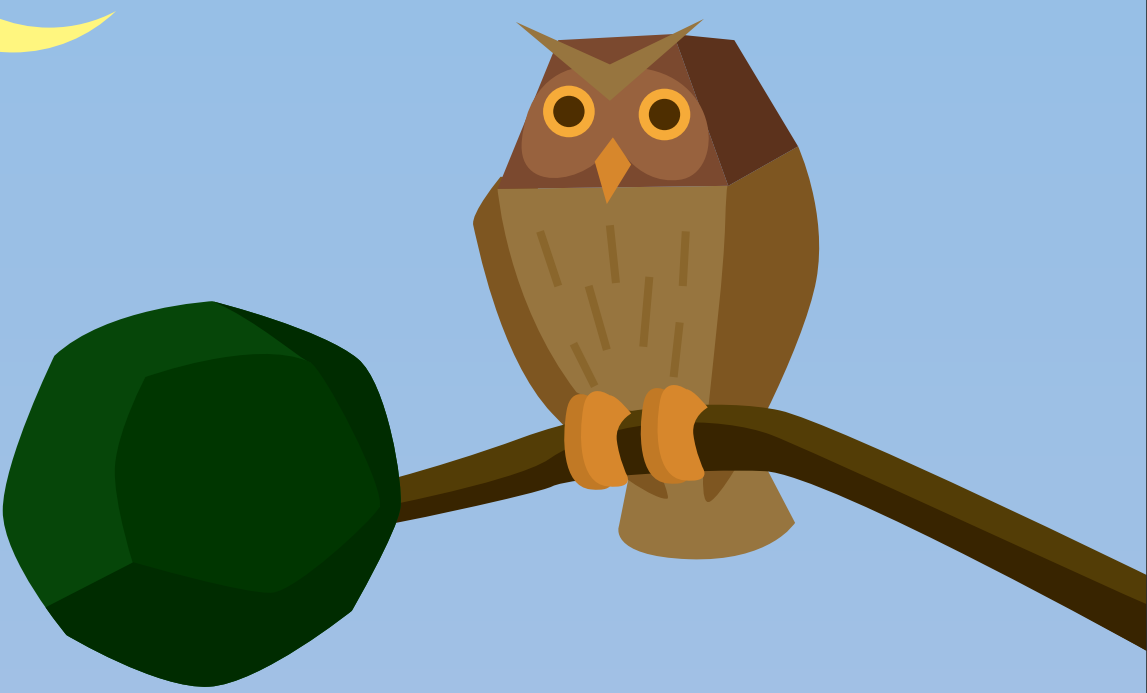


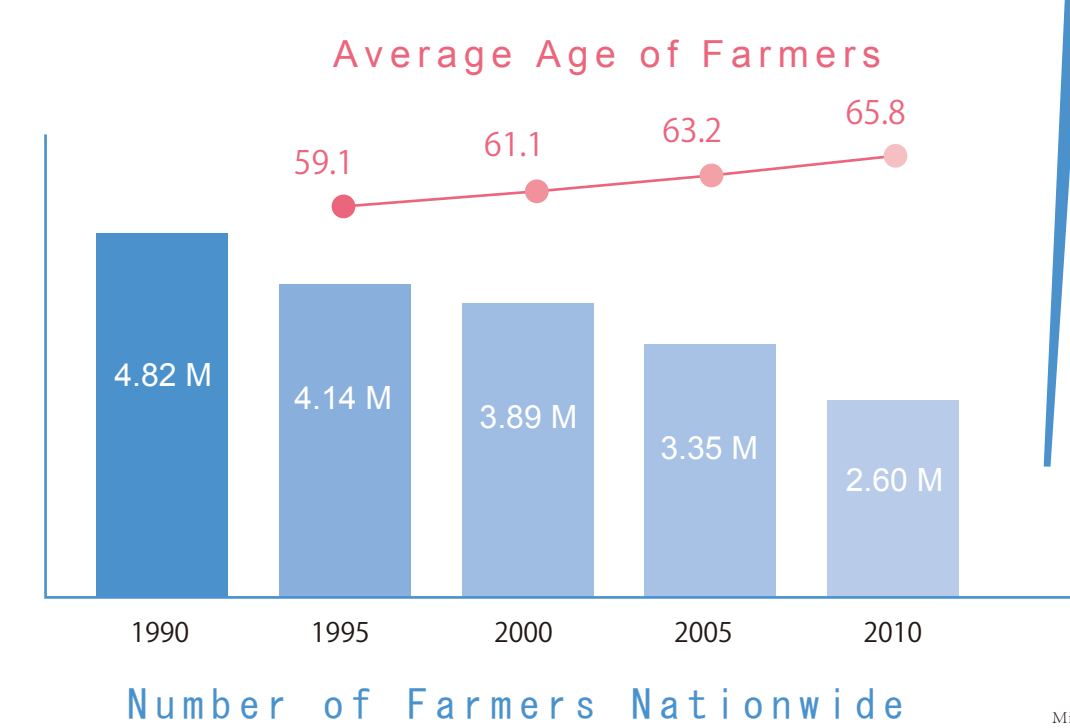
# Not only under the sun, but also under the moon!



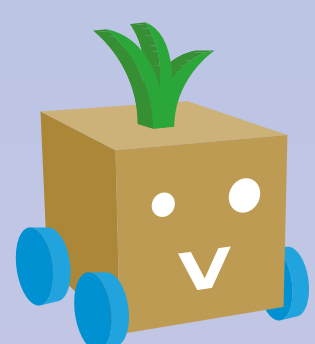
**Unmanned Agricultural Robots** can perform agricultural labor. While people sleep, land plow and crop harvest can be carried out.

## Japanese Agriculture, the Young People's Choice.

Agriculture supports Japan's food, and protects the land and the environment. Although it's an important industry, the number of farmers keeps decreasing; there's an aging problem with farmers having an average age of 66 years old. Agriculture is a heavy labor, susceptible to weather factors, and learning agricultural technology takes a long time. Affected by this impression, leadership shortage is a serious issue. To solve this problem, "Agricultural Robots" is one of the key technologies.



This is a serious state for agriculture!



## Hokkaido was First! Successful Operation of an Unmanned Tractor

In modern agriculture, tractors and other agricultural machinery are essential. The Laboratory of Vehicle Robotics (VeBots) of Hokkaido University School of Agriculture has succeeded conducting researches on unmanned tractors and developing new technologies. Sensors are installed on a tractor, and its position is measured by satellite (GPS). A computer commands its movement, replacing manual operation and thus giving birth to robot tractors.

Position measurement sensor (GPS)



Attitude measurement sensor (IMU)



Computer

A tractor equipped with sensors travels in the farmland!

## By Supporting Farmers for 1 year, these Farming Operations are Possible

A Robot Tractor not only moves in the fields accurately, but also can be programmed to complete all kinds of farming tasks. By entrusting the field labor to the Robot Tractor, farmers can focus into product development, market research and other important work.





## Power up! Using multiple Tractors for "Labor Cooperation"

One farmer operating a single Robot Tractor is not really efficient. Therefore, "VeBots" laboratory has developed a management system for simultaneous operation of multiple Robot Tractors by using a wireless communication system. This "labor cooperation" is close to practical use.



Example of Labor Cooperation

productivity improvement is linked to cost reduction

## Smaller Tractors are Environmentally Friendly

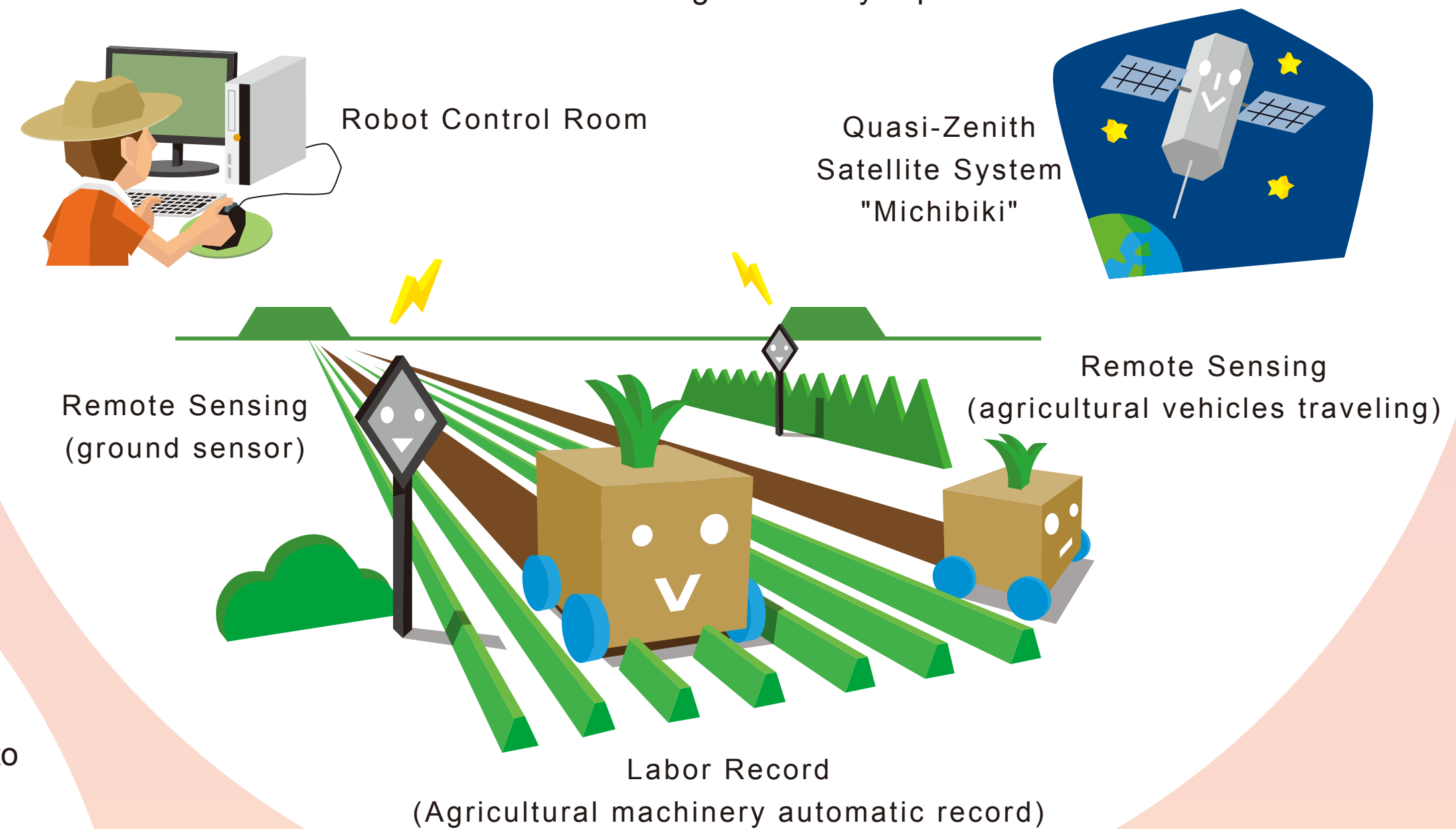
Tractor size can improve operational efficiency, but it affects the crop growth due to soil compaction. By using multiple small robot tractors, the "labor cooperation" scheme is a good prospect. Also, by sending information from a computer, it's possible to adjust the amount of fertilizer, harvest only mature crops, and perform other tasks concerning the environment; which is one of the goals of precision agriculture.



Futuristic robot concept for ultra-precision farming work

## Satellite Positioning and Wireless Communications are the Basis of Agricultural Robots

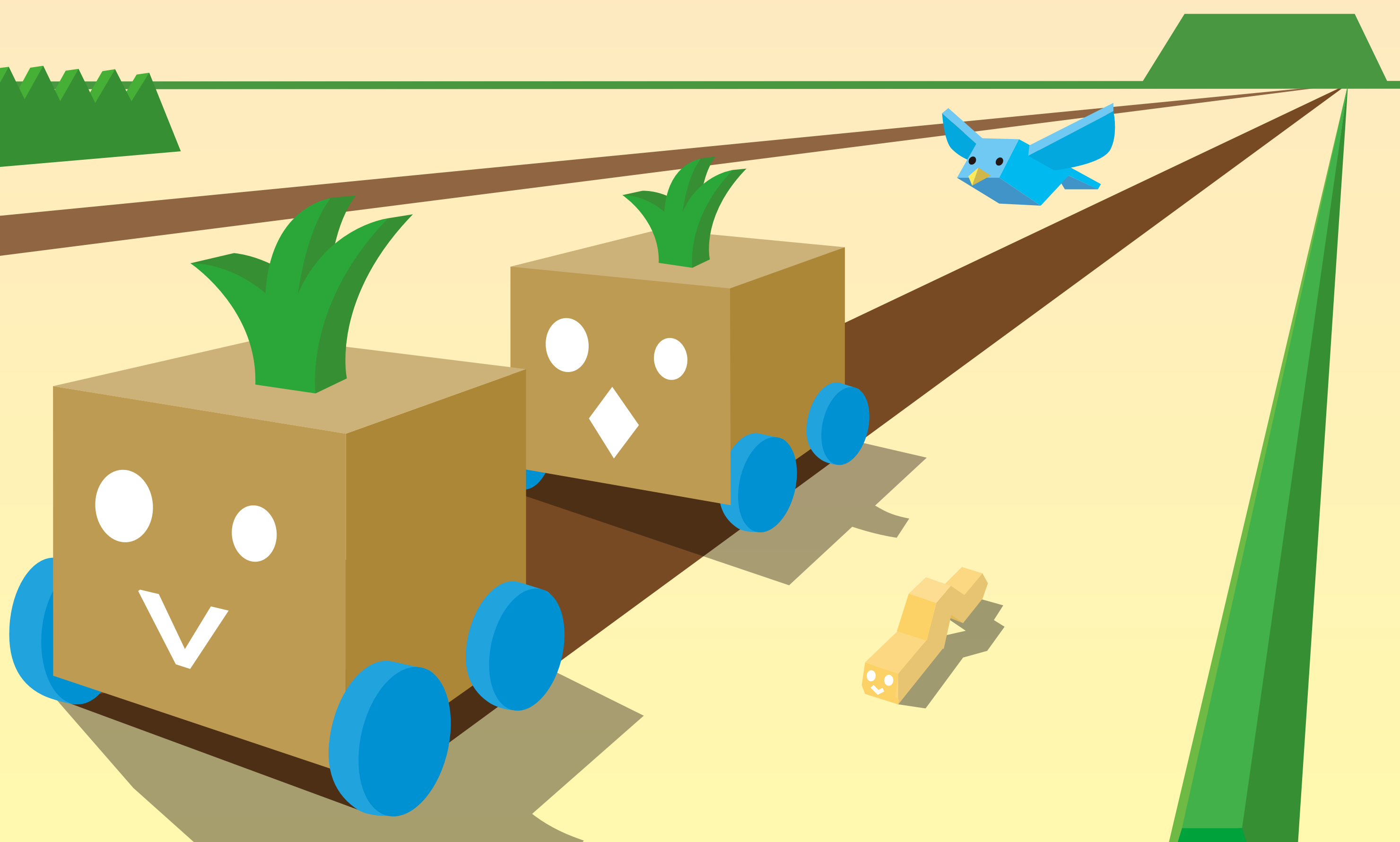
The Quasi-Zenith Satellite System "Michibiki" and other high-precision GPS satellite positioning technologies are vital for agricultural robots. Moreover, in order to monitor the work of multiple robots from a remote control room, geospatial information and wireless information and communication technologies are very important.



Ready, Set, Go!  
But it's not a  
race, it's  
cooperation.

1 person can manage multiple tractors thanks to agricultural robotics .

By using *Labor Cooperation*, efficiency improves significantly. It has shown a good performance in wide agricultural lands.





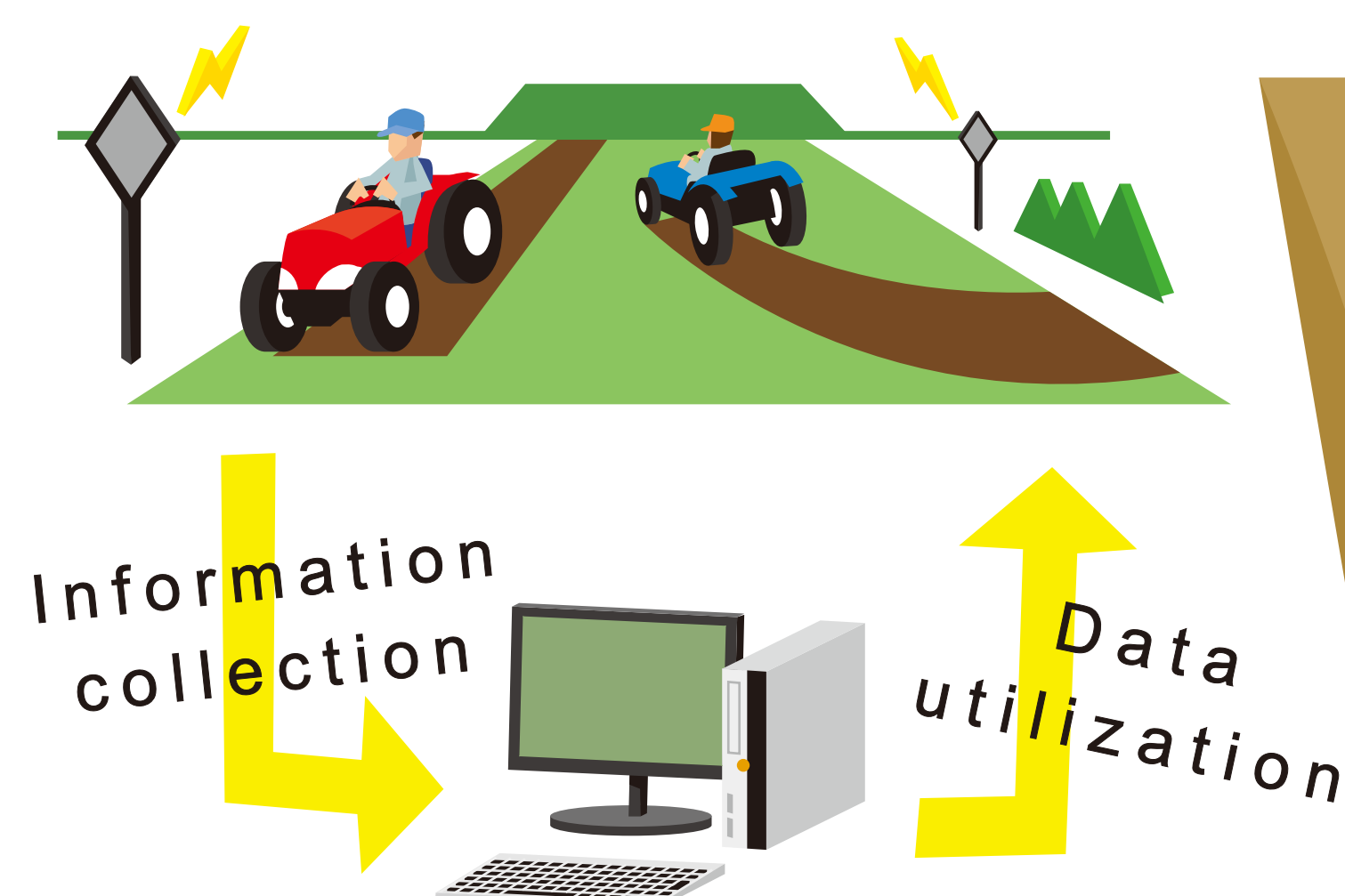
## "Big Data" to Support Farmers now and in the Future

The reason behind the good flavor of vegetables and rice is an adequate agricultural environment, supported by the joint efforts of farmers and people related to agriculture. Accumulation of Big Data takes place by gathering the *know-how* from every point of view concerning the "Hokkaido Agriculture", cultivated both naturally and by humans. By using the appropriate data it's possible to support daily farm labor, and help Japanese Agriculture by carrying out a variety of researches about Agricultural Information.



Data Analysis • Know-How abstraction

Accumulation of Big Data  
Useful for Japanese  
Agriculture



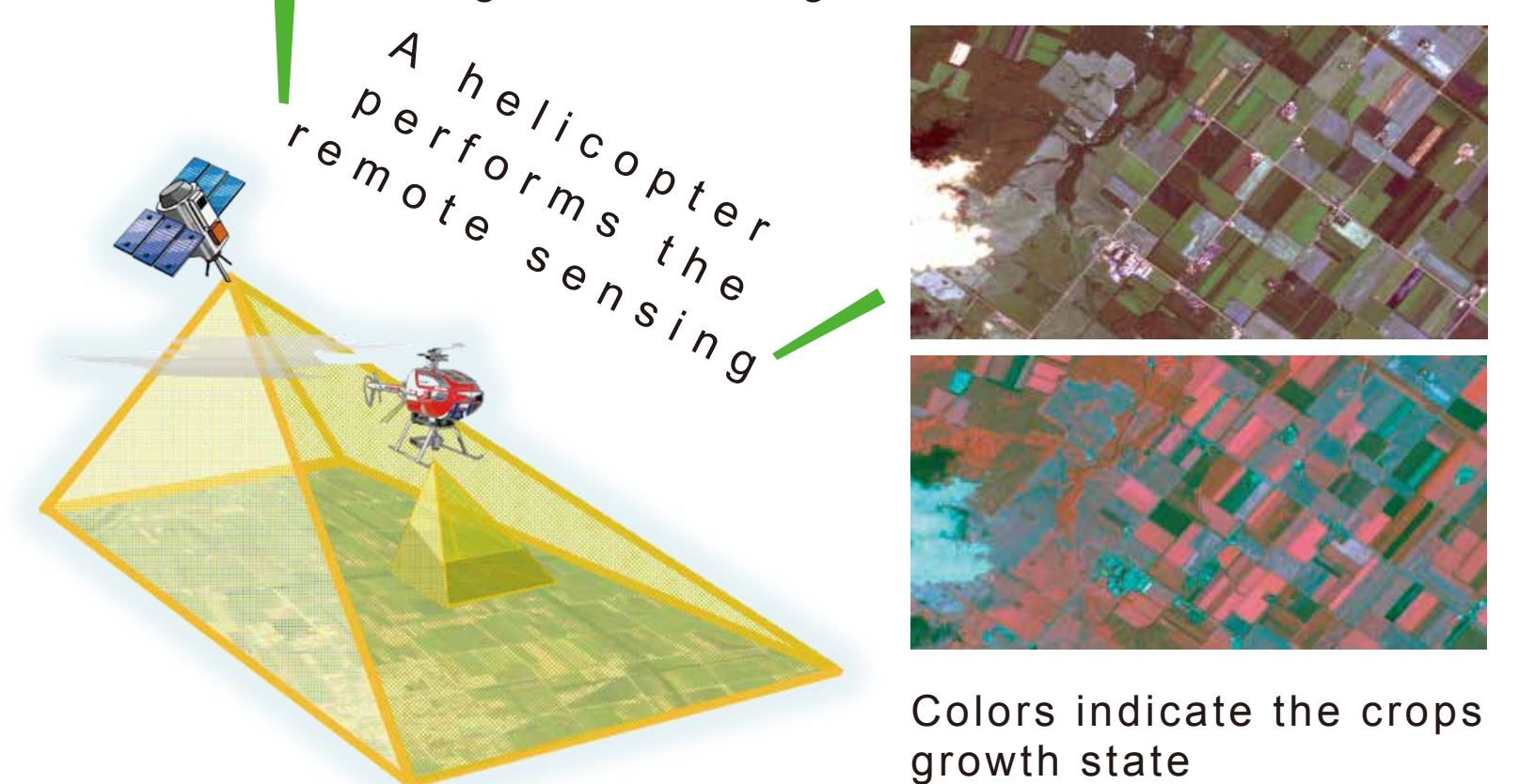
More and  
more  
delicious  
food!  
But, can it  
really  
become  
Smart  
Agriculture?



**Smart Agriculture** aims to help Japanese Agriculture by combining the know-how of experienced farmers with agricultural robots.

## Achieve Precision Agriculture with Artificial Satellites + UAV

With the gradual expansion of farming lands and paddy fields, soil and moisture states change, showing a discrepancy for the growth of crops. Thus, the concept of **Precision Agriculture** has got the world's attention. Artificial Satellites and UAV (Unmanned Aerial Vehicles) are combined to obtain precise large-scale agricultural information, and to adapt the crop growth to the environment. Fertilizers and pesticides are not wasted, creating a link to safe agriculture.



## Future Trends of Japanese Agriculture: towards "Smart Agriculture"

Since 80 percent of the agricultural labor accounts for tractor operations, the Laboratory of Vehicle Robotics "VeBots" focuses in the research of unmanned Robot Tractors, but it's also engaged in agricultural remote sensing and information technologies. The laboratory aims to achieve "Smart Agriculture" as the goal for the future of Japanese Agriculture, through collaborative efforts of farmers and related personnel. Through this research, we are hoping to attract attention towards agriculture, and involve young people in agricultural work.

