

Sustainability Report 2019

Toward a Sustainable Campus

Greenery for You and Us



Greenery for You and Us

The Hokkaido University Sapporo Campus is described by many as a pleasant place with lush greenery. What does greenery refer to?

Leafy trees, green spaces with flowers, surroundings with birds and insects, or a place where residents can relax? Is the greenery of Hokkaido University exclusively for use by the university?

What is its value for you and me?

Again, we would like to consider the greenery of Hokkaido University

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Message from the Executive Director

To realize a sustainable world, Hokkaido University contributes to the resolution of global issues

Executive Director
Sustainable Campus Management Office

Kazushi MINAKAWA



Hokkaido University is an institute comprised of more than 20,000 faculty members and students. The university has recognized its direct and indirect influence on the community and the global environment, measured environmental load quantitatively and promoted energy-saving programs on a daily basis.

Concerning international trends, the UN World Commission on Environment and Development advocated the concept of “sustainable development” in 1987, and educational institutes adopted a number of declarations to promote sustainability from the 1990s to the 2000s. The Sustainable Development Goals (SDGs) were adopted at a UN summit in 2015, accelerating these movements toward a sustainable world. Against this backdrop, contribution to the realization of a sustainable society through education and research and the promotion of environmental load reduction on campus are two critical points for the university to fulfill its social responsibilities. With the Sustainable Campus Management Office (SCM Office) established in April 2018 at its center, Hokkaido University actively promotes activities toward not only a sustainable campus but also a sustainable society.

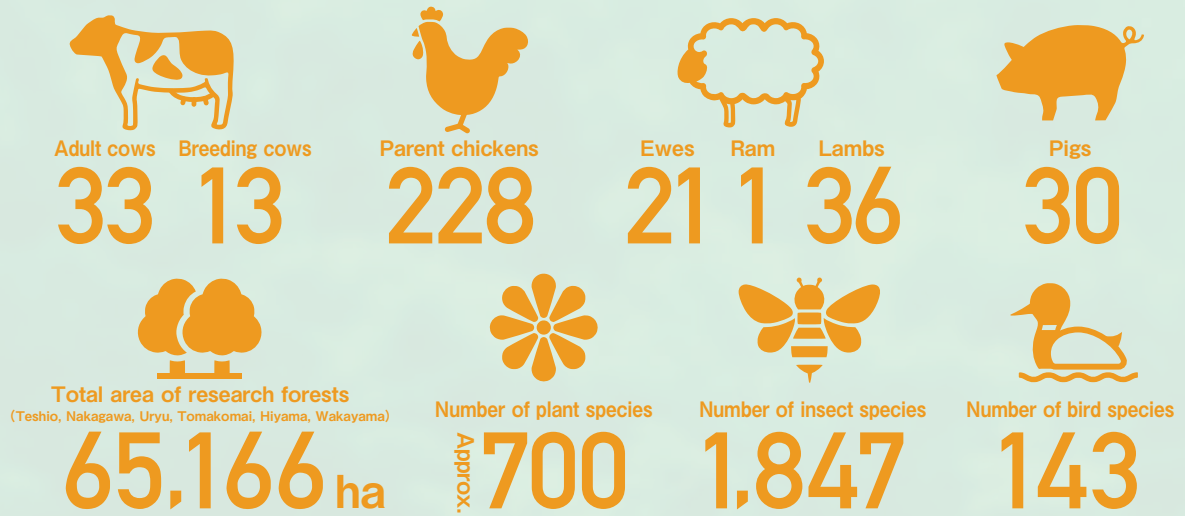
This Sustainability Report features the greenery and farms of the Sapporo Campus. These create a valuable field for research and education on flora and fauna, provide a place of relaxation for nearly two million residents in the center of Sapporo and function as evacuation area during disasters. I hope this booklet will help each reader reconsider the importance of handing down the ecological environment of the campus to future generations.

In 2018, Hokkaido experienced record-breaking typhoon Jebi and then the Hokkaido Eastern Iburi Earthquake before we confirmed the damage rendered by the storm. This booklet outlines the university’s response to these disasters, such as the confirmation of damage by faculty, as well as efforts for recovery and voluntary support activities by students.

I hope this booklet will help people understand the efforts of Hokkaido University to use its vast campuses to promote various activities toward becoming a university contributing to the resolution of global issues.

Hokkaido University in Numbers

Ecosystem *figures in June 2019



Following in the footsteps of Sapporo Agricultural College, the predecessor of Hokkaido University, it conducts diverse research, contributing to Japanese dairy farming and the development of Hokkaido.

Management and maintenance



Compared with figures in FY 2015 (base year)
① Up 0.6% ② Down 56.4% ③ Down 11.1% The university has worked on waste compaction since FY 2016.



The figure decreased by 36.7% more than that in FY 2010 (1,210,000). The vehicle reduction target was achieved. The manners of bicyclists are still an issue to be addressed.

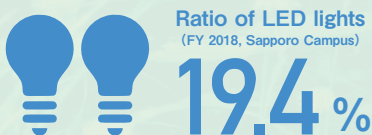
Facilities and energy



2005: 767,818 m², 2010: 807,934 m², 2015: 854,463 m²
Buildings are added or extended as much as possible for research and education.



It decreased 4.4% in comparison with 2012 (1,762,391 GJ)



Solar power generation at Hokkaido University started at the Conference Hall in 2009.

Education and research

Hokkaido University in the SDG 9: infrastructure, indoctrination and innovation section



In rankings published by The Times Higher Education, a U.K. educational magazine (released in April 2019), Hokkaido University ranked 79th in SDG 13: climate change, 88th in SDG 17: implementation method and 101st - 200th in the overall ranking (4th among Japanese universities).

*This booklet describes "SDGs: sustainable development goals" on page 21.

Number of academic subjects related to sustainability (FY 2018)



A variety of subjects are provided, and systematic program enhancement is now being considered.

Number of donated secondhand books (2018)



Donated secondhand books are turned into money, which is used to purchase library materials and make facility improvements.

Earthquake-resistant Architecture Award of Excellence Given at the Seismic Retrofitting Architectural Excellence and Contributor Commendation

Seismic retrofitting of important cultural properties at the Second Farm of the Faculty of Agriculture and the Museum at Hokkaido University Botanic Gardens



Structures where seismic retrofitting work was conducted (the Second Farm)

[the Second Farm]

Located in the northern part of the Hokkaido University Sapporo Campus, this farm encompasses 12 structures built on the model farm for the development of Hokkaido based on the farm management concept developed by Dr. William S. Clark. It was used for practical training until 1967, and then designated as a National Important Cultural Property in 1969.

Hokkaido University has worked on improving the medium- to long-term historic building maintenance system since 2004. Based on the five evaluation indexes of history, obsolescence, risk, utilization and regional contribution, the university set its repair priorities and decided to conduct seismic retrofit, preservation and repair work for the Important Cultural Properties at the Second Farm and the Museum at Botanic Garden. The main construction work involved

This project was implemented over a short period of time with the full cooperation of researchers throughout the planning, design and construction phases, such as the establishment of a committee comprised of members of the Architectural Course (primarily related to the design and structure of the university), the

[Museum at Botanic Gardens]

Located at the Botanic Gardens southwest of Sapporo Station, this oldest museum in Japan was built in 1882 as a museum for the Hokkaido Development Commissioner. Six structures related to the Botanic Gardens, including the office, Museum Store-room, Museum aviary and Gate House, remain there today.

the seismic retrofit of 12 wooden structures and the preservation and repair work of 18 Important Cultural Properties including the 12 wooden structures. It was conducted based on the following policies: (1) To minimize the demolition of the structures and prevent damage to the existing members, (2) to install removable members for reinforcement that are distinguishable from the original members, and (3) to avoid impact on buried cultural properties.

museums and the Archaeological Research Center, as well as discussion at study meetings. For its creative construction techniques, the university won the Seismic Retrofitting Architectural Excellence Award at the 2018 Seismic Retrofitting Architectural Excellence and Contributor Commendation.

City, Campus and Green Spaces

Professor Masahiro Ohara, who specializes in systematic entomology, and Associate Professor Tetsuya Aikoh, who specializes in landscape architecture and planning, manage the green spaces at Hokkaido University.

They talk about the meaning of and issues with having a campus full of greenery.



Please choose three especially valuable assets of the Hokkaido University Sapporo Campus with lush greenery.

Ohara: One would be the Japanese elm trees that you find beyond the main gate. They are roughly 300 years old. The Sakushukotoni River System and the forest area are also valuable. Another is the grass and farmland. The grassfield is generally not considered important. In the vast farm to the west of the northern campus, however, the grass is a habitat for various creatures including frogs.

Aikoh: I have almost no objection with those choices. If I may add one, it is the people. Lush greenery has been protected and utilized by people for nearly 150 years. As a result, we can study and research in the rich surroundings with greenery and living creatures. We greatly benefit from it, and I think we are happy.

What is the value of greenery? What is the significance of the university maintaining green spaces in the city?

Ohara: As Professor Aikoh said, living amid greenery has significant meaning for people in the university. It has an immeasurable positive effect on our mental health. It is also good for Sapporo residents who jog or walk on the campus. Tokyo has the Imperial Palace and Meiji Shrine, which make Tokyo a city with a high ratio of greenery on flat land. On the other hand, the ratio of greenery in Sapporo is high in hilly areas such as Moiwa and



Masahiro OHARA
Professor, Hokkaido University Museum

After working as a Research Associate at the School of Agriculture at Hokkaido University, he has worked for the Hokkaido University Museum since 2000. He assumed the post of professor and became the vice director in 2011. He is responsible for the management of insect specimens in the museum and their use for research and exhibitions. His specialty is systematic entomology, especially with Histeridae of Coleoptera. In addition to entomology, he gives lectures on museum material preservation and museum practice. He has introduced Saturday citizen seminars, museum volunteers, a parataxonomist training course and the CISE network to the museum, opening the museum to the community.

Tetsuya AIKOH

Associate Professor,
Research Faculty of
Agriculture



From Kagoshima Prefecture. He started working as a Research Associate of the School of Agriculture at Hokkaido University in 1993 and assumed his present post in April 2008. His specialty is landscape architecture and planning, especially the planning and management of recreational areas. He studies the monitoring and management of recreation in protected areas, and the management of natural and city parks in collaboration with the community and residents. He served as the head of Management of Ecological Environment Working Group and is actively involved in Japanese Association of National Park Studies, Mountain toilets in Hokkaido, as well as the development of playgrounds for children.

Maruyama, but it is extremely low on flat land. Windbreaks, Hokkaido University, the Botanic Garden and designed green spaces are the only green areas on flat land. It is difficult to convert mental health to a monetary amount, but if you changed the greenery of the university to concrete, it would wreak considerable damage. The greenery is also very effective in reducing a heat-island effect, while in the event of disaster, forests serve as a buffer to mitigate damage. In that sense, greenery is also essential for cities.

Aikoh: I took a taxi to go from the east of the university to the west quite some time ago. The driver said, "The campus is in our way, so we have to go a long way around. I am sorry." Some people may think the huge campus is an obstacle. However, there are few parks around the university. Block parks, which are the smallest of the parks to be established in cities, are in the residential areas around the campus, but there are no larger parks there. That is why people come to the campus for running and walking. The campus is an asset for neighbors.

Is the greenery utilized for research and education?

Ohara: A faculty member of the School of Agriculture conducts the following research. "Members of aphids add something that look like red fruit (called insect galls) to the leaves of Japanese elm trees. Four or five kinds of insects

Special Feature 01 City, Campus and Green Spaces

compete with other species or among same species on a leaf. The ecology of the aphids varies depending on the time of sprouting of Japanese elm.” The green spaces are important for research on global warming and climate change, although some students just enjoy *jingisukan* barbecue there.

Aikoh: Hokkaido University adopts a notification system for surveys on animals and plants on campus. Approximately 30 applications for conducting a survey are made each year. The campus is an excellent place for research on plants, insects, birds and fish. The School of Agriculture benefits the most. I hear that in other universities, they take students to the suburbs by bus for practice on farms. It takes too much time just going back and forth between the university and the farm. In Hokkaido University, it is just a five-minute walk to an experimental place. In addition to animals and plants, there are also ruins, which make the campus a valuable field for archaeological study.

Do you have any suggestions or requests for the use of green spaces?

Ohara: People recognize various things by seeing. In particular, seeing multiple insects and birds in nature as a child is very educational and essential for growth. This campus allows children to easily do that. A survey shows that there are more than 800 kinds of moths on campus, indicating the forest is rich in biodiversity. It is good to use the campus for educational observation and other events. When a sizeable Japanese elm tree fell in the 2004 typhoon, children climbed and sat on that tree. I was surprised to see that only one tree attracted people and became the focus of so much activity. It might be dangerous for children to climb a standing tree, but personally, I think it may be OK if their parents accompany them.

Aikoh: It is difficult, I can't say that. Considering this is a university campus, we cannot manage it like a park. That is what's bothering me the most. No ground keeper checks the safety, so visitors are required to be responsible for their own safety. We give the utmost consideration to ensure the

safety as the university campus. If someone gets injured by a falling branch, the person may blame the university for leaving the dead branch. However, the university cannot guarantee the safety of neighbors and visitors at the same level as city managed parks. However, I hope that the university is open to neighbors. I hope that people feel close to the campus and use it as a place to earn a variety of knowledge and experience and a place for recreation. I hope people enjoy on the premise that it is a university campus.

Green space management must be a taxing role.

Aikoh: In the past, the cutting of old poplar trees in front of Chuo Cafeteria attracted attention from not only people in the university but also local people, causing controversy. After that, a system to manage trees, including their cutting, was established. The university determines whether to cut trees on campus, but local people are also interested in the greenery of Hokkaido University. We are thankful for people's interest and make decisions carefully though it takes time and effort. Applying for permission is now required to cut tall trees. Management of Ecological Environment WG, to which Professor Ohara and I belong, determines whether to cut trees. We check the site and the reason and determine in team.

Ohara: I haven't suffered much since managing insects are rather economical. However, bark beetle infection occurred in Japanese elm trees in 2017. I was worried that all trees on campus might die down, but most were all right in the following year. Researchers of mushrooms and insects expelled the pests





from the trees with chemical agents based on surveys.

What are the issues and ideal image of Hokkaido University Sapporo Campus?

Ohara: Considering the use of the limited space, we want to preserve the greenery, and to increase buildings and research facilities at the same time. The City of Sapporo may hope to maintain the greenery of Hokkaido University. Then the university cannot build structures. If the City of Sapporo buys green spaces and offers its land for buildings, it becomes possible to preserve the existing green spaces. When considering only on campus, it is inevitable that green spaces will be reduced. If you think of the green spaces as the properties of Sapporo, Hokkaido, or city residents and citizens, you need to make other choices. Natural surroundings the campus has is undoubtedly invaluable considering that there aren't many green spaces left in Sapporo. we will feel regret if we don't protect them. Our predecessors have protected this campus for nearly 150 years, we also hope to inherit it in good condition.

Aikoh: I agree. I like to see happy families having a picnic or kindergarten children playing with nurses. I wonder how long we can maintain this environment, with a sense of crisis. It is necessary to rebuild buildings in line with the development of education and research, but there are places to be protected. It is vital to divide areas to preserve and areas to develop, and to manage individual areas according to the

Campus Master Plan. Nevertheless, this requires manpower and budget. I doubt whether the university can continue to manage the campus alone. It seems to be challenging to maintain it without cooperation with local governments, companies, citizens and tourists.

Are there other issues?

Ohara: Seven or eight years ago, an acquaintance who lives in Soen said, while looking at the farm of Hokkaido University, "I like that environment, but I don't know what they do on the farm." I told a faculty member involved with the farm about this, then a tour of the farm was given to residents. Apart from the forest, people may doubt whether the farm is a research facility. It is a good idea to provide campus tours to residents to gain their understanding towards the campus while maintaining green spaces and biodiversity. Although it is not a Satoyama landscape, this area maintains the way it was as a village. I hope we can cherish not only trees but also the grass and farmland.

Aikoh: I feel the lack of communication both internally and with outside of the university; especially in terms of releasing information and exchanging opinions. We have to hear many opinions and adjust to them. The Hokkaido University Campus has almost the same area as the Imperial Palace does, and it is said to have more insects than the Imperial Palace. Regarding the ecology in Hokkaido University Sapporo Campus, we have intensively surveyed the forest located between the Institute for the Advancement of Higher Education and the Student Center for Extracurricular Activities for the past five to six years. The survey is to be completed this fiscal year. There must be a sizable number of plants, insects and animals, including valuable species. We will promote the results of the survey inside and outside the university and hear opinions on the greenery maintenance / management on campus.

Grazing and Hokudai Marche Café & Labo

Although the scale of dairy farming is expanding, Hokkaido University maintains small-scale dairy farming based on grazing. Some of the milk produced on the farm is sold at Hokudai Marche Café & Labo. In this feature, faculty members involved talk about the significance of having the farm, cowshed and café on campus.



Hokudai Marche Café & Labo

(Operated by Hokkaido Agricultural Village Laboratory Co., Ltd.)

Opened on the first floor of the Hokkaido University Centennial Hall in November 2017. Its concept is “maintenance, honesty, fair pricing and being suitable for the terroir.” It intends to convey the value of produce from Hokkaido and preserve agriculture for the future.

※Hokudai Marche will be closed from September 24, 2019 to March 31, 2020 due to seismic retrofitting.





Tomohiro MITANI

**Assistant Professor
Experiment Farm
Agro-ecosystem Research Station
Field Science Center for
Northern Biosphere**

After graduating from Otani High School in Kyoto, he studied at Hokkaido University/graduate school. He worked as a researcher at the National Agriculture and Food Research Organization and then assumed a post at Hokkaido University in April 2007. After serving as a specially appointed assistant professor at the Creative Research Institution and at the Research Faculty of Agriculture, he assumed his present post in February 2015. Based on the cycle of soil-grass-livestock as the original form of dairy farming, he conducts research aimed at sustainable and efficient dairy production in Hokkaido. He conducts research across Hokkaido. Having close relationships with various organizations and farmers, he aims at dairy farming harmonized with terroir in each region.

Please tell me why you got involved in the launch of Hokudai Marche Café & Labo.

Mitani: The farm of Hokkaido University is in a tough management situation. We thought about how we could sell milk at a high price and then started Hokudai Marche Café & Labo. We also hope to convey the value of milk produced in Hokkaido University and let people know the existence of the farm in Hokkaido University.

Is it good to promote the existence of the farm in Hokkaido University?

Mitani: While traveling in Hokkaido to talk with farmers, I feel today's dairy farming may head in an undesirable direction. Most farmers seem to think that they should expand the scale of their operations, raise as many as 400 cows and hire employees. I think it's all right for some farmers to grow about 50 cows. Hokkaido University's farm will be a place that proves you can do farming on such a small scale. The cowshed used to be at Kita 19-jo

but moved to the present place more than 10 years ago. There was a plan to develop the northern campus into a research park, and I was worried that the farm might be pushed out of the campus. I recognized the need to promote the farm.

What kinds of problems are there with large-scale farming?

Mitani: There will be no people in the area. One large-scale management unit will raise many cows, but there will no people nor schools. The community may collapse. Accordingly, I would like to show that even small-scale management units can survive. With 1,000 cows, the management unit can enjoy large sales of milk. Even if it achieves sales of 400 million yen, earnings will be only 40 million yen with a profit margin of 10%. Farmers who raise about 40 cows with self-supplied feed are expected to have sales of approximately 30 million yen, but some may make a profit of more than 15 million yen. Which is more efficient? The latter is better from the perspective of dairy farmers. I hope small-scale management units will be able to survive.

What is the significance of having a cowshed on the campus of Hokkaido University?

Mitani: Firstly, this is an educational facility and research facility. The School of Agriculture is on the Sapporo Campus. It is highly significant that they can practice and research nearby the campus. There are almost no dairy farmers who put cows to graze in Sapporo. I think, however, we should preserve the scenery of cows on the grass at the center of the city.



CAFÉ

Hamburger, curry, gratin and other hot dishes, as well as pudding, parfait and various other sweets are sold here.



SHOP

In addition to Hokkaido University milk, canelé and Baumkuchen that are made using the milk, plus soft-serve ice cream made with Okoppe milk, are sold here.

Please give us an example of research on the farm.

Mitani: The dominant view is that to increase milk production per cow you should feed cows more grain. In Hokkaido University, however, our research focuses on grazing during summer and feed self-supplied grass as much as possible. Every time I presented this method at an academic conference, most people used to say, “You are still on that?” These days, however, some people say, “That is also necessary.” I will continue to study grazing. Almost no grain for livestock is produced in Hokkaido, and we import 100% of our grain. Half of that comes from the United States. We should remember this.

What is the main characteristic of Hokkaido University milk?

Mitani: Its flavor changes with the season. Major distributors hate that the flavor and constituents change, but it is natural that the flavor of milk produced in grazing changes. Milk is a farm product, so its seasonal change is natural. Promoting this fact as a value may be a strategy. From a different perspective, you can evaluate the milk produced based on self-supplied feed as a higher-quality product. How we should see and convey the quality of milk in the future is one of my research themes.

What do you think of the future challenges of Hokudai Marche Café & Labo?

Mitani: The word “Labo” in the name means “social experiment” rather than “laboratory.” I hope that visitors will learn something there, and then want to take a tour of Hokkaido University. Speaking of the menu, Hokkaido University raises shorthorn beef cattle at its farm in Shizunai. We’d like to add dishes made using the beef to the menu in the future. We are particular about ingredients and use organic vegetables. This fact is not so well-known. We have an issue with the dissemination of information. Hokudai Marche sells various things related to Hokkaido University, allowing visitors to enjoy eating, shopping and seeing. We will add new items to the menu and provide information to make it a more interesting place.

● Research on the utilization of grass that humans cannot eat

At Sapporo Agricultural College, they considered how to utilize grass that humans cannot use directly and researched under the concept of agriculture centered on livestock farming facilities. So, their research focused on livestock production based on grass and how to milk. However, Japanese dairy and livestock farming drastically changed in the 1970s. Concentrated feed imported from the United States, so-called grain, boosted the milk yield per cow. The milk yield, which had been 6,000 kg per 300 days at most, jumped to 10,000 kg. In those days, Hokkaido University produced 5,000 to 6,000 kg of milk and raised about 50 cows. People repeatedly said, “It’s not modern dairy farming.”

For a while now, we have focused on grazing during summer, both in terms of experimental work and feeding management. However, just letting cows loose doesn’t mean they feed on grass. The nutritional value of plants varies depending on the growth stage, so it is necessary to maintain grass at heights of 7 to 15 cm. This requires us to let cows graze rather than us mowing the grass. You need skill to let 30 cows loose in a specific area and maintain sufficient grass at such heights. Based on ample experience of 30 years, today’s young Hokkaido University researchers do it well.

● Hokudai Marche sells milk produced through grazing

After we started grazing, our idea about the milk yield changed. We had pursued the amount per cow, but we thought, “Milk is an agricultural product, so it may be better to increase the milk yield per hectare.” We worked based on this idea for 10 years and produced 10 tons of milk per hectare on the farm of Hokkaido University. This figure is among the world’s top level. I think they could not produce 7 tons per hectare even in To-

kachi and Konsen at that time. It is difficult to achieve a high yield per hectare because of deductions for concentrated feed. Cows at pasture are often seen in commercials. In Japan, however, concentrated feed accounts for approximately 45% of the total feed used, and grass accounts for roughly 55%. Only Hokkaido University and some diligent farmers feed 100% grass at this time. This is something we should be proud of.



We sell milk at Hokudai Marche to appeal to consumers who seek milk produced using 100% grass. Some people may disapprove of this, but I want people to know that there is a space where cows are put to grass in the center of Sapporo and that Hokkaido University utilizes the space for research and education.

● Significance of having green spaces and cows on campus

To raise milk cows on grass, one hectare of grassland per cow is necessary. A grassland area of 10 hectares is essential to raise 10 cows. Hokkaido University once raised 70 to 80 milk cows but now raises roughly 30 cows. The reason behind the decrease in cows is the construction of new buildings in line with the development of the university in quality and quantity. The grass is just an open space from the perspective of people in other fields. This is a big problem. "There is an open space. We want to build a structure there." I have often heard such a request over the last 40 years. Some people may doubt the necessity of a farm on campus. However, the advantage of having this much grass and cows on campus as experimental facility is immeasurable. I want to maintain the farm at any cost.

In New York and London, people have voiced a theory that large cities should have various spaces, including farming spaces. The city has a campus at its center, where there are grazing cattle, orchards and rice paddies. I personally think that is good.

Dairy farming of Hokkaido University, which has continued unique research

Seiji KONDO

Specially Appointed Professor,
Research Faculty of Agriculture

Born in Kyoto. 1975: Graduated from the Department of Animal Science, School of Agriculture, Hokkaido University; 1977: Completed the Master-degree Program, Graduate School of Agriculture, Hokkaido University; 1986: Doctor of Agriculture (Hokkaido University); 1977: Assistant Professor, Rakuno Gakuen University; 1983: Assistant Professor, School of Agriculture, Hokkaido University; 1988: Associate Professor, School of Agriculture, Hokkaido University; 2002: Professor, Research Faculty of Agriculture, Hokkaido University; 2014: Retired, Specially Appointed Professor, Professor Emeritus, Hokkaido University.
His books: Shitteokitali Nyugyu no Kodogaku (lit. Behavioristics of Milk Cows You Should Know, 2005), Tochishigen wo Saidaigenniikasu, Dai 4-sho, Junkangatarakuno wo Kositetorimodosu "Junkangatarakuno heno Apurochi" (lit. Making the Most Use of Land Resources, Chapter 4. This is How Circular Dairy Farming is Recovered - "Approach to Circular Dairy Farming" 2010).
Responsible for arrangement and commentary for the Second Farm, which is opened to the public.



■ Highlights of Cutting-edge Research

Transistor current amplification without a power supply



Yasuo TAKAHASHI

Professor (at that time)
Graduate School of Information
Science and Technology

Technical advancement in the performance of computers depends on increasing the transistor current with very little electricity. With researchers of Shizuoka University, Professor Yasuo TAKAHASHI and his research group have successfully amplified the current without a power supply by applying the principle of an aspirator (tee) ejecting water and air from a nozzle under high pressure. They showed that a new electron flow can be produced from energy that is usually consumed as heat and that it is possible to suppress heat generation from current amplification. This experiment was conducted under a low temperature of 8K (-265.15°C). If this technology is put into practical use after a proving test at room temperature, power saving and the acceleration of computers will be possible.

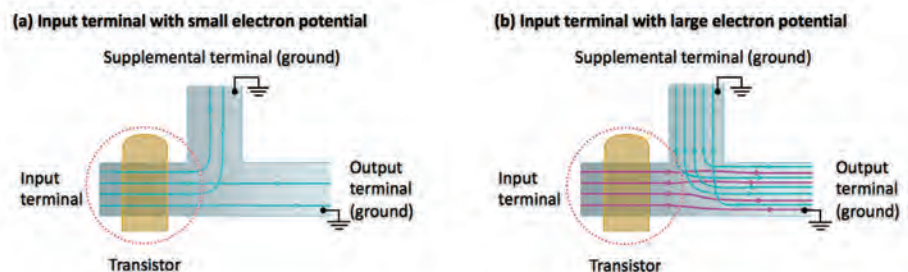
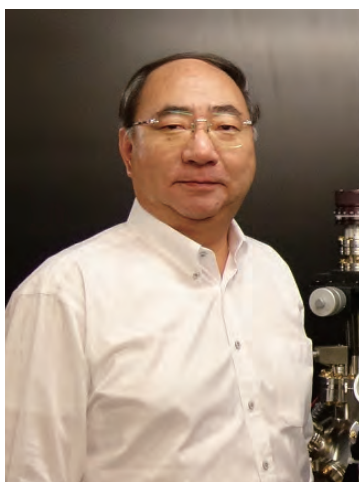


Fig. 1 Electron flow for (a) input terminal with small electron potential and (b) input terminal with large electron potential. Arrows denote direction of electron flow.

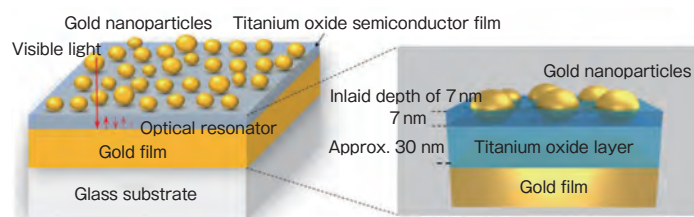
Development of an ultrathin 30-nanometer photoelectrode that is 10 times more efficient than the conventional one



Hiroaki MISAWA

Professor
Research Institute for
Electronic Science

There is a global need for the development of technologies to efficiently harvest and transform incident visible sunlight into other forms of energy such as chemical fuels and electrical power. Professor Hiroaki MISAWA and his group have applied photon-management concepts to successfully develop a photoelectrode that efficiently confines visible light into a space of 30 nanometers in thickness. They demonstrated that a titanium oxide semiconductor film sandwiched between gold nanoparticles and a gold film can absorb more than 85% of all visible light due to this strong optical confinement. This ultrathin photoelectrode can convert optical energy to chemical energy with more than 10 times the efficiency of conventional photoelectrodes. This effective use of renewable energy with an extremely small amount of material is expected to make a significant contribution to the realization of a sustainable society.



Rough sketch of gold nanoparticles/titanium oxide/gold film substrate (light is confined in the transparent titanium oxide layer) *Source: *Nature Nanotechnology*

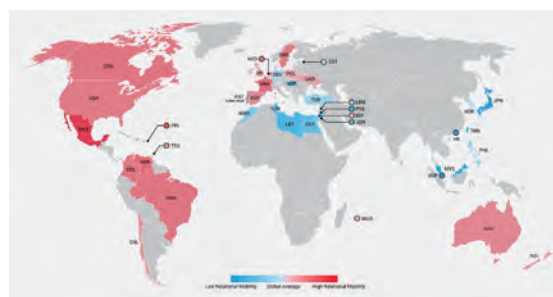
Finding that a harsh environment and the means of food production influence the freedom of personal relationships



Masaki YUKI

Professor
Faculty of Humanities and Human Sciences /
Center for Experimental Research in Social Sciences

Professor Masaki YUKI and collaborators from 18 countries have conducted a psychology survey of 16,939 people in 39 countries/regions around the world and drawn the following conclusion: (1) Relational mobility is high in the North American and European countries, Oceania, Central and South America, while it is low in Asia and the Middle East. (2) People in societies with high relational mobility voluntarily help other people and are more actively involved in interpersonal relations. (3) Regions with harsh natural/social surroundings and that employ a food production system requiring mutual cooperation, such as rice cultivation, tend to have lower relational mobility. The results of the research will serve as a useful reference for education and business in contemporary societies with mobile interpersonal relations.



Countries and regions in red reported higher levels of relational mobility, while those in blue reported lower levels. (Thomson R. et al., *Proceedings of the National Academy of Sciences of the United States of America*, June 25, 2018)

Discovery of an ice pump supporting the ecosystem of a fiord

Shin SUGIYAMA

Professor
Institute of Low Temperature Science

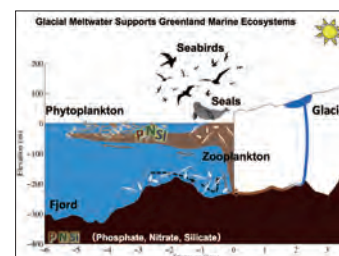
Naoya KANNA

Doctoral research fellow
Arctic Research Center

A joint research group of the Arctic Research Center, the Institute of Low Temperature Science and the Faculty of Fisheries Sciences at Hokkaido University has found that upwellings (plumes) from glacial meltwater in Greenland function as a pump to lift out nutrient salt from the medium layer (200 m in depth) of a fiord. They also showed that nutrient salt delivered to the surface spread horizontally in the subsurface (10 – 50 cm in depth) and caused the growth of phytoplankton just above the plumes. Previous research has proved the role of meltwater in basic production (organic production through photosynthesis) in this fiord. In the future, it will be important to comprehensively understand how the ecosystem created meltwater.



Sampling of glacial meltwater



Numerous creatures gather in the sea in front of a glacier

Success in the direct observation of organic matter that moves from seawater to the air by sea spray



Yuzo MIYAZAKI

Assistant Professor
Institute of Low Temperature Science

Fine particles (aerosol) in the air scatter/absorb sunlight and affect the climate, including the amount of clouds and the precipitation process. Almost no information was previously available about how organic matter included in aerosol at rates of up to 80 to 90% is affected by the surface of the ocean. Using a research vessel in the North Pacific Ocean in the west of the subarctic zone, the research group has succeeded in the direct observation of microbially derived organic matter that moves from seawater to the air by sea spray. Comparing the air and surface seawater, they have found there is a great deal of humified organic matter that is resistant to biological degradation in ambient aerosol. Expectations are placed on the clarification of the impact of marine microorganisms on climate change through the air.



North Pacific Ocean in the western subarctic seen from the Hakuohmaru academic research vessel

Clarification of the fact that the river branching structure supports the survival of groups of organisms



Akira TERUI

Researcher (at that time)
Research Faculty of Agriculture

One of the missions of today's ecologists is to clarify the mechanism of how groups of organisms survive environmental changes and contribute to sustainable fishery and forestry and the conservation of biodiversity. With researchers of the University of Minnesota, Akira TERUI and other researchers have clarified that the complexity of the branching structure (ecosystem form) of river networks with numerous tributaries contributes to the stable maintenance of groups of organisms. The spatial size of the ecosystem used to be considered the key. This study showed the complexity of a river ecosystem's form is the key factor supporting the long-term sustainability of groups of organisms based on a mathematical model and the analysis of long-term monitoring data.



Nobuo ISHIYAMA

Research fellow (at that time)
Research Faculty of Agriculture



Sustainability Education

Hokkaido University Eco Campus

As general education seminars for first-year students at Hokkaido University (freshman seminars), two subjects on the eco-campus were provided in FY 2018.

Subject name	Nature of the Hokkaido University Eco Campus - Introduction to Botany	Nature and History of the Hokkaido University Eco Campus
Schedule	April 12 - August 2 (5th period on Thursdays)	April 13 - August 3 (5th period on Fridays)
Objectives	<ul style="list-style-type: none"> ○ To feel the beauty of the Hokkaido University Campus, nurture a school spirit and master field-ism (hands-on approach, activism) that the university has nurtured through the observation and surveying of plants and ecology ○ To gain direction for future specialty through small-group seminars with students who are interested in diverse fields 	<ul style="list-style-type: none"> ○ To obtain comprehensive knowledge on the nature and history of Hokkaido University and its campus through seminars including the outdoor observation and survey of plants, insects, ruins and architecture on the Sapporo Campus and in related facilities ○ To raise awareness as Hokkaido University students, nurture a school spirit and set direction for future studies by experiencing the "guiding spirits" of Hokkaido University, the biodiversity of nature on campus and the weight of history

Nature of the Hokkaido University Eco Campus - Introduction of Botany

Shiro TSUYUZAKI (Professor, Faculty of Environmental Earth Science) [On-campus Plant Seminars 1, 2 & 3]

Land plants are the foundation supporting all creatures. These days, they are expected to reduce global warming. Is it OK to expect that from plants? We will measure how much carbon dioxide trees absorb based on the size of the trees. After germinating, plants do not move. They must adapt themselves to the environment of the place they have germinated for survival. Plants that cannot adapt themselves to the environment will disappear. What kinds of plants are seen in what type of environment? We will experience this using the quadrat method.



Nature and History of the Hokkaido University Eco Campus

Masaki EDA (Associate Professor, Hokkaido University Museum)

[Observation of the Ruins and Environment in the Midstream of the Sakushukotoni River]

[History of the Use of the Hokkaido University Campus Seen from an Archaeological Perspective]

First session: After learning that almost the whole campus is designated as a site where cultural properties are buried (ruins) and that Hokkaido developed a unique culture that is different from that of Honshu (the main island of Japan) after the Jomon period, we walked around the ruins on campus along the Sakushukotoni River.

Second session: We visited the excavation site at the K39 Site/Research Building (mechanical engineering) under investigation at that time, and then learned about the history of the use of the Hokkaido University Campus (first half) at a lecture room.

Third session: We visited the Archaeological Research Center at Hokkaido University, and then learned about the history of the use of the Hokkaido University Campus (latter half) at a lecture room.



Response to Disasters

[1] Typhoon Jebi

A record storm occurred predominantly in the Kinki region on September 5 (Wed.), 2018, also causing tremendous damage in Hokkaido. Hokkaido University suffered damage to its buildings in Sapporo and Hakodate, and the amount of damage totaled more than 80 million yen.

■ Damage situation



School of Agriculture



Front of Chuo Cafeteria



Botanic Garden

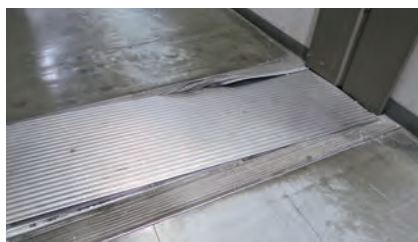
[2] Hokkaido Eastern Iburi Earthquake

A strong earthquake occurred in a widespread area of central Hokkaido at 3:07 a.m. on September 6 (Thu.), 2018. The earthquake measured an intensity of upper 5 in Kita-ku, Sapporo, where the Sapporo Campus is located, and 4 in Hakodate, where the Hakodate Campus is located. Hokkaido University suffered substantial damage, including 95 buildings in Sapporo, and the amount of damage totaled more than 3.3 billion yen.

■ Damage situation



Food Processing Plant of the Model Barn (distorted masonry chimney)



School of Engineering Material Chemistry Research Building (broken hardware)



Shelter on campus (gymnasium No. 2, September 6)

■ Response to damage

Since the scale of the earthquake on the campuses and in regional facilities was upper 5 or lower, a crisis control headquarters was not established based on Hokkaido University's Disaster Management Guidelines. Under the direction of the person responsible for risk management, the safety of students and faculty was confirmed, and the damage situation was checked. An ad hoc Deans and Directors Sync Up Meeting and an administrative staff liaison meeting were held to share information across the university.

Academic affairs	<ul style="list-style-type: none"> ·The safety of students was confirmed quickly by phone or e-mail. ·Some undergraduate classes were canceled.
Evacuated students	<ul style="list-style-type: none"> ·A shelter was established at gymnasium No. 2. (540 users, of which the number of international students was 293 and the number of other people was 84)
Facilities	<ul style="list-style-type: none"> ·Power went out at the whole university on September 6. The power supply was re-established at the hospital and other priority areas by the evening of the same day. ·Power was restored at the whole university on the morning of September 10. ·Notification of power saving was given to all departments at the request of the Ministry of Education, Culture, Sports, Science and Technology, the Ministry of Economy, Trade and Industry, and Hokkaido Electric Power Company (power saving of 20% in the beginning, 10% power saving on September 18 and 19) ◎The Sustainable Campus Promotion Division of the Facilities Department notified all departments of <i>Efforts for Power Saving "Power Saving Follow-up," Energy Saving Handbook 2018 (limited to the campus) Power Monitoring System (limited to the campus)</i>.
Information infrastructure	<ul style="list-style-type: none"> ·After the power outage, outbound communication was handled using an in-house power generator. Communication was restored on the morning of September 7. ·All servers, including that for the website, were down. They were restored in the afternoon of September 10.

Movements toward the Creation of a Sustainable Campus

Assessment of Hokkaido University in FY 2018 using the ASSC

Compared with the assessment in FY 2017, the score decreased in the Education and Research field because the percentage of subjects dedicated to or related to sustainability declined slightly. In the Environment field, the score increased because the ecological survey of the Hakodate Campus was completed, and because the change of the power supplier on the Sapporo Campus reduced carbon dioxide emissions. In the Local Community field, the university was awarded a score for the first in the area of the role of the university after a disaster because of the revision

of the Disaster Management Guidelines and the formulation of the Hokkaido University Crisis Management and Business Continuation Manual to maintain the university function after a disaster. The overall score rate was 78.7% thanks to the score increase in the Environment and Local Community fields. As was the case for the assessment in FY 2016, Hokkaido University was awarded gold certification for the assessment in FY 2017 from the Campus Sustainability Network in JAPAN (CAS-Net JAPAN).

Fig. 1 Score percentages of Hokkaido University in four fields

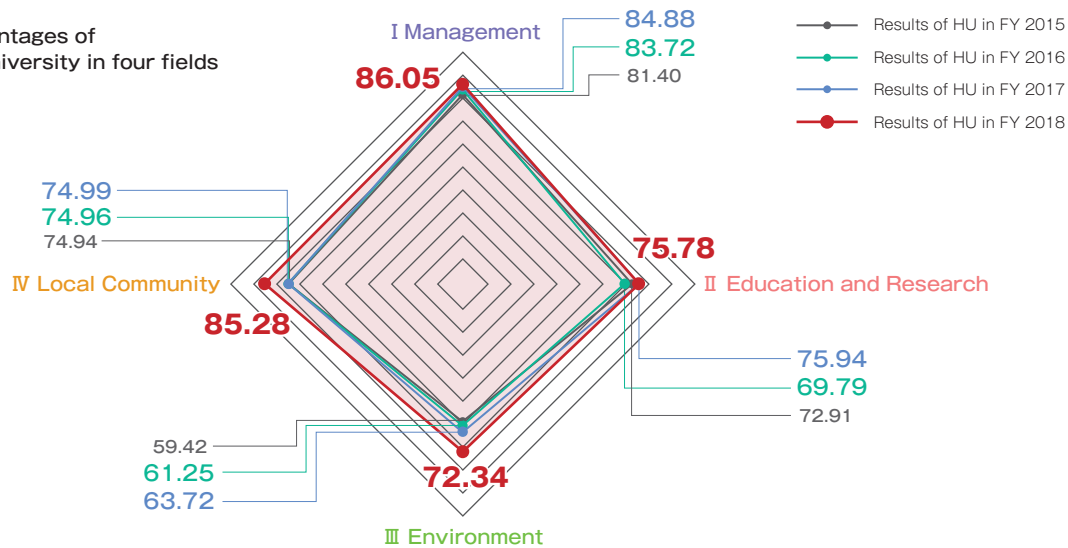
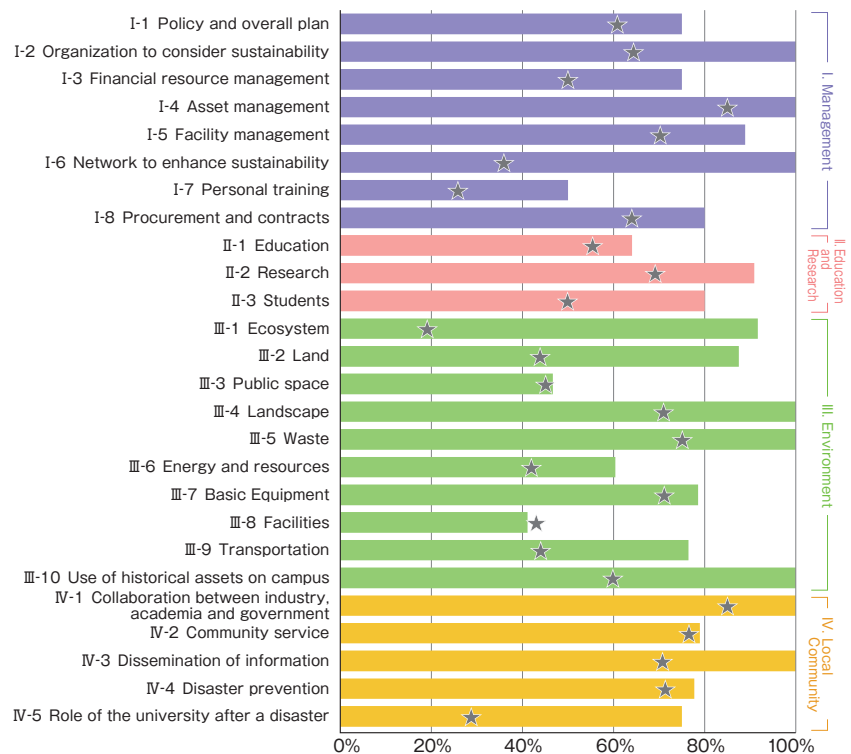


Fig. 2 Score percentages of Hokkaido University by assessment area

Bar graph indicating the results of HU in FY 2018
★ : Other 19 national universities' average



The Assessment System for Sustainable Campus (ASSC), which was developed by Hokkaido University in 2013, is an evaluation tool in the questionnaire style that allows users to check the aptitudes necessary for the realization of campus sustainability based on evaluation criteria. It helps universities that conduct assessment to make decisions on the management and set targets.

■ Sustainable Laboratories: Debriefing Session for Energy/Resource Saving Measures Dedicated to Experiment Facilities

■ October 31, 2018 ■ Main conference room, Centennial Hall 1F ■ Organizer: Sustainable Campus Management Office

Hokkaido University has worked on energy/resource saving for quite a while, but experimental facilities at the center of research activities were difficult to address. We invited Mr. Martin Farley, who pursues

energy/resource saving dedicated to experimental laboratories, to give a talk about what should be done to make laboratories more sustainable at Hokkaido University.

Outline of projects in the U.K. and a proposal for energy/resource saving

Mr. Martin Farley

Director of Green Lab Associates
Sustainable Laboratory Advisor of University College London

PROFILE

Martin was UK's first full-time sustainable laboratory specialist, having started at the University of Edinburgh. Today he consults for a variety of laboratories including University College London (UCL) to make science and research more sustainable. One of the projects running at the University of Edinburgh is to examine the set temperature and storage period of ultracold freezers and the state of the preservation of samples. He developed and manages the Laboratory Efficient Assessment Framework (LEAF) at UCL, a new standard in sustainable science.

Today, there is an international organization for sustainable labs, and research to improve the efficiency of labs is conducted all over the world. What should be done to improve their efficiency? I will show you some projects to highlight useful efficiency measures. At one lab, they introduced new waste boxes and posters and separately collect waste for cost saving. At another lab, they had mugs made with each researcher's photo on, so that they will not throw away cups every time they drink coffee. You can reduce the use of plastic by purchasing versatile experiment kits. At the laboratories of Hokkaido University, numerous glass products are used. It is very good.

Regarding equipment management, use a reservation system to increase the utilization rate, and prepare a digital timer. These are simple measures but reduce energy consumption and extend the life of equipment. It is important to use less-toxic chemicals. The American Chemical Society has prepared a guide on eco-friendly chemicals. You can also utilize this. It is important to think about the size and temperature setting of a freezer, but before that, consider the size of samples. The easiest way is to reduce the size. Consider distinguishable labels so that anyone can use them. If there are samples that can be used, share



them to help everyone save time and cost.

Another idea is a participation program with gold, silver and bronze awards. Researchers of multiple universities visit and evaluate labs with each other, and awards are given to those who have made bigger improvements. Programs we have begun in a test base are implemented in the entire U.K. We'd like to welcome the participation of Hokkaido University. I have visited two laboratories at Hokkaido University. I think both laboratories are efficiently operated. If I may, I'd like to suggest the tracking of chemicals. All users of the labs will be able to figure out the stock status of materials and save space. The collection method of waste seems to vary depending on the lab. I recommend that waste collection should be conducted consistently. The suggestion beyond labs is that initiatives should be supported by head office. The entire university should be involved in the management of waste and the introduction of new equipment, which helps the university in energy/resource/cost saving. Also, if you see good practice in another lab, it is important to tell others. Easy and low-cost solutions lead to sustainability and have great significance from the science and research perspective. Thank you very much for your attention today.

■ Efforts for Energy Saving and Environmental Load Reduction

Validation of energy saving at Hokkaido University (report published in March 2019)

● **Details of validation:** Ventilating installation (total heat exchanging ventilator) and heating installation (GHP: gas heat pump air conditioner) in existing facilities were used to measure the difference in heating energy consumption between different ventilation operation modes during winter and examine the effect of energy saving.

● **Place of validation:** Mid-Campus Open Laboratory No. 2

● **Period of measurement:** February 1 (Fri.) – 8 (Fri.), 2019

[Validation results (outline)]

1 Ventilation operation when the room is used:

Gas consumption when the total heat exchanging ventilator is on weak mode is approximately 9% less than on strong mode. However, the room temperature near the floor becomes lower.

2 **Ventilation operation when the room is not used:** GHP gas consumption on the day after the total heat exchanging ventilator is turned off (down overnight: 17:00 – 8:30 on the next morning) is approximately 11% less than when it is operated on strong mode. Gas consumption when the ventilator is stopped on the weekend (17:00 on Friday – 8:30 on Monday) is approximately 16% less.

3 **Recommended ventilation operation:** The ventilator should be set on weak mode when the room is used and should be turned off during the night and holidays when the room is not used. However, ample attention should be paid to ensure sufficient ventilation.



Mid-Campus Open Laboratory No. 2

Waste separation pilot project

■ **Places:** in front of the office and the library of Faculty of Pharmaceutical Sciences.

■ **Period:** February 26 – March 6, 2019

The installation of waste boxes was classified into the following five patterns for waste composition analysis.

① Existing boxes for three types of waste (combustibles, RDF, glass bottles/cans/PET bottles)

② Existing boxes for three types of waste + additional cardboard box for recyclable waste paper

③ Change from existing boxes for three types of waste to mesh boxes

④ Change from existing boxes for three types of waste to mesh boxes + additional mesh box for wastepaper

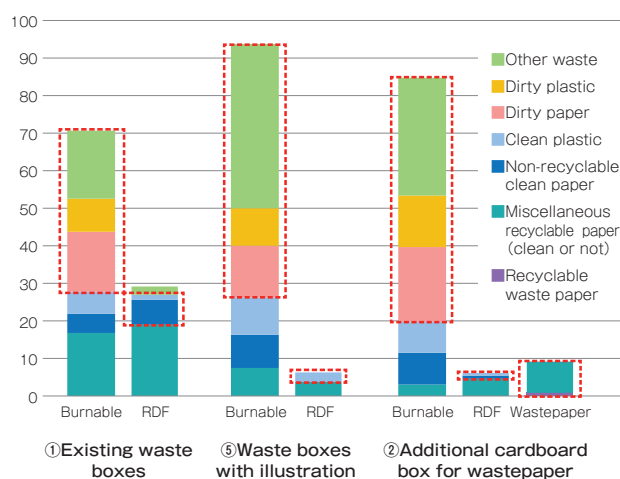
⑤ Existing boxes for three types of waste; an A-4 sheet with illustration and guidelines is put on boxes for combustibles and RDF



Pattern⑤

[Composition analysis results]

(in front of the office)



Note: The part enclosed by a red dashed line is appropriately separated waste. The total volume of waste is set to 100 in each pattern.

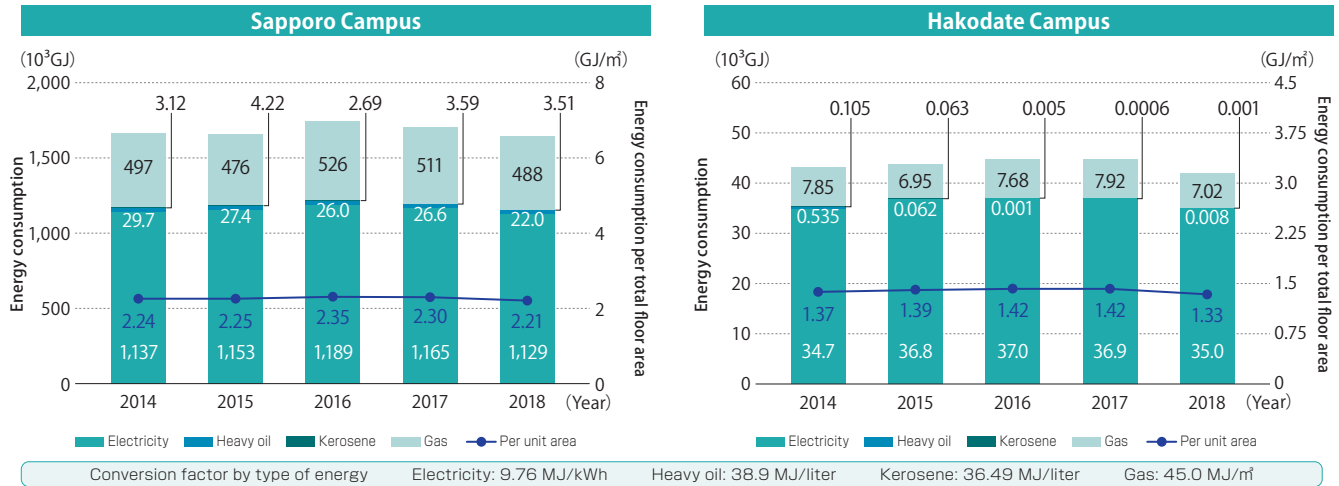
In the future, we will consider (1) the creation of pop-type illustration guideline tools and (2) installation of boxes for waste paper as university-wide policies.

Movements toward the Creation of a Sustainable Campus

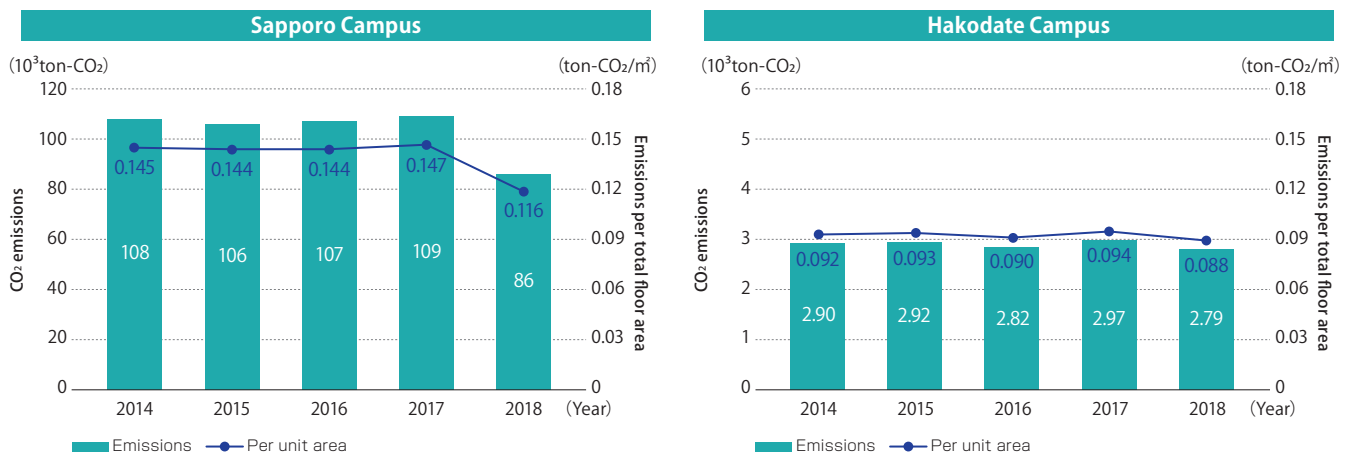
Changes in Environmental Data



Primary energy consumption



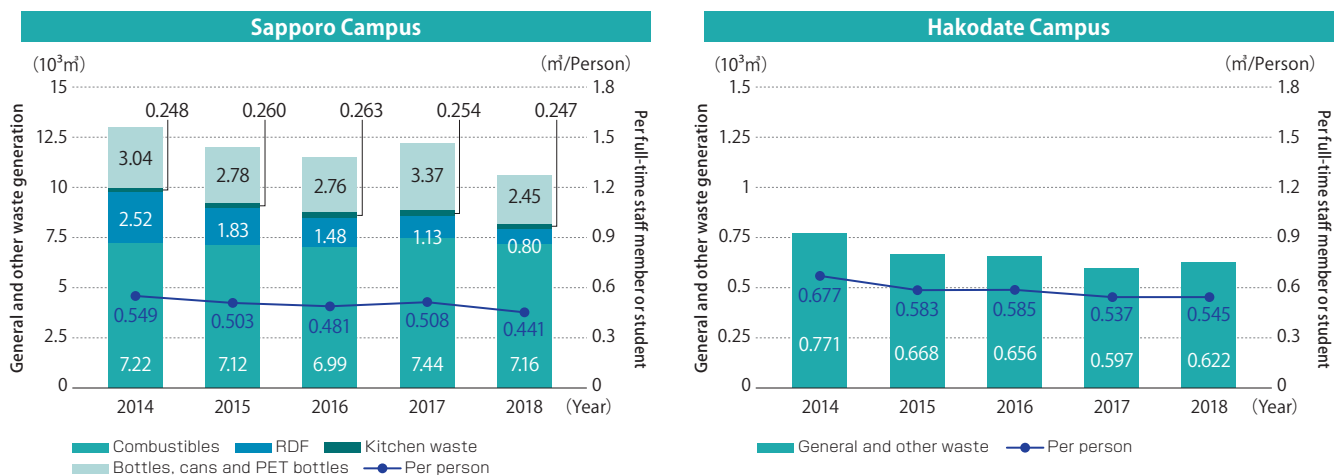
Greenhouse Gas Emissions



Note: The adjusted electricity-derived CO₂ emission factor [kg-CO₂/kWh] used for calculation was 0.688 in FY 2014, 0.676 in FY 2015, 0.640 in FY 2016 and 0.678 in FY 2017. Since the value in FY 2018 has not yet been revealed, the value in FY 2017 was used for FY 2018 (i.e., 0.511 (new power company) at the Sapporo Campus and 0.678 at the Hakodate Campus).



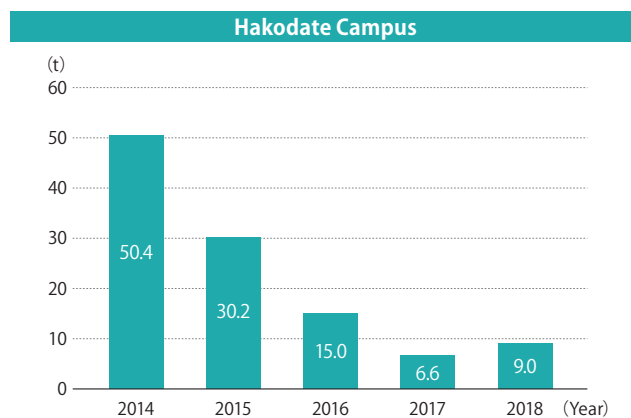
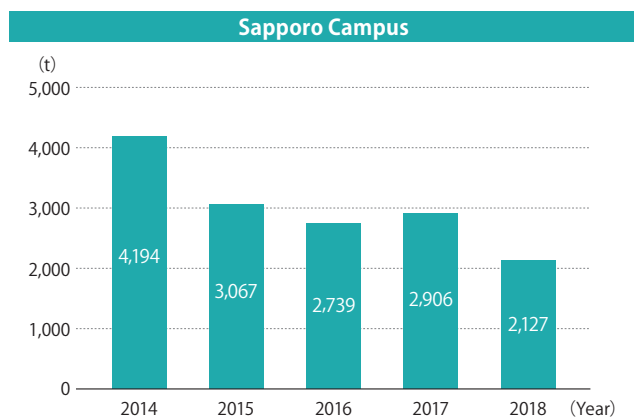
General and Other Waste Generation



Note 1: "Kitchen waste" refers only to that generated by the university hospital's food preparation facilities.
 Note 2: Per capita generation figures include temporary staff.



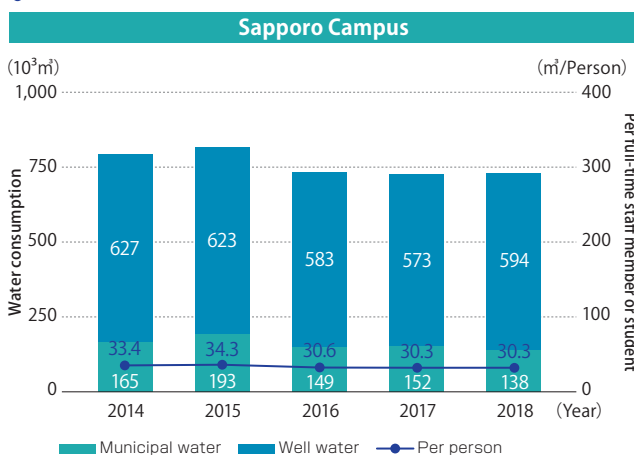
Industrial Waste Generation



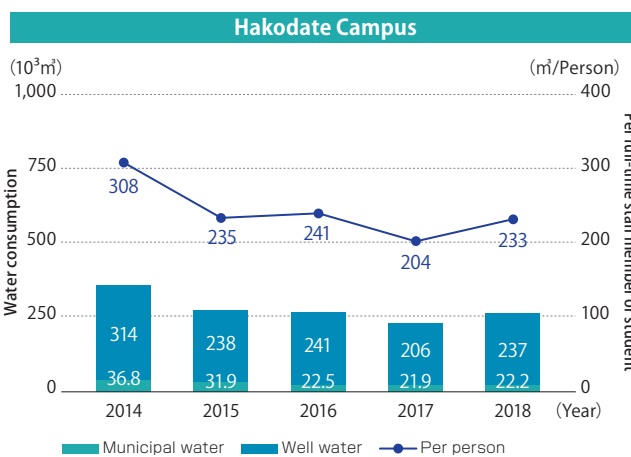
Note: The figures for the Sapporo Campus exclude waste disposed by individual faculties (e.g., electrical appliances). The figures for the Hakodate Campus include discarded electrical appliances, but exclude plastic waste and mixed waste, which are measured per cubic meter, and infectious waste, which is measured per liter.



Water Consumption



Note: Per capita consumption figures include temporary staff



Material Balance (FY 2018) *Sapporo = Sapporo Campus, Hakodate = Hakodate Campus

Input

- Primary energy**
 - Electricity **1,163,987GJ** ([Sapporo] 1,129,015GJ+ [Hakodate] 34,972GJ)
 - Heavy oil **21,979GJ** ([Sapporo] 21,971GJ+[Hakodate] 8GJ)
 - Kerosene **3,513GJ** ([Sapporo] 3,512GJ+[Hakodate] 1GJ)
 - Gas **494,937GJ** ([Sapporo] 487,916GJ+[Hakodate] 7,021GJ)
- Office supplies**
 - Paper **224 t** ([Sapporo]+[Hakodate])
 - "Green purchase" items **157 items** ([Sapporo]+[Hakodate])
- Amounts of chemicals handled**
 - Chemicals controlled under the PRTR [Sapporo] **41,656kg** ※None in Hakodate notifications
- Water**
 - Municipal water **159,799m³** ([Sapporo] 137,612m³+ [Hakodate] 22,187m³)
 - Well water **831,458m³** ([Sapporo] 593,982m³+ [Hakodate] 237,476m³)

Output

- Greenhouse gas**
 - Carbon dioxide **88,531t-CO₂** ([Sapporo] 85,744t-CO₂+ [Hakodate] 2,787t-CO₂)
*Since the carbon dioxide emission factor of electricity in FY 2018 has not yet been revealed, the value for FY 2017 was used. Sapporo Campus: 0.511 kg-CO₂/kWh; Hakodate Campus: 0.678 kg-CO₂/kWh
- Waste**
 - Non-industrial waste **11,272m³** ([Sapporo] 10,650m³+ [Hakodate] 622m³)
[Sapporo]: combustibles 7,159m³/ RDF 799m³/ Kitchen waste 247m³/ bottles, cans and PET bottles 2,445m³
 - Waste paper **574t** ([Sapporo] 565t+[Hakodate] 9.0t)
 - Industrial waste **1,830t** ([Sapporo] 1,821t+[Hakodate] 9.0t) (other than infectious waste)
 - Infectious waste [Sapporo] **306t** + [Hakodate] **90ℓ**
- Liquid waste from experimental facilities**
 - Inorganic liquid waste **17,908ℓ** ([Sapporo] 17,238ℓ+ [Hakodate] 670ℓ)
 - Organic liquid waste **114,784ℓ** ([Sapporo] 110,793ℓ+ [Hakodate] 3,991ℓ)



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Sustainability Report Compilation

Editorial policy

This Sustainability Report was compiled in line with the Law Concerning the Promotion of Business Activities with Environmental Consideration by Specified Corporation, etc., by Facilitating Access to Environmental Information, and Other Measures (also known as the Environmental Consideration Act) with reference to the Japanese Ministry of the Environment's Environmental Report Guidelines 2018.

Organizations involved

Hokkaido University
Sapporo Campus (incl. contracted commercial operators on campus)
Hakodate Campus

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April 2018 - March 2019

Field

Environment

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 <https://www.osc.hokudai.ac.jp/>



Printed with environmentally friendly vegetable oil ink.