FOOD FOR THE FUTURE IN A DEGRADING BIOSPHERE

WORKING TO FEED THE WORLD HEALTHY, SUSTAINABLE FOOD, now and in the future, will be a mammoth undertaking. At a recent Nature Café, experts gathered to learn from each other the methods being tested to achieve this important goal.

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According to the United Nations, almost 690 million people worldwide are hungry. The UN has a Sustainable Development Goal to eliminate hunger by 2030, but instead, the trajectory is for the number of people affected by hunger to surpass 840 million by that date. The resilience of global food systems is being put under additional pressure by a number of different crises, including the global COVID-19 pandemic, a locust plague in east Africa and the deteriorating biosphere — land, water and air.

"We need to move on from 'why' to 'how' to take action," says Atsufumi Yokoi, vice president of Okayama University and UNESCO chairholder in Research and Education for Sustainable Development. "We need to meet the needs of the present population while safeguarding the Earth."

On 12 November 2020, Hayashibara sponsored the Nature Café on Environmental Stress and Food Crisis to meet virtually to discuss a complex question: how to grow enough food to meet global demands.

HEALTH CHALLENGES

There are three important challenges to human and planetary health: feeding a growing and increasingly affluent population; reducing environmental impact; and adapting to a changing climate.

Global food systems need to produce enough food, animal feed, and biomaterials for 8 billion people today and projected to reach 10 billion by 2050.

"Global food systems are part of at least 12 of the 17 the UN Sustainable Development Goals," said Alexander Mathys, a professor in ETH Zurich's Sustainable Food Processing group at the Nature Café.

He said food production currently has a huge environmental impact. Agriculture is one of the largest global sources of particulate emissions, and is driving biodiversity loss and climate change. In turn, climate change will affect what crops can be grown in different parts of the world.

"To deal with the food gap, we need to reduce demand and increase production without expanding land use," said Nathan Mueller, from the Department of Soil and Crop Sciences, Colorado State University.

Geospatial sciences are providing exciting new tools to help researchers understand and address these challenges, using data from a number of sources, including remote sensing; census and survey data; in situ monitoring; and gridded and modified datasets.

Geospatial data analyses can track global crop yields, point out where there are gaps between potential and actual yields and map environmentally important variables, such as nutrient excesses or deficits, fertilizer use, greenhouse gas production, or where agricultural land is replacing natural vegetation. Another role for geospatial data is to guide the migration of crops to more suitable climates in the wake of climate change.

ONE HEALTH

The One Health initiative aims to work locally, nationally and globally to achieve optimal health for people, animals and the planet. "Agriculture must play a role in protecting and promoting health," said Barbara Amon, of the Leibniz Institute for Agricultural Engineering and Bioeconomy, University of Zielona. "We need to invest money at the start of the chain, with agriculture."

This can be done through nutrient management and recycling, which includes crop rotation, the use of legume crops in nitrogen fixation, and ensuring nutrients do not flow only in one direction into urban areas. Better health and welfare of livestock and sustainable products will reduce the environmental impact of food from farmed animals. Consumers also play an important role through better use of food, biomaterials, and energy.

Being able to see livestock health and welfare, and livestock–environment interaction is vital to understanding how effective or cost-effective interventions are. Farmers, whether in a low- or high-income country, always want to know how much an intervention will cost. Measuring results on the farm is costly and intensive, so the data are usually derived from laboratory experiments, and from modelling and simulation.

NEW SOURCES FOR FOODS

To remain healthy, people need 0.8 g/kg body weight of protein per day. Meat is an important source of protein, but its large-scale production is putting increasing pressures on the environment. Researchers are exploring alternative sources of protein, both directly as food ingredients, and indirectly as animal feed.

Pulses, which can be consumed directly, incorporated into food such as bread or pasta, or fed to animals, are a good source of protein. Insects are eaten as in some regions, and their increased production in 'insect factories' for food and animal feed is expected in the medium term. Longer-term approaches include algae and other single-celled organisms, grown in a biorefinery in urban or rural settings, producing different proteins, with residual biomass used as fertilizer or animal feed. The furthest from the market is lab-grown muscle tissue as meat. The availability of these alternatives depends on technology readiness level, and on economies of scale.

"Emerging sources, such as algae and insects, are not performing as well as expected, but have not yet been optimized," said Mathys. "We also need to collaborate with consumers to see if they will accept it as a food source."

MEASURING INTERVENTION

Ceres2030, a partnership between Cornell University, the International Food Policy Research Institute, and the International Institute of Sustainable Development used applied machine learning and analytics to evaluate the interventions in around half a million papers.

"We found major gaps in the evidence base," said Jaron Porciello, Research Data Engagement, Department of Global Development, Cornell University. "Interventions rarely succeed alone, and we found that very few of the publications evaluated the interventions with farmers," she said.

In order to make an impression on world hunger, and to reduce the environmental impact of the food crisis, there needs to be a holistic approach to change, based around the socio-political context. The urgency could not be greater. As Yokoi said: "We do not have a Planet B." ■

GREEN BIOMATERIALS

Immediately after the Nature Café, event sponsor Hayashibara and Nature Research Custom Media held an exclusive meeting on the theme of 'a green-biomaterial-based approach to environmental and food sustainability'. Naoki Yasuba, Hayashibara's chief executive said the meeting was "a great opportunity to share knowledge on the application and potential of naturally derived biomaterials to solve the problems of a sustainable environment, food, and food systems." Invited participants and senior researchers of Hayashibara discussed the features of an ideal bio-based material and the obstacles to wider adoption of such a product.

In a wide-ranging discussion, participants pointed out that nature has no concept of waste. Therefore a biomaterial that utilizes an existing waste product as a feedstock will be inherently sustainable.

To ensure our society moves toward the United Nations' Sustainable Development Goal of 'zero hunger', participants agreed that collaborations between academia, industry, and policy makers were key to making progress.

Corporations, such as the sponsor, can play a role in moving good ideas out of the lab by nurturing creativity and start-ups with material and in-kind support. Governments can, at times, drive innovation through new regulations, and certification of new products can lead to their wider adoption.

One participant cited the example of BT corn in the United States. As a new, genetically modified food, there was concern about its introduction. When a working group formed, comprised of scientists, government and industry, concerns were dealt with more easily.

HAYASHIBARA
NAGASE Group

nature café

GUEST SPEAKERS

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