Biodiversity in and across food and agriculture systems provides tremendous value to present and future generations. However, across the world we are losing genes, species, and ecosystems faster than we can account for them. With one million plant and animal species at risk of extinction, our society is challenged to address the drivers of ecosystem degradation and species loss. Increasingly, the negative impacts of agriculture and food systems on biodiversity are being raised as well as the global risks to health associated with unhealthy diets. Recent efforts in North America to raise awareness of crop diversity and coordinate plant conservation efforts culminated in a symposium with botanic gardens, agricultural researchers, wild land managers, conservation organizations, academics, and government bodies. The gathering focused primarily on production-side solutions such as crop diversity, crop wild relative conservation, and agricultural education. Although not present at the symposium, chefs were commonly highlighted and discussed as key collaborators in plant conservation through their important role in connecting consumers to agriculture production and new food plants. This paper shares examples of chefs and culinary programs working to impact agriculture, diets, and plant diversity. To critically assess which chef and culinary programs are having the greatest impact future research is needed, but as we race to save plant species from extinction, it is clear that chefs connect to consumers in unique ways and are important potential allies in cooking up new sustainable consumption and production patterns that support biodiversity in food systems.
plant diversity. Critically assessing the direct and indirect impacts that chefs are having is difficult and future research is needed to better understand what projects and initiatives are most effective. However, in the race to save the world’s plants, improve agriculture, and promote healthy diets, we highlight chefs as important collaborators in cooking up new sustainable consumption and production patterns.

**PROTECTING BIOLOGICAL DIVERSITY IN FOOD AND AGRICULTURE**

Biodiversity and its ecosystem services provide tremendous value to present and future generations and are considered one of our greatest tools for adaptation to climate change (Newbold et al., 2015). However, agriculture policies, investments, and practices have prioritized high yield and high-input productions systems that have significantly reduced the genetic diversity of our diets, affected health and nutrition, and eroded ecological landscapes (FAO, 2019; Maxwell et al., 2016). Accelerating species extinctions and unprecedented losses of biodiversity significantly threaten the resilience of our current and future food system (United Nations, 2019). Globally, >6000 plant species are cultivated as food plants, but only nine species account for 66% of all crop production by weight (FAO, 2019). Collaborative conservation of plant and animal diversity and a combination of solutions are needed for future food security, adaptation to climate change, nutritional security, poverty reduction, and sustainable agriculture (Crop Trust, 2019; Springmann et al., 2018).

**PLANT BLINDNESS**

A key challenge to conserving food plants is “plant blindness,” a term coined in 1999 to describe a public lack of awareness of plants as compared with animals (Wandersee and Schussler, 1999). With one in five plants facing extinction, the impacts of plant blindness have repercussions on policy, funding decisions, and conservation priorities (Royal Botanic Garden, Kew, 2016). In Krishnan et al. (2019), fruitful collaborations between botanical gardens, academic researchers, nonprofits, and conservation organizations highlight examples of initiatives already underway to increase the public’s understanding of the importance of food plants to people and the planet. Educational experiences such as exhibits, demonstration farms, tours, and community outreach opportunities showcase the power of collaboration with educational allies available across many disciplines (see also Moreau and Novy, 2018).

**UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS: ALIGNING GLOBAL AND LOCAL EFFORTS FOR BIODIVERSITY**

Global and local efforts must be aligned to protect gene, species and ecosystem biodiversity. The United Nations Sustainable Development Goals (UN-SDGs) are the 2030 global agenda for improving our world (United Nations General Assembly, 2015). The 17 goals describe where we need to go as a global community and outline actions for how to get there without leaving anyone behind. While biodiversity for food and agriculture connect with multiple UN-SDG goal areas, “Target 2: Zero Hunger” and “Target 15: Life on Land” are most directly related. In particular, Target 2.5 is key, calling on the international community to safeguard and share the genetic diversity of crops and livestock. Unlike most UN-SDG targets that go to 2030, Target 2.5 is an urgent and short-term target for 2020 to drive action and mobilize efforts to protect biodiversity for food and agriculture. As a collaboration of chefs worldwide to reach Target 2.5, the Chef’s Manifesto is a campaign to outline how chefs can contribute to the UN-SDGs (SDG2 Advocacy Hub, 2019). The manifesto, organized by the SDG2 Advocacy Hub and aligned to Target 2: Zero Hunger, outlines eight thematic areas written by chefs for chefs, including (i) ingredients grown with respect for the earth and its oceans, (ii) protection of biodiversity and improved animal welfare, (iii) investment in livelihoods, (iv) to value natural resources and reduce waste, (v) celebration of local and seasonal food, (vi) a focus on plant-based ingredients, (vii) education on food safety and healthy diets, and (viii) nutritious food that is accessible and affordable for all. With the campaign currently underway, it is not yet clear what impacts the manifesto is having on zero hunger and safeguarding crop and livestock genetic diversity. However, efforts to aggregate recipes that align with the manifesto’s thematic areas can be accessed and shared, but future evaluation will be important to determine which thematic areas and recipes are having an impact.

A similar campaign aimed at engaging chefs is called 2020for2020 (Food Forever, 2019). The campaign aims to recruit and engage more than 2020 chefs in working towards Target 2.5 (safeguarding the genetic diversity of crops and animals). Safeguarding the genetic diversity of crops and animals is a difficult challenge. By aggregating chefs’ actions from around the world, highlighting events, recipes, and examples of individuals promoting biodiversity through their recipes, the campaign will likely have both direct and indirect impacts on genetic diversity of food. However, as an ongoing joint effort of the Chef’s Manifesto and Food Forever, the impacts remain to be seen. Food Forever is an educational initiative through the Global Crop Diversity Trust (Crop Trust) and various governments (the Netherlands, Germany, Norway, and Switzerland) aimed at rallying support across multiple stakeholder groups to conserve, grow, sell, and consume livestock, and crop diversity. Capacity development programs aimed at education and awareness can be difficult to assess for their impacts, and clear metrics of success are important to track progress.
In the context and complexity of global and local food systems, tracking progress and measuring impacts of chefs’ interventions on agriculture, plant diversity, and diets presents some significant challenges. Interesting examples of seed-to-table programs exist, but measuring how chefs are affecting food supply chains currently takes on many different forms. For example, Community Grains is a California-based collaboration between farmers, bakers, and cooks (Community Grains, 2019). This organization aims to advance accountability of products and sources through traceable product lines and created a 23-point system to evaluate product traceability. Alternatively, there are other evaluation systems such as Life Cycle Analysis, True Cost Accounting, and the TEEBAgriFood evaluation framework that aim to holistically assess sustainability across food supply chains (Hauschild et al., 2018; Sandhu et al., 2019; Sustainable Food Trust 2019).

DIVERSE DIETS AND DIETARY GUIDELINES

Across global, national, and regional scales, food-based dietary guidelines and their associated food guides provide recommendations for healthy diets. Global guidelines are set by the World Health Organization (WHO, 2018). National food guides are traditionally consumer-facing resources aimed at the general public where food preferences and traditions are presented with various food groups such as starchy staples, fruits and vegetables, protein foods, dairy, fats and oils, and food components to limit. There is significant variation across countries and regions in how food groups are presented and the proportions are suggested. Common to many food-based dietary guidelines is the message to consume a variety of foods—fruits and vegetables, legumes, and animal-sourced foods—and to limit sugar, fat, and salt (Herforth et al., 2019).

PLANT-BASED INITIATIVES

Plant-based initiatives are increasingly popular in the context of human health and environmental sustainability. In early 2019, EAT–Lancet was launched as an independent scientific review outlining how healthy diets from sustainable food systems can feed a future population of 10 billion people within planetary boundaries (Willett et al., 2019). The commission provided a review of what constitutes a healthy diet from a sustainable food system and links nutrition with environmental sustainability. The suggested diet calls for increased consumption of plant-based foods and fewer animal-sourced foods within a context that food choices can be powerful drivers of change. Chefs and food service providers in particular are highlighted as agents to drive demand for new diets through messaging and new menus inspired by cultural food influences, flavors, biodiversity, and farmers. About the same time that the EAT–Lancet report was launched, a new Canada Food Guide was released that significantly differed from previous food guides in the stakeholder engagement process and in the final guidelines presented, which suggest eating plenty of vegetables and fruits, choosing whole grains, and eating plant-based proteins. The Canada Food Guide website provides a diversity of recipes, tips, and resources that are being used to adapt diets and meal planning across the country (Government of Canada, 2019).

EXAMPLES OF CHEF AND CULINARY PROGRAMS

There are many examples of innovative cooking and culinary programs happening across large and small scales. Menus of Change is an initiative out of the United States that works to support chefs and the food service industry to change menus that will drive improvements in our health, planet, and people (Culinary Institute of America, 2019). Grounded in evidence-based principles of health, Menus of Change is a partnership of the Culinary Institute of America and Harvard T.H. Chan School of Public Health. Through annual leadership summits, the initiative is promoting plant-forward dining as a mainstream concept for chefs and the food industry. Plant-forward dining is defined by Menus of Change as “a style of cooking and eating that emphasizes and celebrates, but is not limited to, plant-based foods—including fruits and vegetables (produce); whole grains; beans, legumes (pulses), and soy foods; nuts and seeds; plant oils; and herbs and spices—and that reflects evidence-based principles of health and sustainability.”

There are many chefs working to promote healthy eating and bridge the gap between farmers’ fields and the public’s plates (Food Tank, 2014). Popular chefs such as Jamie Oliver promote healthy recipes through family foods, online videos, and sales of many cookbooks. Other chefs, such as Manjit Gill in India, investigate regional cultures to discover new dishes with diverse ingredients and culinary expressions (Food Tank, 2018). In Minneapolis, MN, the Sioux Chef is working to revive indigenous diets through education and the use of traditional ingredients (Sioux Chef, 2019). Dishes are prepared with no wheat flour, dairy, or modern sweeteners and instead use wild fruits, nuts, root crops, mushrooms, wildrice, and many other plants. Along with the goal of creating healthy indigenous foods, Sean Sherman, an Oglala Lakota Sioux, cooks as a way to heal long-standing wounds and reinvigorate traditions and history. In 2018, his book The Sioux Chef’s Indigenous Kitchen Cookbook won the Best American Cookbook award from the James Beard Foundation. Today, Sean Sherman is developing an Indigenous Food Lab to make Indigenous food more accessible through a restaurant and an education and training center run by North American Traditional Indigenous Food Systems.

Over the past 10 years, Row 7 Seed Company has been working as a seed company to grow and adapt its breeding efforts to focus on food plant nutrition and flavor (Row 7 Seed Company, 2019). This collaborative venture between
a plant breeder (Michael Mzourek at Cornell University), chef (Dan Barber), and seed grower (Matthew Goldfár) promotes plant breeding as an important part of the food chain. In addition, the company ensures that its seeds are publicly available through the USDA-ARS National Plant Germplasm Systems and supports research and development for organic seed breeders. Success thus far is measured by the number of farmers growing their food plants each year.

Food movements and food trends come and go, but some stand the test of time. For example, the Slow Food movement was born in Rome in 1986 after a demonstration at the intended site of a McDonalds at the Spanish Steps (Slow Food, 2019). Over its 30-yr history, the movement has engaged millions of people in celebrating the strong connections between plate, planet, people, politics, and culture. Their philosophy today is based on the three interconnected principles of good (quality, fistome, and healthy food), clean (production that does not harm the environment), and fair practices (accessible prices for consumers and fair conditions and pay for producers). Their network engages chefs, youth, activists, farmers, fishers, experts, and academics.

PROMOTING HEALTHY DIETS THROUGH UNIVERSITIES AND COLLEGES

In North America and across the globe, universities are significant providers of food and food services through their purchasing powers and young adult student audiences that are learning and making food decisions on their own for the first time. Increased programming around student well-being and health is supported by “The Okanagan Charter: An International Charter for Health Promoting University and Colleges,” which identifies post-secondary schools as key leads for health promotion, action, and collaboration (Okanagan Charter, 2015). Signed in June 2015, the charter was developed with representation from educational institutions and health organizations to promote health and well-being and emphasizes the interconnectedness between individuals and their environments. The charter calls on post-secondary institutions to integrate health promotion values and principles into their visions, missions, and strategic plans and to model and test new approaches and solutions for society. Recently, at the University of British Columbia (UBC) in Vancouver, Canada, the charter and its calls to action guided the development of a well-being strategic framework including food and nutrition targets with indicators (UBC Wellbeing, 2019).

FOOD AND NUTRITION AT THE UNIVERSITY OF BRITISH COLUMBIA

In addition to its recently developed food and nutrition targets and indicators, there are a number of programs at the UBC Vancouver campus aimed at advancing student health and well-being, improving on-campus food assets, closing the gap between food production and consumption, and supporting on-campus biodiversity conservation and agroecology across UBC Farm and UBC Botanical Garden. In 2017, UBC Food Services developed and launched a “Food Vision and Values” document that helps shape and inform decision making for UBC Food Services leadership (UBC Food Services, 2019). As a self-operated enterprise, UBC Food Services works with registered dietitians to advance plant-based initiatives and food literacy in their residences, retail operations, and catering services. Procurement goals such as a recent commitment to purchase only certified sustainable seafood and purchasing targets with UBC Farm (about Can$75,000 in 2018–2019) support both the on-campus organic farm and local and regional seafood industries. Chefs from UBC Food Services also participate in an annual harvest day at UBC Farm and work alongside the farmers to learn about the knowledge, effort, and expertise that goes into growing organic food.

The UBC Food Systems Project brings together cross-campus initiatives around the key priority areas of sustainability and student learning (UBC Food Systems Project, 2019). For students or other stakeholders looking to explore the campus food system, a UBC Food Asset Map provides information about accessing food, food-related organizations, research centers, academic experts, nutritional resources, courses, and more. Student engagement in biodiversity in food and agriculture is enhanced through research and education programs at both UBC Farm and UBC Botanical Garden (Fig. 1). Other food literacy programming such as recipes contests, tasting tours, grocery store tours, and cooking workshops aim to get students involved with healthy cooking. Benefits of food programming at UBC reach beyond student and campus communities. Annual events such as the Apple Festival at UBC Botanical Garden can attract >12,000 community members to celebrate, purchase, and taste 50 to 75 different available apple (Malus domestica auct. non Borkh.) varieties, which supports consumer education of food diversity, as well as farmer sales of rarer apple types.

CONCLUSIONS

In kitchens and cafeterias across the world, chefs and culinary programs are bridging the gap between seeds, farmers’ fields, and public plates. By transforming raw ingredients into healthy and nutritious foods and through their purchasing choices, chef and culinary programs are central to the conversations about biodiversity in food and agriculture. Future work is needed to understand and evaluate how chefs and their programs are directly and indirectly affecting agriculture, plant diversity, and...
diets. In the race to save plant species and engage the public in food and agriculture, chefs connect consumers to production and are important allies in advancing biodiversity in food systems.

**Conflict of Interest**
The authors declare that there is no conflict of interest.

**Acknowledgments**
We acknowledge that the UBC Point Grey campus is situated on the traditional, ancestral, and unceded territory of the Musqueam People. Ideas for this paper were inspired by a collaborative project to connect North American agricultural and botanical organizations. We thank the Alliance of Crop, Soil, and Environmental Science Societies (ACSESS) and the American Public Garden Association (APGA) for facilitating this unique collaboration supported by USDA National Institute of Food and Agriculture (Grant 2017-67019-26289), the US Botanic Garden, the Leichtag Foundation, and the World Food Prize Foundation. The opinions expressed in this article are the authors’ own.

**Fig. 1.** Demonstration food garden at University of British Columbia (UBC) Botanical Garden where educational programs like Harvesting Food Skills engage university students and volunteers with (a) growing, (b) harvesting (c), preparing, and (d) sharing foods. (a) Growing: students and volunteers share knowledge and skills about growing diverse food plants in demonstration beds with nearly 300 food and pollinator plants. (b) Harvesting: the harvesting of food involves weighing, cleaning, and preparing the food. (c) Preparing: students learn knife skills and cooking techniques by preparing the freshly harvested food. (d) Sharing: students and volunteers share a meal together to finish off the morning harvest.

**References**


