

EDITORIAL

The history of crop science and the future of food

1 | HISTORY ACROSS DISCIPLINES

Historical memory is often short, and perhaps nowhere more so than in scientific research. As scientists chase new insights and novel tools, they are rarely rewarded for possessing deep knowledge of their disciplines' past trajectories. Textbook sidebars spotlight singular individuals or celebrated experiments, and institutional accounts highlight founders and funders. Such highlights introduce a tiny—and unrepresentative—fraction of scientific work. Yet, the possibilities and pitfalls of today's research are conditioned by the past.

Our contention in bringing together this special issue is that examining the history of plant science and technology is essential to the goals of *Plants, People, Planet*—that is, to the development of cross-disciplinary approaches in the plant sciences that will foster the insights and energy necessary to tackle the global social and environmental challenges of the present (Hiscock et al., 2023). As the contributions highlight, attention to history can serve many agendas: guiding breeding programs, shaping conservation strategy, tempering expectations for extension work, informing public policy, highlighting the continued legacies of colonialism, and more. It can also serve as the glue that brings researchers from different disciplines into conversation. In this issue, readers will encounter historical accounts (co-) developed by agroecologists, anthropologists, biologists, breeders, development experts, historians, sociologists, and scholars of science and technology studies (STS). Though the contributions traverse many decades and continents, their shared terrain is the archive of past plant science and technology, whether inscribed in books and written records, genes and landscapes, or memories and oral traditions.

Our cross-disciplinary histories center on another cross-disciplinary domain: crop science. The study of plants we use as food and fodder (and fuel and fiber, too, though they do not come in for scrutiny in this collection) has played an outsized role in exploring and promoting solutions to the challenges of feeding the world. Over many decades, researchers with expertise in fields such as agronomy, genetics, plant physiology, crop ecology, and biotechnology have reconfigured genes, fields, and ecosystems to extend the biophysical limits of food and fodder production. The outcomes of this work are undeniable yet still indeterminate. Crop production has steadily increased (Evenson & Gollin, 2003; Ray et al., 2013), but so too have the social and ecological costs of the modes of agriculture most often

sustained through investments in crop science (Ramankutty et al., 2018; Tilman, 1999). Disagreements about who has gained and what has been gained abound and show no evidence of imminent resolution. Starting from a position that acknowledges both the influence of crop science on plants, people, and the planet and the need for interdisciplinary expertise to understand better the nature and extent of this influence, the contributions to this issue examine the historical role of crop sciences and scientists in the uneven and often inequitable development of today's global food system. They explore a range of crops, countries, and cultures, focusing on the dynamic historical relationships among ecologies, societies, knowledge systems, and technologies that have produced the institutions and insights of crop science and as such condition the possibilities for the future of food.

2 | CROP SCIENCE IN HISTORICAL PERSPECTIVE

Existing histories of crop science provide a robust foundation on which many of our contributors build. Research into the development of institutions for agricultural science show how and why communities, countries, and colonial authorities often came to favor the insights and solutions to farming concerns provided by technical experts (Bonneuil, 2000; Harwood, 2005; Henke, 2008; Hodge, 2007; Lavelle, 2015; Lin, 2015; Maat, 2001; Méndez Rojas, 2019; Nehring, 2016; Rosenberg, 1997; Wolford, 2021). In many settings, agricultural colleges and experiment stations developed and promoted crop varieties and cultivation practices that would in theory improve upon those employed by farmers (Fitzgerald, 1990; Charnley, 2011; Harwood, 2012; Kumar, 2012; Baranski, 2022; see extended bibliography in Berry, 2021). Although sometimes created to satisfy the demands of rural constituents clamoring for government support, these agricultural institutions typically aligned with larger state objectives, whether expanding the agricultural economy, sustaining national food autonomy, or rooting settlers in stolen lands (Camprubí 2010; Chu, 2023; Fullilove, 2017; Kim, 2018; Nehring, 2022; Saha, 2013; Saraiva, 2018; Schmalzer, 2016; Wang, 2020). Historical studies have also traced the steady privatization of crop science (breeding in particular), its acceleration since the 1970s, and the consequences of leaving such a vital enterprise to private interests (Howard, 2016; Kloppenburg, 2005).

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Many studies reveal the contributions of plant breeding and agronomy to farm productivity and their role in reshaping global diets. However, historical accounts also implicate these sciences in the creation of new problems, from novel disease vulnerabilities propagated through industrial monocrops (McCook, 2019) to the negative ecological and public health consequences of crops dependent on chemical inputs (Grandia, 2022; Hetherington, 2020; Nash, 2004) and industrialized food systems more generally (Otter, 2020). Increasingly, historical analyses also highlight the expertise variously usurped, overlooked, abandoned, or suppressed in the pursuit of “modern” agricultural science (Chapman, 2022; Curry, 2022; Fenzi et al., 2022; Fullilove, 2024; Sclavo, 2023a, 2023b; Soto Laveaga, 2021). Experiment stations and “improved” plants were instruments of colonialism, means of controlling lands and lives of peoples typically labeled as “primitive” and “backward” by imperial authorities (Bonneuil, 1999; Sollai, 2022). In many cases, the assumptions of colonial improvers persisted in the international development programs that have sought since the mid-20th century to deliver “modern” science to farming communities in the Global South (Cullather, 2010; Curry & Lorek, 2024; Hurt, 2020; Lorek, 2023; Wolford, 2021). Awareness of these issues has brought alternative domains of crop science such as agroecology to the fore in recent decades, as researchers reconcile the need for robust crop knowledge and know-how with the imperatives of addressing social and environmental injustice (Altieri & Nicholls, 2017; Altieri & Toledo, 2011; Wezel et al., 2009).

3 | PEOPLE, PLACES, PLANTS, POLITICS, AND POWER

Perhaps the best-known historical accounts of 20th- and 21st-century crop science center on *people*, recounting the life experiences of individual researchers through biography. It is likely that for many readers an effort to recollect the past work of crop agronomy, breeding, genetics, or biochemistry will bring to mind celebratory accounts of famous scientists like George Washington Carver, M. S. Swaminathan, Yuan Longping, or Evangelina Villegas. Biographies can do more than illuminate an illustrious career, however. A focus on one individual can reveal the larger patterns and processes that shape scientific research, as several contributions to this issue exemplify. As Brown (2023) shows in his account of the Indian peanut geneticist and breeder V. K. Badami, researchers in colonial settings had to navigate the conflicting expectations of academic scholarship in the metropole and practical accomplishments in the colony as they pursued professional advancement. Curry (2023) similarly delves into the career of one extension agent in the US Corn Belt to understand the challenges of producing local solutions (in this case, locally adapted maize) within institutions that overwhelmingly prioritized generalizable outcomes. Meanwhile, Méndez Rojas (2024) uses biography as a means of recovering technical aspirations and research contributions overlooked in the constant heady pursuit of new tools. Her study of the maize cytogeneticist Takeo Ángel Kato Yamakake highlights the knowledge of maize chromosomes made possible through local studies, transnational

collaborations, and Mexican ambitions for maize improvement—knowledge later sidelined in the turn to molecular genetics.

An alternative to bringing people to the fore in telling history is settling into specific *places*, understanding the nature and influence of crop science through the transformations it has wrought on broad landscapes. This might involve tracking change over centuries rather than lifetimes, as Gomes et al. (2023) do in their study of maize landscapes on the Iberian Peninsula. They show how changing patterns of cultivation shape rural sociabilities and contribute to dynamic notions of heritage and culture over the long term. Alternatively, it could focus in on periods of particularly dramatic change. Consider modifications in the vegetative composition of Brazilian pasturelands in the 20th century detailed by Nehring (2023). As he argues, the introduction and breeding of *Brachiaria* grasses by both state and private actors enabled the “ecological transformation (and destruction) of the Brazilian frontier”—a change in ecological conditions that in this case further cemented centuries-long social inequalities.

One could object that Nehring's (2023) study is in fact a history of a specific group of *plants*, the *Brachiaria* grasses, and the technical work of biological reconfiguration that has been essential to the making of industrial crops. Do the histories of different crop plants and their unique qualities offer different insights into this process? An examination of bread wheat in the United Kingdom by Fradgley et al. (2023) makes a case that political and economic forces contributed to the prioritization of sheer productivity (quantity) over characteristics sought in milling and baking (quality) for much of the 20th century, diminishing opportunities for sustainable UK wheat farming in the twenty-first. While Fradgley and colleagues draw on the history of wheat to motivate further innovations in breeding strategy, McCook and Montero-Mora (2024) narrate a history of coffee in Latin America that emphasizes shifts in breeding that have already occurred. As they show, the political, economic, and ecological conditions of coffee farming in Central America since 1990 have prompted the focus on breeding plants for high productivity to give way to producing plants that help farmers navigate the pressures of diseases, pests, price volatility, and changing consumer tastes. Wang (2024) turns her attention to an industrial crop that is probably rarely thought of as such—the blueberry—to reveal similar negotiations among scientific approaches, biological possibilities, and industrial demands in the making of a singular, mass-marketable “blueberry” from the modest wild species known to 19th-century US growers and eaters. In each of these cases, from wheat to coffee to blueberries, readers are reminded that markets and policies give rise to specific forms of crop plants, and not always those forms most needed or desired, depending on who has influence.

That insight points to the possibility of making *politics* the central object of study. For example, state ambitions for economic growth and national security inevitably shape agricultural policies, with important consequences for the opportunities and outcomes of crop science. Sollai (2023) exemplifies this approach in his analysis of the Italian “Battle of the Wheat” inaugurated by Benito Mussolini in 1925. As he shows, “elite” wheat seeds were pursued and produced as a technology for bringing modernity to the Italian countryside, with the intention of securing the ambitions and consolidating the power

of the fascist regime. Politics shaped the science of crop systems as well as crop seeds. In his study of research on multiple cropping in Taiwan, Chu (2024) emphasizes its origins in political positioning demanded by the Cold War, specifically the desire of the Republic of China (ROC) government to demonstrate its achievement of a “bloodless social revolution” by developing tenant farmers into landowners. And politics also foreclosed important possibilities for crop research agendas. Scavo (2023b) investigates the more recent case of 21st-century *chile* research and conservation in Mexico. She argues that the government's emphasis on food security, narrowly defined as caloric intake, neglected the importance of food culture and flavor and, as a result, limited the pathways for research on and conservation of *chile* genetic diversity.

The neglected study of flavor as a component of food security offers a reminder that knowledge may be obscured, suppressed, or erased as well as advanced, especially in the institutionalization of research and the setting of state priorities for crop science. Ultimately, **power** dictates what is known and who is recognized as having knowledge, and so this must also be a key organizing principle in histories of crop science. Harwood (2024) charts the abandonment of intercropping as a topic of agronomic research prior to its re-emergence as an object of study in the 1970s. He makes the case that this is representative of wider patterns in which the study of alternative modes of agricultural production was marginalized in the pursuit of an industrial agricultural ideal. The alignment of scientists' valuations of particular knowledge or ways of knowing with state priorities is visible in textbooks, as Harwood demonstrates. It is also visible in government policies and the mechanisms used to enforce these. Fenzi et al. (2023) examine the attempted management of “native” maize by the Mexican government. Among the many issues considered by the authors is the state's insistence on “scientific” management of the risks to maize biodiversity posed by novel biotechnologies. This emphasis authorized only certain actors to speak to potential hazards and relied on only certain tools to reveal the consequences that arose. In this case, as in many others, already powerful institutions dictate whose knowledge is recognized as “scientific” and therefore has influence. Of course, marginalized knowledges and technologies persist outside the gaze of these official determinations. This is true for farmers in Mexico who identify, develop, and manage maize diversity as a matter of daily routine. It is also true of Maroon communities in Suriname. Maat et al. (2023) document that these communities' practices of “escape agriculture”—that is, modes of farming that facilitate escape from or survival under repressive governing power—include the creation and perpetuation of distinct rice varieties. Their rice varieties “reveal the inventiveness and importance of escape agriculture” and also serve to illustrate the imperatives of conceiving of crop science in inclusive rather than exclusive terms.

4 | THE FUTURE OF FOOD

What do the histories collected here and others like them suggest for the future of crop sciences and their role in shaping the future of global agriculture? For one, they ask today's researchers—natural scientists and

social scientists—to be aware of the social, political, economic, institutional, and disciplinary histories that have positioned them and their research in the world. As our contributors show, imperial impositions, political ambitions, and disciplinary hierarchies have shaped who counts as a crop scientist, what they do and know, and the long-term consequences of their research. These factors continue to be relevant, and it is our responsibility as researchers to pay attention to the interplay of research with power and politics, especially when it comes to shaping the plants that provide sustenance for the world. Practicing crop science that is sensitive to history means abandoning linear accounts of scientific progress to acknowledge not only the contingencies involved in the pursuit of new knowledge and technologies but also past mistakes, misjudgments, silencings, and harms. This awareness, in turn, will help crop science become ever-more attuned to the diverse needs and complex challenges of the present and future.

KEYWORDS

agricultural development, agricultural history, crop science, food futures, global food system, interdisciplinary research

ACKNOWLEDGEMENTS

Helen Anne Curry's work on this editorial and the special issue was supported by the Wellcome Trust (217968/Z/19/Z) as part of the project “From Collection to Cultivation: Historical Perspectives on Crop Diversity and Food Security.” Ryan Nehring's work on the special issue was also partially supported by the Wellcome Trust (217968/Z/19/Z) as part of the “From Collection to Cultivation” project. We are grateful to the Wellcome Trust for its support and to members of the Collection to Cultivation project and several collaborators, who provided the impetus for the special issue through their participation in a series of panels at the 2022 Agricultural History Society meeting.

FUNDING INFORMATION

Wellcome Trust, Grant/Award Number: 217968/Z/19/Z

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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