



# Shallow fixes and deep reasonings: framing sustainability at the Brazilian Agricultural Research Corporation (Embrapa)

Maíra de Jong van Lier<sup>1</sup> · Jessica Duncan<sup>2</sup> · Annah Lake Zhu<sup>1</sup> · Simon R. Bush<sup>1</sup>

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## Abstract

The need for urgent, structural transformations to dominant food systems is increasingly recognized in research and policy. The direction these transformations take is in great part influenced by how the problem is framed and what future pathways become seen as plausible and desirable. Scientific knowledge and the organizations producing it hold considerable authority in suggesting what alternatives are or are not worth pursuing, ultimately shaping frames and in turn being shaped by them. This paper examines Brazil's federal Agricultural Research Corporation (Embrapa), a major contributor to technological advances that made Brazil into an agricultural powerhouse. We examine the ways in which Embrapa's leadership has framed sustainable agriculture in its public communication and the wider implications for food systems transformation. Drawing from Embrapa news articles in the period 2015–2020, we identify four interrelated frames forming Embrapa's prevalent position on sustainability. Our results show that while Embrapa promotes practices based on alternative approaches such as agroecology, its deeper framing often reflects the core assumptions driving dominant industrial food systems. This framing reinforces underlying logics of control, efficiency, and competition aligned with the productivist paradigm and excludes divergent perspectives that exist within the organization.

**Keywords** Politics of knowledge · Food systems transformation · Framing · Science and technology · Agricultural research · Brazil

## Introduction

As dominant food systems are shown to undermine “the very foundation they rely on” (IPES-Food 2021), calls for urgent, structural transformations are increasingly made in both research and policy (Webb et al. 2020; Froidmont-Goertz et al. 2020; Caron et al. 2018; UNFSS Scientific Group 2021). What pathways are followed toward sustainable food systems greatly depends on the narratives shaping societal views about what futures are possible and worth pursuing (Béné et al. 2019; Rivera-Ferre 2018). For example, across the global South, narratives of the Green Revolution symbolizing the rise of technoscientific modernization still resonate in agricultural research and policy (Cabral et al. 2022).

However, these narratives are also challenged by counter-narratives focused on alternative forms of agriculture, such as agroecology (Holt-Giménez et al. 2021). Both Green Revolution and agroecology narratives arise from particular framings of the challenges each form of production faces, as well as the kinds of solutions they imply for transforming food systems. In their work on transformations to sustainability, Abson et al. (2017, 35) argue that “the way in which problems are framed” has “significant implications for policy development and societal outcomes”. Following Scoones (2015, 23), critically analyzing processes of framing also enables “confronting the power of entrenched, incumbent professional and other interests”, and even points to the need for “a different type of science” (ibid.). Scientific knowledge plays an important role in shaping dominant frames, owing to the objectivity and legitimacy often ascribed to that knowledge. Achieving far-reaching food systems transformation thus requires attention to the knowledge claims shaping the framing of sustainable agriculture, as this framing defines which kinds of futures are even thought possible.

✉ Maíra de Jong van Lier  
mairadejong@tutanota.com

<sup>1</sup> Environmental Policy Group, Wageningen University,  
Wageningen, The Netherlands

<sup>2</sup> Rural Sociology Group, Wageningen University,  
Wageningen, The Netherlands

An important step in this direction consists of explicitly situating agricultural research organizations within their sociopolitical context and recognizing the ways in which “the social is always and already enmeshed in the techno-scientific” (Jasanoff 2021, p. 849). That is, attending to the politics of knowledge shaping agricultural research (Cabral et al. 2022). Highlighting this politics means making visible the ways in which agricultural research systems are implicated in the production and reproduction of problem definitions and corresponding solutions (e.g. Vanloqueren and Baret 2009), again delimiting what becomes regarded as virtuous pathways for transformation.

Brazil’s federal Agricultural Research Corporation, or Embrapa, offers a highly relevant case of an organization that is seen to have laid the foundations for the transformation of Brazilian agriculture since its creation in 1973 (Raices et al. 2023), and is held as an example to be followed in the global South (Correa and Schmidt 2014; Cabral et al. 2016). Many of the advances made in Brazilian agriculture are attributed to Embrapa’s research and development efforts. Most often cited are its seed breeding programs, notably the development of soybean cultivars adapted to the Cerrado savannah (Martha et al. 2012). This adaptation allowed for the large-scale conversion of Cerrado land into soy monoculture.

Filho (2008) traces Embrapa’s work on more sustainable agricultural practices back to the 1980s. He shows that, as food system sustainability grew in salience, Embrapa increasingly sought to adapt how its ongoing research agendas were framed. For example, in 2006, as Brazil’s groundbreaking National Policy on Agroecology and Organic Agriculture (PNAPO) was still being developed, Embrapa published its own Landmark Report on Agroecology (Embrapa 2006). In recent years, it published a series of reports on Embrapa’s role in the Sustainable Development Goals (SDGs) (e.g. Hammes et al. 2018; Bueno and Torres 2022). In each case, Embrapa has continued to redefine how it applies the notion of environmental sustainability in its research and policy advice. Given the various ways in which sustainability can be understood, it is crucial to shed light on Embrapa’s framing to understand the underlying politics (Urbinatti et al. 2020; Deijl and Duncan 2021; Preiser et al. 2017) of why some pathways to transformation of Brazilian food systems are favored over others.

In this paper, we investigate whether and how Embrapa’s increasing attention to environmental sustainability was accompanied by changes in the assumptions underlying its public framing. To do so, we focus on the underpinning assumptions shaping frames and steering the direction of food systems transformation at a deeper level. We thus distinguish between more superficial—or shallow—aspects of framing and the deeper logics that underpin them. More specifically, we analyze Embrapa’s framing in the news

media as steered by the organization’s leadership. As a major national institute, Embrapa has the power to either promote or absorb and depoliticize alternative modes of production that challenge the status-quo (Levidow et al. 2014; Giraldo and Rosset 2018; Montenegro de Wit and Iles 2021). Accordingly, we use a framing analysis to shed light on the underlying logics that inform Embrapa leadership’s public discourse on sustainable agriculture and the implications for food systems transformation.

The next section further defines the central concept of frames and its application in our analysis. We then describe our methods, including further background on Embrapa and Brazil’s agri-food system. Following this, our results present and analyze four interrelated frames that characterize the public-facing communication of Embrapa’s leadership on sustainable agriculture, drawing links where these frames resonate with broader food system narratives. Our discussion specifies three underlying logics—that of control, efficiency, and competition—that inform the identified frames. Based on this analysis, we argue that in reinforcing these underlying logics Embrapa’s prevalent framing inhibits deep, system-wide transformation. We conclude the paper with a brief reflection on the heterogeneity of perspectives within Embrapa and how this presents opportunities for future research.

## Frames as framing and reasoning devices

Frames are broadly understood as collections of interrelated symbols, labels, and categories that actors draw on to make sense of their reality and to communicate their ideas (D’Angelo 2002; Gamson and Modigliani 1989; Van Gorp 2007). Following Buijs et al. (2011) and Van Gorp (2007), we argue that deeply entrenched cultural values and beliefs are explicitly and implicitly propagated through frames and framing. Adopting a constructionist approach to framing, we define frames as articulations of political standpoints as part of an ongoing “symbolic contest over which interpretation will prevail” (Gamson and Modigliani 1989, p. 2). Their symbolic nature implies that frames contain underlying meaning structures. In this sense, framing is a meaning-making process through which actors communicate their ideas, consciously or unconsciously, selecting certain aspects of an issue while omitting others. Which aspects are selected and propagated in a given frame depends on their resonance with broader cultural themes such as actors’ identities (Eck and Dewulf 2020, p. 455), as well as a group’s predominant values and beliefs. In framing an issue, actors draw from a cultural stock of metaphors, images and sayings, meaning that the frames they produce reflect a group’s culture (Entman 1993). Furthermore, framing also reflects contestation, where some actors and institutions advance specific frames

over others, consequently determining the parameters of the debate (Snow and Ketelaars 2019; D'Angelo 2002).

In this paper we use frames as a discursive means of understanding how existing and potential food systems are known and made possible. Frames, as such, can be identified in text and interpreted as representing the degree to which the values and beliefs expressed might enable fundamental or superficial change to how a system is known and ultimately *performed*. To analyze frames and their underpinning sets of values and beliefs, we borrow Gamson and Lasch's (1983) conceptualization of "framing devices" and "reasoning devices". We use this distinction to identify how frames include both shallow and deep discursive representations of sustainable food and agriculture; where framing devices comprise more superficial, or shallow aspects of framing, and reasoning devices comprise the deep, underlying meanings informing that framing.

More specifically, framing devices are the manifest symbols from language such as metaphors, images, and sayings that form a logical pattern and suggest how an issue is to be thought about (Van Gorp 2007). Framing devices, as such, tell us something about what is being framed rather than the deeper values and beliefs that underpin why a frame is being used. Reasoning devices, in contrast, operate at this deeper level. They are the latent meaning structures that provide justifications for a given framing based on the perceived causes, consequences, and potential responses to an issue. By analyzing these framing and reasoning devices, we explore how Embrapa's leadership has engaged in both shallow framing of problems and their solutions, as well as deeper reasoning which justifies technological trajectories that either reinforce or fundamentally challenge prevailing modes of production and consumption within the food system.

## Methods

### Case description

Embrapa was founded during the military regime in 1973 as part of state efforts to modernize Brazilian agriculture to serve as a "research arm" of the Ministry of Agriculture, Livestock, and Food Supply (Martha et al. 2012). Despite this interconnectedness with the government and reliance on public funding, Embrapa was conceived as a public enterprise with considerable autonomy in its management and organization. Mengel and Aquino (2015) show that an important characteristic of the Embrapa model at its inception was a shift from agricultural producers to *production systems* incorporating the entire industry. This was accompanied by a crop-specific focus, in which the production system and its corresponding *technological package* were

developed in such a way that the choice of crop varieties, agrochemicals, and machinery all fit together in an agro-industrial complex (idem).

Accordingly, multiple Embrapa research centers were created specialized in specific crops (Embrapa Soybeans, Embrapa Maize and Sorghum, Embrapa Cotton, etc.). Embrapa is currently made up of a total of 43 such research centers spread across the Brazilian territory referred to as decentralized units, as well as seven central units including its headquarters in Brasília (Embrapa 2022). In addition to the crop-focused decentralized units, there are also units focused on ecoregions (Embrapa Cerrados, Embrapa Semi-arid, etc.) and basic themes (Embrapa Digital Agriculture, Embrapa Agroenergy, etc.). Despite its territorial dispersion, the Embrapa chain of command remains hierarchical, with overall decision making remaining with the central units and presidency (Mengel and Aquino 2015). In terms of projects, a significant part of Embrapa's work has been dedicated to plant breeding. In particular, the development of soybean cultivars played a crucial role in agricultural expansion in the Brazilian Cerrado, which is acclaimed as one of Embrapa's great achievements (Hosono and Hongo 2016).

Another important aim from Embrapa's creation was to develop a culture of scientific excellence by recruiting and training the country's top talent (Nehring 2016), hence fostering "a vision of agriculture based on science and technology" (Martha et al. 2012, p. 211). In 2021, 75.7% of Embrapa researchers held a PhD (Embrapa 2022), many of whom were trained abroad. In the late 1990s and early 2000s the organization established major programs of international collaboration in the US, Europe, and Asia called Labex (Cabral 2021). The creation of Labex put Embrapa on par with international research organizations.

Throughout the decades, Embrapa put considerable effort into the promotion of its public image. From the 1990s on in particular, communication became a central activity with the implementation of an official Communication Policy (Embrapa 2002). This communication structure is coordinated through a Communications Superintendence (SUCOM) tied to the Embrapa presidency, and centers of organizational communication (NCOs) in each of the decentralized units. These developments were aimed, among others, at strengthening Embrapa's corporate branding (Júnior et al. 2009) and legitimating its actions to the public. Duarte and Silva (2007) state that this new communication strategy led Embrapa to be perceived as a single enterprise with a unified mission, rather than as scattered and institutionally dissociated research units.

Embrapa's current mission is "to create research, development, and innovation solutions to ensure the sustainability of agriculture, for the benefit of Brazilian society" (Embrapa 2020b, p. 16). This broad statement accommodates any number of definitions of sustainability. Additionally, it

emphasizes Embrapa's commitment toward Brazilian society, reflecting its communication strategy. An important element in this branding is its annual Social Report which calculates Embrapa's returns to society (Embrapa 2023). In recent years, following a period of economic crisis in Brazil, Embrapa went through a series of budget cuts that exposed its reliance on public funding and forced the organization to seek funding opportunities from private investment (Moreddu et al. 2017). While having become a nationally and internationally recognized brand, Embrapa's future is not free of challenges and the organization is continually seeking to maintain public support in the face of competition from multinational corporations (Cabral 2021).

### Data collection and analysis

To investigate the framing of sustainable agriculture by Embrapa we conducted a preliminary analysis of documents published between 1984 and 2021 by relevant food system actors in Brazil (supplementary material: Appendix A). This included actors representing both agribusiness (e.g. Brazil's Confederation of Agriculture and Livestock (CNA) and Agribusiness Association (ABAG)) and agroecology networks (including the National Articulation of Agroecology (ANA) and the Landless Workers' Movement (MST)). The dataset included some publications dating back to the 1980s—namely the annals of the Brazilian Meetings on Alternative Agriculture—as well as more recent publications up to and including 2021—such as open letters, official statements, and news articles from actors presenting a diversity of positions on food and agriculture.

Analysis of these publications, combined with the first author's prior field experience in Brazil (including a total of eight months of participant observation and interviews in October 2016–January 2017 and February–July 2022), provided the contextual background against which analysis of Embrapa's framing was carried out. It was first observed that wider narratives of Brazil's food systems show two broad competing visions of sustainable food systems: agroecology, chiefly promoted through social movements (Van den Berg et al. 2022), and low-carbon agriculture, more often tied to greening conventional agriculture (Da Silva and Filho 2020). This distinction is also directly observable within Embrapa. For example, an analyst at Embrapa Environment who incorporates agroecology in his work noted that "we have different generations within the unit, with different ideas about what is environment, what is agriculture, [some] more and [some] less aligned with the approach of agroecology." (online interview August 2022).

Building on this initial round of observations and interviews, our analysis of publications focused specifically on Embrapa news articles published between 2015 and 2020 retrieved from Embrapa's own news archive. This time

period was selected because it corresponded to a period of major political transition in Brazil from the leftist Workers' Party governments, that enabled wider promotion of agroecology in public policy, to Jair Bolsonaro's far-right administration, leading to the dismantling of virtually all Workers' Party's progressive policies (Niederle et al. 2022). By making this selection we sensitized our analysis to the potential impact of this political shift on Embrapa's media representation. In doing so, however, our results indicated there was no apparent effect. We attribute this to the fact that, although projects on alternative lines of inquiry such as agroecology gradually increased since the early 2000s (Filho 2008), Embrapa's focus on large-scale industrial agriculture has remained predominant throughout its history.

Articles were retrieved based on separate search queries for "sustainability *or* sustainable", "environment", "agroecology", and "low-carbon" (in Portuguese), producing, respectively, 6044, 4303, 1312, and 832 results. Search results were further filtered to only include those items categorized as "articles" by Embrapa and exclude short announcements which are less suitable for identifying fully-developed frames (e.g. Meyers and Abrams 2010). The resulting set consisted of 199 articles containing "sustainability" or "sustainable", 64 containing "environment", nine containing "agroecology", and 30 containing "low-carbon". Finally, after an initial round of coding, we further limited the selection of articles to those (co)authored by individuals with most influence over Embrapa's public-facing communication and thus the framing of its mission and corresponding visions of sustainability as a research organization. These authors included three Embrapa presidents (including one Embrapa co-founder), the heads of eight Embrapa research units, one executive director, and one senior researcher, resulting in a total of 55 articles. This means that a large number of articles, presenting a heterogeneity of topics and positions, were excluded from analysis. Nonetheless, our selection fits with the aim of understanding how Embrapa's leadership portrays the organization through its public framing.

A last search query for the names of the first authors already present in the dataset resulted in an additional two articles by an Embrapa president, resulting in a final set of 57 news articles (supplementary material: Appendix B). The two additional articles did not contain any of the keywords. One did employ the concept of environmental "resilience", while the other discussed the role of science and was therefore also deemed relevant for our analysis. Furthermore, the dataset was comprised of 52 articles containing "sustainability", "sustainable", *or* "environment". Of these, 11 articles contained "low-carbon", and one article contained "agroecology". Additionally, one article contained all five keywords, and two articles contained only "low-carbon".

Although all articles were retrieved through Embrapa's news archive, several articles were originally published in major daily newspapers. Over one third of the articles (20) were originally published in *Correio Braziliense*—which is among the ten newspapers of largest circulation in Brazil (Yahya 2021). Of these, nearly all (18) were authored by Embrapa's former president Maurício Lopes (2012–2018). Another three articles were originally published in *O Estado de São Paulo*—including one by former president Celso Moretti (2019–2023)—that has the third largest circulation in Brazil (idem). Finally, three articles were published in the *Zero Hora* newspaper, and the remaining 31 articles were published on Embrapa's website.

We initially coded the news articles inductively according to a variety of emerging themes. These were eventually narrowed down to four main themes: food security, knowledge & technology, markets, and land & nature. The articles were then coded deductively based on the four themes, allowing for the identification of four interrelated frames, presented in more detail in the next section. After defining the four frames, we proceeded to identify signature framing devices such as keywords and catchphrases. The importance of words and phrases was judged based on their power to summarize a central idea in a concise and direct way (Van Gorp 2007), as well as on parallels with insights into the Brazilian context as described above. To identify reasoning devices, we focused on sentences or paragraphs containing problem definitions, proposed solutions, as well as corresponding justifications and related goals, values, and beliefs (see Van Gorp and van der Goot 2012). These were compared to the framing devices to define which reasoning devices were central to each frame. The main framing and reasoning devices for each frame are summarized in a frame matrix (Table 1).

## Results

### Food security and sustainability

In this first frame emerging from our dataset, the articles highlight Embrapa's role in developing knowledge and technology to address food insecurity and meet shifting consumer demand. This corresponds directly with Embrapa's mission mentioned above, concerning the development of technological solutions for the benefit of society. Pointing to consumers' heightened demands for sustainability, Embrapa's leadership presents solutions such as carbon-neutral meat. Within these themes, both food security and sustainability are reasoned from a position of scientific progress as a means of serving societal needs, while at the same time justifying progress towards these needs within a wider frame of Brazilian exceptionalism.

A common framing device concerning food security in the articles reviewed centers around food scarcity. This frame is expressed through global projections indicating the need for increased global food production. For example, references to United Nations projections that global "population will exceed 9.2 billion by 2050" are combined with references to "FAO estimates ... that twice as much food will be consumed (by 2050) than is currently produced" (E15-h). The use of these framing devices create a broad justification for the expansion of food production in Brazil. These statements also position the knowledge produced by Embrapa as central to any expansion: through its research, Embrapa is "proud to be a protagonist in the ... development of rural and urban populations in Brazil" (E18-q).

Sustainability is also used in framing devices that give recognition to a growing number of better-informed consumers, who demand sustainably produced food. The role of consumers is highlighted, for example, by Embrapa's former president Maurício Lopes who refers to "a better-informed and more demanding society that, more than mere advertising and merchandise, demands transparency and value delivery" (E15-d). Consumer demands for transparency, value and sustainability are linked in other articles to foodstuffs with a high environmental footprint, such as beef. This is made most explicit by a former head of research and development at Embrapa, who links "... a growing demand for beef to meet the growth of the Brazilian and world population" with a "consumer ... [who is] increasingly exigent about food safety and the associated sustainability" (E17-i).

A number of underlying reasoning devices related to food security are observed in the articles reviewed that provide self-justification for Embrapa as an independent science and technology provider for sustainable food production. In doing so, the articles frame the role of scientists as responding to external developments, specifically societal demand, rather than themselves playing a role in shaping demand or its corresponding production systems. This aligns with Embrapa's broader framing as a research organization attending to changing demands from governments and industries—e.g. Embrapa's 2020a, b master plan (Embrapa 2020b)—as will also become clear in the remaining frames. The perceived independence of its research is evident in the presentation of sustainable beef production in the form of "carbon-neutral meat". The reasoning device present in this framing implies the need for win-win solutions where sustainability goals are met without compromising consumer demand. This in turn takes demand as given rather than as a social construct (Streeck 2012). The presentation of carbon-neutral meat is, however, reasoned through a strong normative position of support to the Brazilian beef industry. Not only are these new production systems "an unprecedented approach to beef production in the tropics, with no net carbon emissions and with solid scientific backing"

**Table 1** Framing and Reasoning Devices Sentences from the news articles were condensed to capture the essence of key framing devices

	Framing devices	Reasoning devices
Frame 1: Food security and sustainability	<p>A better-informed and more demanding society</p> <p>Brazilian agribusiness bears the responsibility to <i>feed the world</i></p> <p><i>Brazil is ready</i> to be the world's largest producer of sustainable food</p> <p>There is <i>no doubt</i> that Brazil can meet future food demand</p>	<p>Demand for more sustainable products is met through Embrapa's technological development</p> <p>Demands are external. Embrapa responds to the needs of society but does not itself shape those needs</p> <p>Win–win relationship between producing sustainably and meeting consumer demand</p> <p>National exceptionalism: Brazilian agriculture is exceptionally sustainable, making it competitive in global markets</p>
Frame 2: Science-driven agriculture	<p><i>Few other countries</i> are prepared to face future challenges like Brazil is</p> <p>Record harvests germinated in research institutions and were planted in the Brazilian soil in the form of technological innovations</p> <p>Science: the manure of Brazilian agriculture</p> <p>No science, no progress, no future</p> <p>Technology frees man from the shackles of nature</p> <p>The clash between knowledge and ignorance</p>	<p>Conventional agriculture can be made sustainable through implementation of technological fixes</p> <p>Sustainable agriculture consists of reducing the environmental impact of large-scale monoculture</p> <p>Primacy of Embrapa's technical and scientific knowledge in addressing the challenges of Brazilian agriculture</p> <p>Technological determinism and reductionism: technological innovation is the <i>only way</i> and the main success factor</p> <p>Knowledge deficit model: solving the problem entails producing more technoscientific knowledge</p>
Frame 3: Sustainable intensification and international competitiveness	<p>Spectacular and extraordinary increases in productivity</p> <p>Today, we have more forests, more agriculture, and more cattle</p> <p>Sustainability is a matter of survival for businesses</p> <p>Sustainability as an <i>inexorable path</i></p> <p>The <i>imperative of sustainability</i></p> <p>Need to <i>demystify legends</i> and <i>strengthen the image</i> of agribusiness</p>	<p>Main goal of technological advances is to increase efficiency and productivity for the sake of competitiveness</p> <p>Win–win relationship: sustainability and competitiveness as mutually reinforcing</p> <p>Sustainability as part of the market imperative</p> <p>States use sustainability-based trade restrictions as a geopolitical instrument rather than as a genuine effort toward more sustainable agriculture</p>
Frame 4: Sparing land for nature	<p><i>No other country</i> protects as much land as Brazil</p> <p>Brazilian agribusiness as an example with <i>no equivalent</i> in the world</p> <p>Brazil as <i>responsible leader</i></p> <p>Brazil as agricultural and environmental <i>powerhouse</i></p> <p>Brazil's agricultural success is <i>a saga</i> that all Brazilians should know</p>	<p>Brazilian agriculture is already sustainable because it involves land sparing through environmental protection areas</p> <p>Sustainability as geopolitical instrument: Brazil is unjustly accused of environmental irresponsibility by foreign powers</p> <p>Linear technological progress has resulted in productivity increases making the scale factor less relevant and enabling more land conservation</p> <p>It is in the national interest to promote and expand Brazil's agricultural sector</p>

(E15-a), they offer “a concrete response from Brazil to the global crusade against cattle farming” (E18-f).

This last quote reflects a broader reasoning identified in the articles, namely that of justifying Embrapa's provision of scientific knowledge to the industrial food sector as a means to refute international reproachment. Embrapa's role was framed as that of building a “(positive) reputation of Brazil's agricultural products ... to neutralize negative perceptions abroad” with the justification that “... truths or half-truths, these issues can affect both the quantities exported and the value of the products” (E19-d). Throughout these examples,

the exceptional capacity of Brazilian agribusiness to feed the nation and the world is repeated. As one article states: “Only a few countries, in the last decades, have developed agricultural production technology and are prepared to face such [sustainability] challenges. They can feed their own population and that of other countries. This is the case of Brazil, a unique example in the world's tropical belt” (E19-b). In other words, Brazilian agribusiness, and by extension Embrapa, are cast as taking on the responsibility of feeding the world and meeting consumer demand through sustainable technologies.

## Science-driven agriculture

This frame emphasizes the importance of science and technology in driving sustainable agricultural development. Within this frame scientific knowledge is presented as a fundamental pillar of progress because of its purported data-driven objectivity. This objectivity is in turn reinforced by the provision of meeting the data needs of an increasingly professional Brazilian agri-business sector—with the implication that non-data based forms of knowledge are excluded. The essence of this frame is captured by a 2020 report titled *Science-driven agriculture*—in Portuguese, *Agricultura movida a Ciência* (Embrapa 2020a).

The framing devices used within this frame position science and technology as the main drivers of both Brazilian agriculture and societal progress. Positioning science and technology so centrally in the success of Brazilian agriculture places Embrapa, albeit often implicitly, as an institution that is central to a national narrative of development and progress. One article written by Embrapa president Celso Moretti (2019–2023) does make this link explicit. Moretti not only claims that “Brazilian agriculture is science-driven” but also that “few countries can claim the same” (E20-a). Moretti continues by positioning agriculture in strongly nationalistic terms, reflecting on the transformation that Brazil has undergone in “less than five decades ... from being an importer to becoming one of the largest exporters of food, fiber, and bioenergy in the world”. This, he implies, is not only a success in economic terms, but also “a saga that all Brazilians, in the countryside and in the city, should know” (E20-a).

Wider statements of technology’s singular role in shaping agricultural development are expressed throughout the data. For example, Embrapa’s co-founder and former president Eliseu Alves (1979–1984) states that the science and technology developed by Embrapa are a means of “free[ing] man (sic.) from the shackles of the market and of nature” (E16-a). This and other articles employ multiple interlinked framing devices to shape this wider observation. First, technology’s contribution is presented as a means of growing absolute production. For example, using agricultural census data to argue that “[in 2006] technology was responsible for almost 70% of the growth in grain production, while in 1996, technology was responsible for 50% of the increase in grain production” (E17-e). Second, technology is framed as a necessary way to achieve sustainable food production. This is expressed both by asserting that there is “no doubt about the importance of technology in the increase of production” (E17-e), and absolute statements that “the use of digital technology in the routines of rural properties is not a matter of choice, but a mandatory path to make agriculture more competitive ... to serve the sustainable development of Brazilian agriculture” (E18-a). Finally, emphasis is given

to particular technologies, notably crop-livestock integration and no-till farming, that were central in the Ministry of Agriculture’s Low-carbon Agriculture Plan (MAPA 2012), being repeatedly presented as examples of sustainable agriculture in the news articles (e.g. E15-g, E17-c, E18-n, E19-g, E20-a). The underlying reasoning in highlighting these technologies—referred to by Filho (2008) as *mild technologies*—is that sustainable agriculture consists mainly of reducing the environmental impact of large-scale monoculture, while largely keeping this production system in place.

Underpinning these wider statements is the use of technology as a fix to agricultural sustainability. This reasoning device is used in many of the articles reviewed as a means of justifying Embrapa’s ongoing investment in science-based technology development as objective, pragmatic and solution-oriented. Across the articles, *technology* refers to techniques enhancing low-carbon forms of production (Vinholis et al. 2021) and to the management and use of big data in industrial or large-scale farming. In many cases, Embrapa’s role in providing technology is justified by the need for farmers to develop a very high degree of professionalism to meet the demands of “modern agriculture” (E20-c). In this context, Embrapa offers itself as “a professional [organisation] who can provide [farmers] with the necessary information for the sustainability of their business” to meet these demands (E20-c).

Furthermore, this frame suggests that such professionalism is made possible through the management and use of “advanced tools ... capable of considering multiple data sources and possibilities ... [that] allow for the identification of trends and patterns, extending the human capacity to analyse and interpret uncertainties of great complexity” (E15-c). By enabling farmers to collect and analyse these uncertainties and complexities it is possible, Embrapa leaders argue, to overcome systemic risks to the current food system. As the same article continues, “Living will continue to be dangerous. The good news is that our ability to generate data and operate advanced intelligence tools can allow us to build a less risky, more enjoyable and sustainable life” (E15-c). Another reasoning device that becomes apparent consists of defining problems as stemming from a knowledge deficit. Accordingly, more knowledge acquired through scientific research offers a solution to these problems – a view that is often challenged when discussing complex sustainability-related problems (e.g. Scoones and Stirling 2020).

## Sustainable intensification and international competitiveness

The third frame emerging from our data builds further on the role of technology by stressing its value to achieving sustainability and safeguarding the competitiveness of Brazilian agriculture internationally. This framing increases from

2017 onwards as the concept of *sustainable intensification* emerges in the wider food systems literature (e.g. Mahon et al. 2017; Rockström et al. 2017). As Embrapa's Executive Director of Innovation and Technology explicitly states, "there are clear signs that emphasis must be placed on sustainable intensification for the production of food, fiber and agro-energy" (E18-m).

The main framing device employed across the articles referred to the role of technology in boosting agricultural productivity. In this framing, productivity is expressed in terms of yield per cultivated area. For example, as one article stated, "cultivated area has grown by 61%, while production has increased by 310%, [representing] a spectacular increase in productivity" (E18-o). This intensification of production is also identified as central to the overall sustainability of the agricultural sector because it reduces or even prevents further land conversion, as will be further elaborated in the next section. Relatedly, another article states that "the sustainability agenda is an agenda of productivity and efficiency" (E20-b). Efficiency is generally framed as measures leading to lower production costs—for example, "Reducing the use of pesticides and fertilizers by improving their efficiency would significantly reduce production costs of farming" (E17-c).

Linking to previous frames, efficiency and productivity increases are used to symbolize the use of technology to foster sustainable intensification, which serves environmental purposes while simultaneously making Brazilian agriculture more competitive in global markets. Competitiveness here entails aptly responding to market signals, particularly regarding sustainability standards, while ensuring profitability. This way, it becomes clear that the framing of sustainability is strongly tied to market incentives. The following example shows how sustainability is framed as a matter of survival for businesses: "If consumers have their demands for sustainability increased, (...) the issue of sustainability becomes something of the utmost relevance for all links in the supply chain, and in some situations even a matter of survival" (E20-b).

As suggested by the idea of sustainable intensification and similarly to the *Food security and sustainability* frame, the main reasoning device evident in this frame is the establishment of a win–win relationship between environmental and economic goals; that is, sustainability does not have to come at the cost of competitiveness and vice-versa, because they are both the logical result of the push for productivity increases. A 2012 journal publication by key Embrapa figures confirms this reasoning: in it, the authors argue that "agricultural production systems, and thus agricultural research, should design strategies that create win–win situations, that is, simultaneous gains in all sustainability dimensions" (Martha et al. 2012, 221).

Furthermore, such a win–win relationship is underpinned by an assumption that, linked to Embrapa's provision of

technology, technologies supporting intensification have already overcome many sustainability challenges faced in Brazilian agriculture. As expressed by the head of Embrapa Environment, "past production increase was based on expanding the area without much concern for the consequences", whereas, he continues, "today agricultural growth is guided by productivity gains and environmental concern" (E20-f). Not only is technology central to this expansion in his argumentation, he reasons that Embrapa's science has "already proven that it is possible to produce and to preserve" (E20-f). This argument relates to the assertion that technology, and not cultivated area, is the main factor determining differences in farm income, which is presented as a truism in Embrapa's broader framing (e.g. Alves, Souza, and Marra 2017; Navarro and Alves 2016).

Two additional reasoning devices are used to further argue the role of science and technology in linking sustainability and efficiency. First, sustainability is cast as having already become an intrinsic part of "generat[ing] a competitive advantage" (E20-f). In line with the emphasis on competitiveness mentioned above, some articles refer to increasingly exigent buyers on the global market demanding food produced using sustainable technologies. For example, "Continuing to occupy international markets is a great challenge we face, because foreign buyers are increasingly demanding when it comes to the production model used. Therefore, it is not enough just to produce more, it is necessary to produce sustainably" (E20-d). Second, sustainability is cast as a geopolitical instrument in the context of international trade relations. In response, multiple articles argue that the only way to overcome trade barriers imposed by importing countries is to develop a 'positive reputation' or to 'improve the image' of Brazilian agribusiness by disseminating Embrapa's evidence of its successes regarding sustainable agricultural development—echoing the goals set by Embrapa's communication policy (Duarte and Silva 2007). As one article argues, "The environmental barrier is already being masterfully handled by the agricultural sector in Brazil ... In the last 10 years, [sustainable technologies] allowed the Brazilian livestock sector to reduce its greenhouse gas emissions per ton of meat at a rate of 4.5% a year ... Brazil has technologies, production systems, public policies and institutions that guarantee its good environmental reputation" (E19-d). Both of these reasoning devices, reflecting the aforementioned sense of Brazilian exceptionalism, link technology-driven efficiency to a wider view of unfair international scrutiny that is not based on genuine environmental concern.

### **Sparing land for nature**

The final frame that emerges from the articles reviewed emphasizes the role of nature protection as evidence for



the sustainability of Brazilian agriculture. In doing so, the authors stress the interaction between the area of land under nature protection and the area used for agriculture following the logic of *land sparing over land sharing* (e.g. Baudron et al. 2021). That is, assigning different parts of an area to either agriculture or conservation, rather than adopting a holistic ecosystems approach to sustainable farming.

A key framing device employed in the articles reviewed compares the percentage of land destined for agriculture and nature preservation and conservation. For example, one article written by the head of Embrapa Coastal Plains stated that “satellite images prove that the area occupied by agriculture covers 7.8% of the national territory”, which is juxtaposed against “a total of 61% of preserved native vegetation throughout the Brazilian territory” (E18-b). As the same article continues, the relatively low proportion of land being used for food production “positions Brazil on a different level of environmental responsibility, especially when compared with other countries” given that “[l]and use for agriculture amounts to 45% to 65% of the territory in the European Union, 17.7% in China, 60.5% in India, and 18.3% in the United States” (E18-b). The logical outcome posed by these figures is that “Brazil must look upon its partners with pride when accused of environmental irresponsibility” (E18-b). This framing is reflected beyond Embrapa, being reproduced by powerful agribusiness actors (CNA 2018; Agrosaber 2020).

In presenting the evidence of Brazil’s environmental responsibility, the authors refer to satellite images, by which their claims are framed as credible and valid since these are presumably based on the objective analysis of said images. At the same time, much is not specified when referring to the numbers, including whether they also account for livestock. This is relevant because, in Brazil, agriculture and livestock are often framed as separate categories—which becomes visible in names such as the Ministry of Agriculture, Livestock and Food Supply. Cattle farming remains a predominantly extensive practice in Brazil, being responsible for land degradation and greenhouse gas emissions (Cerri et al. 2016; Pereira et al. 2020a, b). Leaving livestock out of the equation would therefore produce a distorted representation of reality. Regardless, it becomes clear that the main reasoning device is the construction of a simple dichotomy between land for *nature* and land for *agriculture*, presenting an apparently straightforward issue with an equally straightforward solution. The underlying assumption is that nature protection areas will offset the impact of agricultural production.

Accordingly, the main reasoning device used to justify land sparing is based on Brazil’s Forest Code, which is consistently argued to be a unique and essential piece of environmental legislation. The Forest Code determines which areas in a rural property can be farmed on and which must be preserved with natural vegetation. The latter includes a

Legal Reserve Area that comprises 80% of the property in the Amazon biome and 20% in most other regions (Soares-Filho et al. 2014). Through reference to the Forest Code, Brazilian agribusiness is reasoned to be the main contributor to environmental protection. As demonstrated in an article written by the head of Embrapa Territorial, the “468,000 rural properties” in the Amazon biome represent “a total area of 103.1 million hectares... dedicated to the preservation of native vegetation” corresponding to “24.6% of the Amazon biome” (E18-j). Based on these figures the author concludes that, thanks to the Forest Code, “the rural world preserves, in the midst of its productive activities, a quarter of the Amazon biome” (E18-j).

Such argumentation once again sets up a simplified dichotomy; this time between legal and illegal land use. As long as productive activities are in compliance with the law, particularly the Forest Code, they can be assumed to be sustainable. In doing so, such argumentation does not reflect other evidence (Azevedo et al. 2017; Vieira et al. 2018; Gibbs et al. 2015) that the Forest Code has allowed for the conversion of massive areas outside the Amazon, and presents serious limitations in terms of biodiversity conservation. This reflects another reasoning device that permeates the four frames identified, namely a strong quantitative orientation in defining problems and solutions. The land sparing example makes this very clear as the main concern is on the area’s size rather than its ecosystemic functions.

## Discussion

The four key frames identified, as presented through their corresponding framing and reasoning devices, legitimize Brazil’s position as a food producer by linking scientific objectivity to broader political debates around the sustainability and international competitiveness of Brazilian food production. Our results demonstrate how the public communication of Embrapa’s leadership positions it as a leading research organization setting the parameters for agricultural science and technology in Brazil (consonant with Nehring 2016; and Cabral 2021).

Whether Embrapa’s trajectory of success will continue into the future is subject to debate. In recent years, mentions of Embrapa’s potential privatization sparked intense debate (Marko and Centeno 2022; Portal CUT 2020). Embrapa has also lost its decades-long dominant position in soybean research to Monsanto (Bonacelli et al. 2015). Relatedly, the organization has received internal criticism for having become excessively bureaucratic and for failing to keep up with increasing rates of technological innovation in the private sector (Navarro 2018; Camargo Neto 2018; Ming 2018). Despite all this, Embrapa continues to be framed as a leader in scientific excellence (e.g. Pastore 2023). This

includes allusions to Embrapa's glorious past that play into current narratives of future progress (Cabral, Pandey, and Xu 2022).

Accordingly, we identify a pattern of framing devices based on the use of scientific facts and figures to characterize problems and solutions in the Brazilian food system. The framing devices used focus on the enumeration of practices such as no-till farming and integrated farming systems. Whereas these solutions can fit both conventional and agroecological approaches, the reasoning devices reveal how underlying assumptions and values reify existing forms of production rather than open up new or alternative ways of farming. This is corroborated by Filho (2008) who shows that, despite the growth in research on greener technologies at Embrapa, a technologically driven productivist model of agriculture has persisted within the organization that is compatible with input-intensive monoculture.

### **Three logics of agrifood research**

Our results show a set of recurrent reasoning devices that reproduce and reinforce technology-led, intensive food production and close down debate on and potential opportunities for alternative forms of production. Following Leach (2015), these reasoning devices reveal a politics of knowledge that underscore whether or not deep sustainability transformations can be made possible, as they justify certain agricultural practices based on particular logics (Van Gorp 2007). We synthesize the range of reasoning devices into three food system *logics* that, reflecting our results, maintain rather than transform extractive, industrial forms of production over agroecological alternatives.

First, we observe a set of reasoning devices that use a logic of control that obscures both deep uncertainties (Stirling 2010) and the normative dimension of decision making surrounding sustainable food production (Deijl and Duncan 2021). Both the *science-driven agriculture* and *sparing land for nature* frames, for instance, suggest seemingly uncontested paths forward. These frames highlight science's role in making problems legible and amenable to ever greater state regulation—in accordance with what Scott (1998) refers to as the *imposition of legibility*. Not only does greater legibility, i.e. control, enable changes to land allocation and yield management, it may also lead to a wider system of accumulation and exploitation (Oliveira 2013, p. 279). As shown by the example of the Forest Code, the imposition of legibility on private land suggests enhanced state control and reduces land use conflicts to a matter of jurisdiction imposed from the top-down. Accordingly, this framing reveals a shallow definition of sustainability that subsumes diverse land uses into conventional agricultural production systems. Furthermore, the logic of control also includes the persistent techno-fix reasoning used to frame problems as stemming

from either a lack of or inappropriate use of scientific knowledge and technology. Such reasoning suggests certainty about the best solution, while neglecting various sources of uncertainty (Scoones and Stirling 2020) and subsuming norms and values that may underpin alternative forms of production (Deijl and Duncan 2021). The issue, as such, is not only that scientific knowledge is framed as the only *true* knowledge, but that the framing of particular solutions as *scientific* serves to promote them as the only plausible path.

Second, we observe a set of reasoning devices that employ a logic of efficiency that reifies predominant forms of knowledge underpinning current agri-food systems. Our results show how Embrapa's ambition for sustainable intensification is reasoned as a solution for simultaneously achieving sustainability and competitiveness. That is, it is argued that these goals can be reconciled through efficiency gains leading to reduced costs and higher productivity expressed in quantitative terms as higher yield per hectare. This logic of efficiency is further supported by positing more efficient technologies and practices as key to Brazilian producers' success in meeting global demands for sustainable products. A common example of such market mechanisms analyzed in the literature are zero-deforestation commitments (Garrett et al. 2019; Pereira et al. 2020a, b; Ermgassen et al. 2020). However, claims of Brazil's success seem overstated considering that this literature points at several limitations that reduce the effectiveness of such commitments. Similarly, mentions of Brazil's large areas of land sparing for conservation emphasize the inherent efficiency of Brazilian agriculture, omitting evidence of rising forest degradation in recent years (Ferrante, Andrade, and Fearnside 2021; Yuanwei et al. 2021). The outcome of such framing is that sustainability becomes seen as a function of increased efficiency gains which, building on prevailing food system thinking, (Gaitán-Cremaschi et al. 2019; Clapp 2017), justifies business as usual rather than any need for structural change.

Third, we see a logic of competition pervade Embrapa's public communications that emphasizes Brazilian exceptionalism in global markets and policy debates. In doing so, Embrapa's leadership frames Brazilian agriculture as being unfairly judged, particularly by foreign actors. As outlined above, its counter-frame is that the scale, efficiency and sustainability of agricultural production, as well as the contribution to global food security, means that Brazil's agricultural sector is relatively sustainable and must be allowed to compete fairly. This framing appears to dismiss various claims made internationally around biodiversity and land use change and in turn discredit what are seen as Brazil's competitors and opponents—alluding to what Milhorange (2022, p. 759) describes as “the populist narrative of a ‘foreign enemy’ interested in Brazil's natural resources” (see also Fearnside 2018). This logic of competition works to

discredit a more critical set of arguments from abroad and within the country regarding the environmental performance of Brazil's agricultural industry (e.g. Branford and Borges 2019; Wasley 2021). Seen as such, this logic of competition again reinforces the use of framing and reasoning devices that support solutions aimed at greening large-scale industrial agriculture, while obscuring alternatives such as agroecology that might lead to deeper transformations.

### Implications for food systems transformation

In the introduction to this article we describe our understanding of frames as reflecting actors' deep-seated assumptions. Drawing on previous work by Gamson et al. (1983; 1989) and Van Gorp (2007), we employ the concepts of framing and reasoning devices to distinguish between more shallow aspects of framing and the deeper logics underpinning them. Accordingly, the three logics that emerge from our analysis demonstrate a deeper level of framing, tied to the politics of agricultural research systems that limit opportunities for alternative narratives and visions for the Brazilian food system. The emphasis on techno-optimist solutions displayed throughout the identified frames echoes dominant approaches in global food governance, as confirmed by the wider food systems literature (Turnhout et al. 2021; Vanloqueren and Baret 2009).

Although the enumeration of techniques and practices aligned with agroecological approaches was present as framing devices in the Embrapa news articles, we observe that the underlying assumptions and values present in the corresponding reasoning devices reinforce the interests of powerful agribusiness actors. In other words, we identify mostly shallow changes in Embrapa's framing, based on the conclusion that the deeper logics are not fundamentally changed. The data analyzed in this paper does not allow us to make definitive claims regarding the material outcomes of this discursive dynamic, but other authors have pointed at the persistence of similarly shallow interventions in environmental governance and their implications for system-wide transformation. In particular, in researching leverage points for sustainability transformations, Abson et al. (2017, p. 33) observe that: "policy interventions (in their role as *levers*) have typically targeted shallow leverage points, failing to address issues of design and intent." While the authors recognize that "such 'shallow' interventions are important and can generate beneficial outcomes", they argue that, on their own, these interventions "are unlikely to lead to transformational change" (ibid.). Comparably, it can be expected that the continued emphasis on the logics of efficiency, control, and competition by Embrapa's leadership reinforces a pattern of shallow change in Brazil's food systems.

It is important to reiterate that our analysis focused on Embrapa's public-facing communication steered by

leadership figures within the organization. As is to be expected, any organization of Embrapa's size is made up of individuals representing heterogeneous positions and holding a diversity of values and beliefs. Nonetheless, through Embrapa's corporate communication, the Embrapa brand is promoted based on a unified mission and vision that makes it easily recognizable to the public. If anything, our results evidence the exclusion of divergent Embrapa voices in its public branding, as also shown elsewhere (Cabral 2021). This internal heterogeneity notwithstanding, the dominant framing shaping Embrapa's communication is ultimately enmeshed with its research agenda and cannot be ignored when considering Embrapa's role in shaping Brazil's food futures.

In sum, our findings show that science and its institutions are often harnessed to justify particular solutions and goals, highlighting the need to make the politics of scientific knowledge production explicit (Nehring 2016). Recognizing and addressing this politics involves, among others, effectively including and recognizing the role of multiple sources and forms of knowledge, as already stressed in the food systems and sustainability transformations literatures (Abson et al. 2017; Leach 2015; Turnhout et al. 2021). Although the diversity of research approaches and lines of inquiry within Embrapa was incrementally broadened over time (Filho 2008), we argue that its narrow framing of sustainability aligned with the dominant productivist paradigm (Gaitán-Cremaschi et al. 2019) continues to form a key obstacle to larger proliferation of research and development based on diverse understandings of sustainability and sustainable agriculture.

### Conclusion

Our analysis of Embrapa's public framing by the organization's leadership sheds light on the underlying assumptions, summarized as three logics, that remain largely unchallenged. We have also observed that, as a large organization composed of numerous decentralized research units, Embrapa hosts a diversity of professionals, likely not all of whom are aligned with the dominant framing. This heterogeneity is confirmed by previous research on Embrapa (Cabral 2021; Filho 2008). At the same time, these and other studies also confirm the construction of Embrapa's unified brand throughout its history (Nehring 2016; Júnior et al. 2009). We conclude that diverging perspectives within Embrapa are largely excluded from its public framing.

Our results provide a way of understanding how deep-seated assumptions reproduced through framing may allow for changes in technical parameters—in this case the technological fixes presented in the articles analyzed—while nonetheless forming a barrier toward system-wide change,

as that framing ultimately reinforces dominant ways of knowing and doing. Considering the limited scope of our analysis, further research is needed to better determine how Embrapa's framing impacts the production of knowledge within the organization. For example, future research should explore the ways in which Embrapa researchers dedicated to the pursuit of agroecological and other alternative solutions are affected by the organization's overarching framing tied to its corporate communication strategy.

Despite these limitations, our findings show that Embrapa's prevalent framing reinforces narrow visions of sustainability rather than a shift toward fundamental transformation. Based on an understanding of framing as shaping which solutions become seen as plausible and desirable, it can be assumed that this framing to some extent limits the exploration of alternatives within the organization. More broadly, the current study underscores the role of framing as part of scientific research organizations' public communication. Whether or not these organizations are formed by a wide diversity of experts, it matters what frames are being propagated and which groups within the organization are shaping these frames. In other words, fostering internal diversity might be no guarantee for the effective promotion of different paths toward sustainability. Research on international expert organizations such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the Intergovernmental Panel on Climate Change (IPCC) provides examples of the challenges of promoting diverse views and knowledges in heterogeneous organizations (Borie et al. 2021; Díaz-Reviriego et al. 2019).

In line with Cabral (2021), we conclude that the prevalent framing in Embrapa's branding offers a simplified history of Brazilian agriculture that obscures the organization's heterogeneous heritage. This heterogeneity in itself weakens claims regarding the unavoidability of a certain technological trajectory as expressed in the frames discussed here. Such frames, in which a particular solution to complex sustainability challenges is presented as *the only way*, must not be seen to represent science as such, even if their proponents appeal to claims of scientific soundness to gather legitimacy. Defining which way to go in working toward sustainable food and agriculture is a fundamentally political decision and must be recognized as such. A first step in this direction in the case of Embrapa would be to include its internal diversity more emphatically in its communication and branding.

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## Declarations

**Conflict of interest** The authors declare no conflict of interest.

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**Maíra de Jong van Lier** is a PhD candidate in the Environmental Policy Group at Wageningen University in the Netherlands. She holds a MSc in Environmental Sciences from Wageningen University with a thesis on agricultural expansion narratives in the Brazilian savanna. Her research interests include governance and transformation of agri-food systems, agricultural research and development (R&D) policy, and social movements. Her current research explores the politics of knowledge production among scientists, farmers, and agricultural advisors in Brazil and its implications for food systems transformation.

**Jessica Duncan** is Associate Professor in the Politics of Food System Transformations in the Rural Sociology Group at Wageningen University in the Netherlands. She holds a PhD in Food Policy from City University, London. She is an ambassador and founding member of the Centre for Unusual Collaborations and sits on the editorial board of the journal *Sociologia Ruralis*. Her research pushes for new ways of understanding and designing food governance processes to support just and sustainable transformations.

**Annah Lake Zhu** is Assistant Professor of Environmental Policy at Wageningen University in the Netherlands. She holds a PhD in Society and Environment from the University of California, Berkeley and a MSc in Environmental Management from Duke University. She studies globalization and the environment from an ethnographic perspective.

**Simon Bush** is Professor of Environmental Policy at Wageningen University in the Netherlands. His research focuses on the global governance of sustainable, healthy and inclusive food system transformations.