Food systems transformations in South America: Insights from a transdisciplinary process rooted in Uruguay

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The wicked nature of sustainability challenges facing food systems demands intentional and synergistic actions at multiple scales and sectors. The Southern Cone of Latin America, with its historical legacy of "feeding the world," presents interesting opportunities for generating insights into potential trajectories and processes for food system transformation. To foster such changes would require the development of collective understanding and agency to effectively realize purposeful and well-informed action toward desirable and sustainable food futures. This in turn demands the transdisciplinary engagement of academia, the private sector, government/policy-makers, community groups, and other institutions, as well as the broader society as food consumers. While the need for contextualized knowledge, priorities and definitions of what sustainable food systems change means is recognized, there is limited literature reporting these differences and critically reflecting on the role of knowledge brokers in knowledge co-production processes. The political nature of these issues requires arenas for dialogue and learning that are cross-sectoral and transcend knowledge generation. This paper presents a case study developed by SARAS Institute, a bridging organization based in Uruguay. This international community of practice co-designed a 3-year multi-stakeholder transdisciplinary process entitled "Knowledges on the Table." We describe how the process was designed, structured, and facilitated around three phases, two analytical levels and through principles of knowledge co-production. The case study and its insights offer a model that could be useful to

inform similar processes led by transdisciplinary communities of practice or bridging institutions in the early stages of transformative work. In itself, it also represents a unique approach to generate a language of collaboration, dialogue, and imagination informed by design skills and methods. While this is part of a longer-term process toward capitalizing on still-unfolding insights and coalitions, we hope that this example helps inspire similar initiatives to imagine, support, and realize contextualized sustainable food system transformations.

Introduction

Scholarly literature has firmly established the urgent need to transform our globalized food systems if society is to secure a sustainable future (Gordon et al., 2017; Pereira et al., 2020; Dengerink et al., 2021; Hebinck et al., 2021). The dynamics and practices that compound food systems are at the core of many crucial issues, including justice, health, poverty, climate change, land use change, loss of biological and cultural diversity, development and human wellbeing (Foley et al., 2005; Whitmee et al., 2015; Lartey et al., 2018; Leach et al., 2018; Rockström et al., 2020). However, while these dynamics significantly connect the local to the global in multiple and intricate ways, transitional processes will likely adopt different orientations and strategies depending on the context-specific needs and priorities, or the network of actors that define them (Dengerink et al., 2021).

For the purpose of this paper we understand transformations as ethico-political (Scoones et al., 2020; Merçon, 2021) and social-learning processes that transcend scientific domains, disciplines, or siloed sectors (e.g., government). This requires understanding, mobilization of collective imagination and purposeful action in processes that need to be transdisciplinary (Pohl and Hadorn, 2007; Fazey et al., 2020; Norström et al., 2020). Many definitions and terms are used to refer to this type of problem-driven, action- and often solution-oriented research. Some examples include post-normal science, type-2, participatory action-research, co-design, knowledge co-production, and transdisciplinarity (Pohl and Hadorn, 2007; Lang et al., 2012; OECD, 2020; Chambers et al., 2021).

An emergent transformational approach (Anderson and McLachlan, 2016) in sustainability science (Miller et al., 2011) has surpassed the so-called knowledge deficit assumption (Howarth et al., 2022; Matsumoto et al., 2022). It posits the need for moving from knowledge to action in ways that engage the different voices and needs at stake (Grunwald, 2004; Tengö et al., 2014; Pereira et al., 2019). While different understandings of transdisciplinarity exist (Cundill et al., 2015),

they most generally imply an improved agency and capacities for action in two ways. First, through the collaboration of participants from different sectors and levels of society (e.g., community organizations, government, industry), aimed at integrating diverse knowledge systems (e.g., modern science, traditional/indigenous knowledge) and generate mutual learning to address locally relevant problems. Secondly, *via* the role that knowledge brokers (often researchers) play in starting or supporting such change processes, known as doing boundary crossing work (Hefetz and Ben-Zvi, 2020). Research institutions labeled as "bridging organizations" play a key role (Hahn et al., 2006) expanding the science-policy interface to allow for improved cross-sector, multi-level collaboration (Folke et al., 2005; Kowalski and Jenkins, 2015). These "arenas" for dialogue can be initiated bottom-up, top-down or from research institutes or other non-governmental organizations, and imply a concerted and directed effort at enabling learning and collaboration for solving socio-ecological problems (Hahn et al., 2006). Similarly, groups not necessarily anchored in a single institution form communities of practice (CoPs; Wenger, 1999) to advance knowledge, methods, tools, and practices in relation to a common interest or need. Such initiatives can create "social learning" platforms (Bergmann et al., 2021) that engage a multiplicity of participants concerned with particular issues to exchange and experiment in advancing solutions. Examples of CoPs abound in educational settings (Tseng and Kuo, 2014; Hernández-Soto et al., 2020; Merçon, 2021) where background areas (disciplines) and perspectives share affinities. However, there is an emerging interest in the role that such CoPs play in transdisciplinary processes addressing socio-ecological issues, especially in confronting the challenge of engaging very different domains (e.g., academic disciplines or sectors) and those "less interested" actors (Cundill et al., 2015; Bergmann et al., 2021; Matsumoto et al., 2022). CoPs tend to be cross-scalar and be structured broadly in three main levels (Wenger et al., 2002; Mavri et al., 2021) that range from a core group with active layers of different engagement and a periphery which may involve outside actors that are less interested or willing

to engage (e.g., industry, political actors; Cundill et al., 2015). Transdisciplinary projects (Walter et al., 2007) are successful in fostering positive social and ecological change when they can connect knowledge and understanding (system knowledge) to desired goals (target knowledge) and also advance the practical ways to realize them (transformative knowledge; Pohl and Hadorn, 2007).

The types of sustainability transformations that food systems need would require systemic and integrative perspectives (van Bers et al., 2019) that transcend traditional disciplinary and sectoral compartmentalization. This work is resource intensive and demands specific leadership and mediation skills (Hahn et al., 2006; Howarth et al., 2022). Beyond the ecological/environmental aspects, food systems' social dimensions include cultural and political characteristics that further complicate their sustainable transformation. Actors in food systems have different values, interests, and needs (often felt or expressed at a visceral and affective level), making the mere identification of problems, actions and outcomes impossible to objectively pin down. In a recent review of the literature, Weber et al. (2020) highlight the value-laden motivation of any type of proposal for change for sustainable food systems (e.g., a focus on sustainable diets/health or on alternative food movements). This confirms how little agreement exists around *how* to define and achieve sustainable food system outcomes (Stefanovic et al., 2020) especially since context becomes a key dependent variable. For example, van Bers et al. (2019) argues that the historical and current governance arrangements of a particular place determines its possibilities for food system governance change. Dengerink et al. (2021) further confirm that strategies and priorities for policy change vary by region and require understanding the local needs and perspectives, and what this means within a landscape of complex local and global dynamics (Caron et al., 2018).

Living Labs (Bergmann et al., 2021), for example, have offered evidence that place-based platforms for joint dialogue, experimentation, and learning offer more meaningful, appropriate and locally relevant outcomes. There are some similar, albeit limited, experiences for food system-focused experiences of situated co-production processes. For example, a recent study by Adelle et al. (2021) rooted in South Africa adopted a collaborative research effort by conforming a transdisciplinary community of practice (TDCoP). This case confirms there is no one-size-fits-all in food system transformations and that this type of transformative social learning environment offers potential to facilitate sustainability transformations. Thus, attention needs to be paid to how they are created and nurtured, and particularly on how to keep these processes open to newcomers, integrate creativity and insights from academic fields such as the arts, as well as to manage power differences. Few empirical studies of co-production exist in the literature that particularly reflect on the process and their

outcomes (Oliver et al., 2019) pointing to a need for a larger pool of cases.

This article aims to fill this gap by reporting and analyzing the process and outcomes of a transdisciplinary project led by the South American Institute for Resilience and Sustainability Studies (SARAS) Institute. We start by introducing and contextualizing our case study, presenting the methodology and process design and development as well as its results. We then discuss the main outcomes and insights drawn, focusing especially on the type of transdisciplinary model and outputs produced while reflecting on the limitations and challenges encountered.

Methodology

Research approach

The research presented here constitutes a descriptive case study (Yin, 2003) of a transdisciplinary process developed by a CoP hosted by SARAS, an interdisciplinary research institute. The transdisciplinary process was rooted in Latin America's Southern Cone region, with Uruguay as the main context (Section Case study: Food system transformation in Uruguay). The research focuses on highlighting the nature of the process (the how) and the types of outcomes and insights produced spanning for over 3 years between preparation, development and outcomes (see Juri, 2021; see Section Design and implementation of the transdisciplinary process for more details). Two of the 3 years coincided with the COVID-19 pandemic which meant that most of the work was constrained to online virtual environments and interactions.

Central to the transdisciplinary process outlined in this paper is SARAS, an interdisciplinary research institute which, for nearly 15 years, has focused on the production of knowledge and insights to help enable sustainable futures in the broader region (Scheffer and Mazzeo, 2019; Calderón-Contreras et al., 2022). Understood as a bridging organization (Folke et al., 2005; Kowalski and Jenkins, 2015), SARAS has essentially been a platform that integrates diverse approaches to enhance resilience and facilitate transformation, especially attempting to expand the science-policy interface in the Uruguayan context (where its headquarters are located). SARAS also constitutes an international CoP that emerged of the conviction that achieving sustainable futures would require new and innovative ways of thinking and acting. To that end it has built a collaborative network that currently includes academics, civil servants at the National Institute of Agricultural Research (INIA, a public institution informing national policies), several ministries and municipal governments, various local commissions, media (e.g., radio, local press), agricultural producers' organizations, and civil society groups, to name a few. Over the years, SARAS

emerged as a trustworthy and legitimate stakeholder, and a well-known reference for dialogue on sustainability and transdisciplinarity in Uruguay. Without this long trust-building effort, it would have been very difficult, if not impossible, to identify and connect with all the actors that later became involved in this transdisciplinary process.

The main activities and outputs reported in this paper took place from 2019 to 2021. These include a collective participatory process known as the "Thematic Cycle on Food and Sustainability" which was part of the SARAS Public Conferences Series[1] This process essentially started in 2018, when a small group of researchers and artists prepared a proposal on how to approach the broad theme of "Food and Sustainability" and leverage the expertize within the network. The proposal outlined an initial 2-year and two-stage participatory process. First, an important feature of the configuration and the process was the fact that participation was based on interest or experience in the topic, which created a CoP within this existing wider network. Second, only limited funding was available, which meant that financial compensation was not a motive for engaging in this transdisciplinary process (i.e., the work was mostly voluntary). The core group members were either already working in similar areas or found ways to connect this work to their funded roles in other institutions (e.g., two PhD students connected this process to their research). The first Cycle activity in 2019 consolidated an Organizing Group that included 11 senior and early career researchers from the fields of: Economic History, Visual Arts, Literature, Ecology, Natural Resources and Environmental Management, Sustainability Science, Biology, Design, Agronomy, and Biophysics. This group later received technical support through three funded roles in communication, graphic design, and project management. The final team converged the necessary knowledge and skills to catalyze and steer an emergent transdisciplinary process by bridging multiple boundaries (Corkal and Sauchyn, 2018; Gustafsson and Lidskog, 2018), organizing and facilitating actual and online events, and communicating and disseminating its products.

As a whole, this cycle at SARAS sought to foster the participation and dialogue of diverse actors and knowledge systems through collective generative modes (co-production). It also sought to achieve a multidirectional/cross-scalar mobilization of knowledge (Anderson and McLachlan, 2016) rather than expert-led unidirectional knowledge transfer. Theoretically and methodologically, the process was informed by multiple system-based approaches thus adopting methods, theories, and concepts from Resilience Thinking (Biggs et al.,

2015), Sustainability Transitions (Loorbach et al., 2017), and Sustainability transformations (Pathways Network, 2021).

Our approach is essentially the result of the hybridization of the knowledge and practices of the members of SARAS CoP (Hefetz and Ben-Zvi, 2020), which involved researchers and artists. The design and facilitation of most of the transdisciplinary process followed the concept of Transition Design (Irwin, 2015; Zurbriggen and Juri, 2021), which leverages capacities and methods spanning design thinking and doing (Dorst and Cross, 2001; Sydelko et al., 2021).By adopting this design-informed approach (Irwin, 2015), our transdisciplinary process aimed at enhancing knowledge integration and mobilization, collaboration, collective learning, experimentation, and creativity while building capacities for action. Transition Design adopts a plurality of analytic, synthetic, and generative/creative methods to serve different purposes along the transdisciplinary process (from problem scoping to dissemination or creating actionable knowledge). For example, this process included co-creation and problem-scoping workshops that sought to outline the problem space and identify local needs and opportunities for action. Arts-based methods such as collage were used to spark collective imagination, creativity, and sense-making, while challenging the status-quo. Visioning and future-search activities including backcasting (Dreborg, 1996) were used to explore change trajectories and the actions and sectors (i.e., types of change) that needed to be activated. Finally, we generated a Theory of Change (van Es et al., 2015) in the early stages to help define a collective vision for the transdisciplinary process itself, discuss participants' assumptions and reach consensus on the types of outcomes and impacts sought by the Cycle. The main participatory activities fall under the broad category of facilitated dialogues (Drimie et al., 2021), a range of flexible methods that can be applicable to different contexts for creating "safe enough" spaces for learning and experimentation.

Finally, we adopted a Multiple Evidence-based Methods approach (Tengö et al., 2014). This was essential for creating an enriched picture of the problem and solution space, while engaging not just academics but also actors from community and local initiatives. This way, local and scientific knowledge systems could be equally valued and leveraged to contribute to knowledge, while allowing their own modes and different expressive media. Pluralistic approaches like these also aim to uphold different knowledge types (explicit, tacit) and transcend the art-science divide (Halpern, 2012; Scheffer et al., 2015). The complementarity and richness resulting from this type of assemblage can thus enable the generation of new insights and more creative innovations.

The projects that were developed within the Cycle further adopted various quantitative and qualitative methods including interviews, expert consultation/Delphi methodology, audiovisuals, and mappings/systematizations (see Section Design and implementation of the transdisciplinary process for

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1 SARAS Public Conferences are a series of open events attempting to bridge knowledge and practice, while integrating voices from academia, decision-makers, and the general public, among others. Refer to: http://saras-institute.org/thematic-cicle-food-and-sistainability/.

more details). Two evaluation and assessment strategies were adopted at the end of the process: a reflexive core-team meeting and an online survey distributed among the Cycle's participants.

Case study: Food system transformation in Uruguay

This work is focused on the context of Latin America, a region with outstanding natural diversity, as well as major significance for global food systems both historically and currently[2] (Baraibar Norberg, 2020). The export bonanza of the first globalization wave (1860–1914) caused unprecedented land conversion and natural resource exploitation, while at the same time exacerbated inequalities in access to natural resources (Baraibar Norberg, 2020). In the last three decades, Latin America has become the largest net food exporting region in the world (Zeigler and Nakata, 2014). Importantly, food production (especially for exports) has been identified as the cause of the largest environmental impacts in the region[3]. Notwithstanding some country-specific variation, the agricultural production structures across the continent remain largely specialized on a few commodities such as beef, sugarcane, or soy. Such simplified agricultural systems often expand in carbon and biodiversity hotspots at a dramatic pace (Graesser et al., 2015) leading to one of the highest rates of biodiversity loss and ecosystem services degradation worldwide (Laterra et al., 2019).

Importantly, despite its wealth of natural resources, there is a critical lack of production models that are sustainable and equitably distribute its benefits. Currently, Latin America is the region of the world characterized by highest inequalities (CEPAL and NU, 2021). At the same time, the quality of prevailing diets is quite low and there have been concerns about their broader effects to human wellbeing (FAO et al., 2021; IFPRI, 2021). For example, food security has been declining in parts of Latin America since 2014, with these patterns intensifying ever since (Rezende Machado de Sousa et al., 2019), especially on the aftermath of the COVID-19 pandemic (FAO et al., 2021)[4] Unequal access to food explains to some degree this prevalence of food insecurity (FAO et al., 2021). While the region is often referred to as the world's future breadbasket (Zeigler and Nakata, 2014)

given the abundance of natural resources necessary for food production (OECD-FAO, 2021), food security improvements in the next 20–30 years would depend on crop expansion (Delzeit et al., 2017; Zabel et al., 2019). This would most likely create further conflicts of interest (OECD-FAO, 2021) and clearly shows the highly complex and multifaceted sustainability issues that underlie food systems in the region (Wigboldus, 2020). Tackling this complexity requires systems-based approaches that can consider and integrate marginal actors and embrace both local and global dynamics, while at the same time having the ability to focus on concrete and contextual circumstances (Eakin et al., 2017; Caron et al., 2018; Anderson et al., 2019; Dengerink et al., 2021; Hebinck et al., 2021).

Uruguay offers an interesting case study in this context, as it shares many of the social and environmental challenges and risks outlined above. Today, Uruguay has some of the largest tracts of native grasslands and grass-fed beef production systems (Table 1), which is seen as a competitive advantage for reducing greenhouse gas emissions from beef production, a food item that is increasingly identified as highly unsustainable at the global level (MVOTMA, 2019). The rapid expansion of crop cultivation (Baraibar Norberg, 2020) over the last 20 years involved a re-primarization of Uruguay's economy, which focused on a few agricultural commodities that presently comprise 82% of export goods in terms of economic value (UruguayXXI, 2020)[5]. While Uruguay's productive capacity could feed an estimated 30–60 million people (Gómez Perazzoli, 2019; i.e., 10–20 times the local population) there is still prevalence of malnutrition and food insecurity[6]. This is aligned with regional trends (FAO et al., 2021; Arrieta et al., 2022) and represents a significant contradiction for a net-food exporting region.

Uruguay has shown a commitment toward improving environmental management in its National Environmental Plan (MVOTMA, 2019) and the latest dietary guidelines (Moratorio and Bove, 2016). However, progress is slow and there is a lack of transversal and participatory processes in the thematic area of food, compared to other thematic areas such as climate

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2 Latin America contains 60% of the world's biodiversity (UNEP-WCMC, 2016) and houses very diverse cultures. Importantly, it also inherits wounds caused by colonization that have both shaped and have been shaped by global change linked to food (e.g., slavery for sugar plantations).

3 For example, according to FAOSTAT (2022), in 2020 >50% of the entire soybean production was exported.

4 The number of people experiencing hunger in South America increased by 36% between 2019 and 2020 alone (FAO et al., 2021).

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5 At least three quarters of the area under agricultural and livestock production caters for exports and the rest the domestic market (see Table 1). Commodities such as frozen bovine meat, soybeans, concentrated milk, and rice comprise 82% of Uruguay's export goods mainly for markets such as China, Brazil, Netherlands, United States, and Argentina.

6 The prevalence of overweight and obesity are particularly high, above global averages and increasing. Overweight and obesity prevalence in 2013 was 65% for adults 25+ and 10.5% for children under 5; "Diagnóstico de la Situación alimentaria y nutricional," (2016). Diet-related diseases and other lifestyle habits contributing to NCDs are the major national public health issue, accounting for about 85% of deaths ("Mortalidad Por Enfermedades No Transmisibles, Uruguay" 2019, Medina et al., 2020).

TABLE 1   Main features of Uruguay's past and present in relation to food systems/agriculture (a), including details on main commodity chains (b).

(A) Uruguay's characterization—main features

Population and area	3,387,605 people (92.5% in urban areas)–176,215 km^2 (second-smallest South American country).
Location	Southern South America (Southern Cone), bordering the South Atlantic Ocean, between Argentina and Brazil.
History and migration	Colonized by Europeans (seventeenth century). Independence reached in early nineteenth century. Livestock production and concentration existent since colonial times. No settler-type development path during European migration wave-early twentieth century. Soil considered not prime for agriculture, land already in the hands of big ranchers (little use of labor, capital, technology).
Economy	Free market economy characterized by an export-oriented agricultural sector (member of Mercosur). Re-primarization of the economy in the last 20 years (agricultural commodities).
Natural resources (production)	Arable land, followed by hydropower, minor minerals, fisheries. Territory covered by native humid temperate grasslands. Majority of farmlands dedicated to beef production. Rapid expansion of cultivation in the last few decades.
Commodities	Agricultural commodities comprise 82% of export goods (UruguayXXI, 2020).
Exports	Top commodity exports: Sulfate Chemical Woodpulp ($1.57 B), Frozen Bovine Meat ($1.51 B), Soybeans ($675 M), Concentrated Milk ($457 M), and Rice ($380 M) (see below). Export destinations: China, Brazil, Netherlands, United States, and Argentina. At least three quarters of the land is destined for export, the rest for the domestic market.

(B) Main productive chains detail*

Supply chain	Area (thousands of Ha)	Exports (approx. %)	Level of concentration of production	Level of concentration of commercialization	Last decade trend
Fruits and horticulture	61	9	Low	Low	Area retraction, slight production rise
Meat (mainly beef)	12,000	85	Low	Intermediate	Area retraction, slight production rise
Dairy	602	70	Low	High	Stable area, Intermediate production rise
Grains	1,156	85	Intermediate	High	Great area and production expansion
Forestry (mainly pulp)	1,140	80	High	High	Great area and production expansion
Beekeeping	N/C	35	Low	Low	Great area and production expansion
Rice	145	75	Low	High	Stable area and production

*This table indicates the total area occupied in 2019, the estimated fraction exported, the level of concentration of production and marketing/industrialization, as well as the trend in area and volume produced observed in the last decade. Data were obtained from the FAOSTAT platform (crop area) and from INALE (milk production). The livestock area was obtained by difference with respect to the total area of the country. Trends were obtained from FAOSTAT production data. Export fractions were obtained by comparing the volume produced according to FAOSTAT and exports according to ResourceTrade.Earth of Chatham House (United Kingdom). Concentration levels reflect a qualitative scale obtained from the literature describing production systems and the Uruguay XXI index of exporting companies.

change or water management. In addition, consumers do not understand well some of the dimensions of sustainability in relation to food (see Ferro et al., 2022 for an example on food waste). For example, the positive and negative sustainability impacts of beef production and consumption are ambiguous given the contrasting narratives that co-exist and interact with long-held preferences and cultural traditions (Laborde, 2017; Arrieta et al., 2022). Until SARAS Cycle, and before the visibility of activities such as the UN Food Systems Summit

Dialogues[7], Uruguay presented a lack of arenas for debate and dialogue in the topic and complexities of food system sustainability. In particular, and as reported by other scholars,

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7   As part of the global agenda of activities belonging to the UN Food Systems Summit, Uruguay organized an official country dialogue which was convened by the nation's vice-president during June 2021 (see more at https://summitdialogues.org/country/uruguay/).

the compartmentalized nature of public institutions as well as knowledge generation platforms (University's disciplinary silos) continuously limits the systemic and integrative engagement that food systems require. In this context, the collective behind this work saw an opportunity to develop a platform for enhancing understanding and motivating action, while exploring the trade-offs, nuances, challenges, and opportunities that currently exist in the region, and how these could shape local and global food system transformations.

Design and implementation of the transdisciplinary process

General overview of the transdisciplinary process

SARAS' IX Public Conference process particularly aimed at facilitating cross-sectoral dialogues among local actors and sectors not well-connected on the topic of food and sustainability. This included academics from different domains, government, civil society organizations, and the agriculture, industry and service sectors. Such dialogues can become a precursor of institutional and social change for systemic transformation (Drimie et al., 2021). To achieve this, the Organizing Group adopted a transdisciplinary approach stressing the engagement of diverse actors with the aim of

approaching commonly defined problems (OECD, 2020) and addressing local needs or gaps in knowledge.

Being particularly interested in sharing and advancing knowledge and skills, the group chose to adopt the encompassing term of knowledge co-production and four of its main principles as defined and characterized by Norström et al. (2020)[8]. In this sense the SARAS Cycle was designed to be: (a) context-based (anchored in Uruguay's reality); (b) pluralistic (multiple knowledge systems and perspectives); (c) goal-oriented (purposefully and collectively planned toward impact); and (d) interactive (via frequent iterations of engagement and dialogue). The goals set by the organizing group ranged from identifying contrasting local wants, needs, and barriers to the generation of new dialogues and alliances while, at the same time, developing novel knowledge, and creative practices to address complex problems.

Therefore, a multi-stakeholder process (Brouwer et al., 2015) was outlined to begin with a problem-scoping/co-design in-person workshop that would determine how the process should unfold during its second phase. The goal was to

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8   The term co-production loosely encapsulates a series of participatory and transdisciplinary research approaches that have emerged in the past four decades. These include mode 2 science, interactive research, civic science, post-normal science, transdisciplinary and joint knowledge production, action research, among others (see Section Introduction).
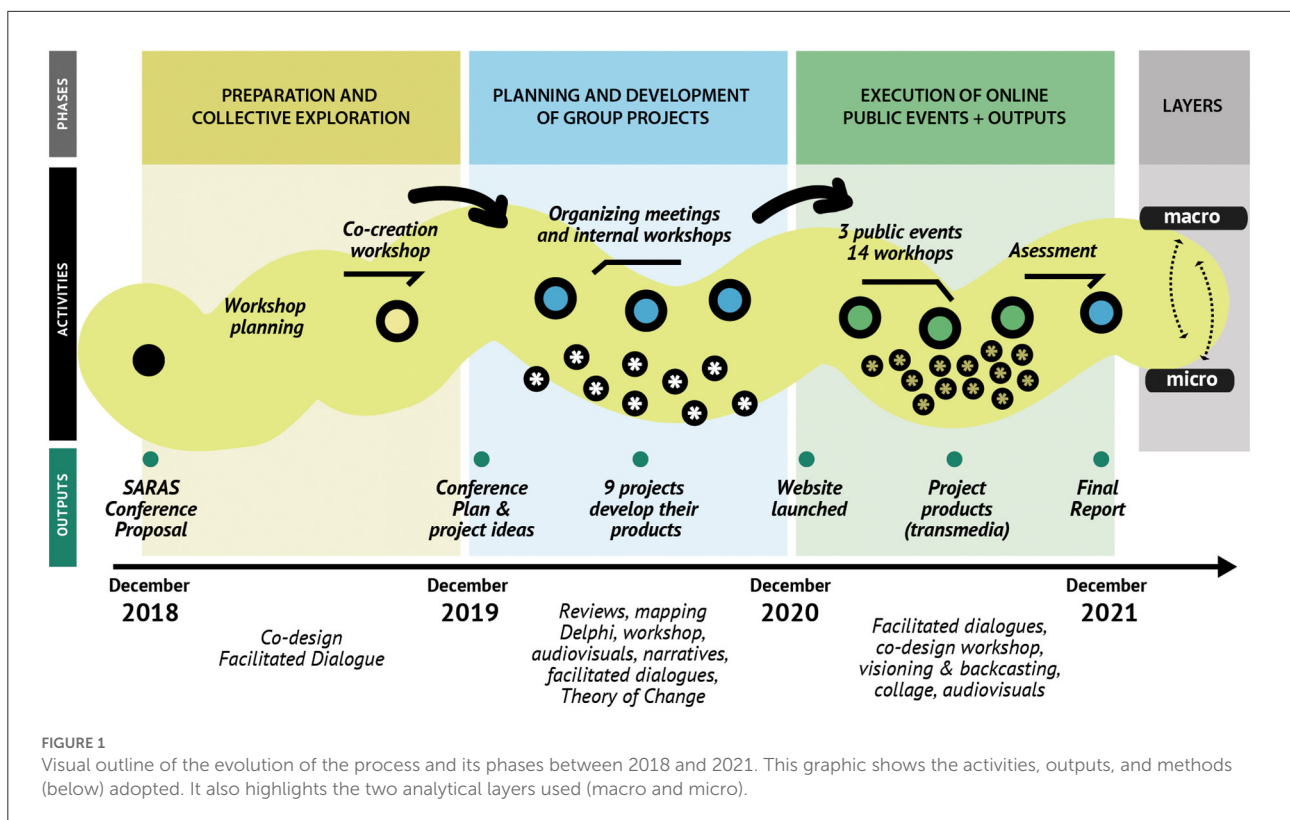

FIGURE 1
Visual outline of the evolution of the process and its phases between 2018 and 2021. This graphic shows the activities, outputs, and methods (below) adopted. It also highlights the two analytical layers used (macro and micro).

TABLE 2 Breakdown of SARAS cycle phases: We display the processes, activities, type of participants engaged, and main outcomes produced.

Phase 1: March 2018–December 2019

Processes	Activities	Participants	Outcomes
Preparation	Group meetings to develop a preliminary proposal to approach Food and Sustainability as a Theme for the following SARAS Public Conference.	SARAS members, core team of organizers.	Cycle preliminary proposal presented to SARAS Advisory Board and approved.
Initial planning (internal)	Initial Organizing Group proposes and design workshop plan and contents.	SARAS members, core team of organizers.	Workshop Plan, structure, and materials.
Collective understanding /Exploration	Participatory workshop to explore understanding, challenges, and opportunities.	SARAS members, RESACA Network, guests by invitation (NGOs, producers, chefs...).	Dialogue and synthesis of main insights. Ideation of a main open event and potential activities. Networking.

Phase 2: February 2020–December 2020

Processes	Activities	Participants	Outcomes
Planning of public cycle	Reconfiguration of Organizing Group. Project/cycle definition and goal setting.	SARAS Organizing Group.	Project outline document and plan.
Generation and development of cycle projects	Definition of series of projects and funding for those.	SARAS Organizing Group. Project leaders.	Project proposals & funding. New alliances formed within projects (transdisciplinary work).
Synergizing of projects and learning	Regular Organizing Group meetings. 3 Internal workshops: 2 to share progress and enhance collaboration, 1 to define ToC.	SARAS Organizing Group. Project participants (transdisciplinary).	Meeting notes (internal communication). Workshop synthesis, videos and Theory of Change document.

Phase 3: January 2021–December 2021

Processes	Activities	Participants	Outcomes
Anchoring/dialogical platform	Developing of website for the project.	SARAS Organizing Group.	Website development. Text, graphic and video contents.
Knowledge co-production and debate	Planning and development of 3 virtual events (March, June, October) Webinars and workshops. Dialogue, synthesis, and integration of new perspectives: website contents, videos.	SARAS Organizing Group. Project participants. Open events (general public, free registration, diverse audience).	Virtual events. Video recordings. Workshop video and written summaries. Video interviews.
Closure of the cycle and outcomes	Organizing Group closing meetings and assessment (including survey). Collective reflection—writing of academic paper. Systematization and synthesis. Dissemination of project results and products. Development of Report.	SARAS Organizing Group.	Survey results analysis. Cycle Report. Website updates. Project products or outcomes dissemination. Promotional video. Academic paper.

engage Uruguayan stakeholders such as policymakers, civil society organizations, food producers, the service sector (chefs), together with scientists, artists and the general public (often in their roles as consumers). This transdisciplinary process eventually evolved over time and unfolded in different layers and phases, which meant that a diversity of modes of knowledge co-production co-existed (Chambers et al., 2021). Retrospectively, however, the process can be analyzed over three main phases: (a) preparation and collective exploration; (b) planning and project development; and (c) public events, dissemination, and outputs. We describe these phases in detail below. Figure 1 provides an overview and timeline of this process, and Table 2 an overview of its main stages.

While the process was envisioned and designed as a whole, it included several activities, smaller projects and perspectives which constituted a rich and adaptive constellation. For the purpose of analysis, it can be conceptualized as comprising two interactive layers. First, the macro layer consisted of the Organizing Group, the main public events and workshops, and the overarching outcomes and products (see Figure 1). Secondly, the micro layer consists of a series of projects which included a series of sub-groups of participants and the products developed by them. The two layers continually interacted and informed each other to offer insights, align goals, and co-define the overall process' outcomes. Projects were given freedom to develop and explore different facets or topics within the entanglement of identified issues related to food systems. This led to further integration of new and diverse actors and the adoption of different methodologies and epistemologies to suit their needs. Overall, nine projects were carried out, representing a significant part of how knowledge co-production evolved. All projects sought to enhance understanding and mobilize knowledge[9] and actors in multiple ways while focused on developing concrete products. These often resulted in tools to aid dialogue, learning, dissemination, and communication. Table 3 provides a more detailed overview of each project, including their processes, approaches, and outcomes.

The flexibility of an emergent process responsive to needs (instead of outlined from the onset or driven by strict project-based timelines) enabled adaptability when faced with disruptions, such as the COVID-19 pandemic. The two-layered nature, with various single projects and events, enabled approaching a series of complex food system issues from different angles by assembling necessary resources (e.g., funds, knowledge, actors) and skills anchored on the delivery of tangible outputs. This helped overcome the challenges of

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9 By knowledge mobilization we mean a process that is not unidirectional but rather allows for knowledge to be created and bridged across knowledge hierarchies' dynamics (i.e., cognitive justice) with a particular attention to valorizing plural, non-academic knowledge in the process of allowing intentional social change (Anderson and McLachlan, 2016).

fund-scarcity and bridging knowledge domains. The individual projects were built around areas of interest and expertize and leveraged social bonds that existed within SARAS' network and with different local stakeholders (more details about individual topics are included in Table 3).

The Organizing Group was fundamental to the design and implementation of this transdisciplinary process. An early-career researcher (the first author) pursuing her PhD within the Transition Design approach played a leading role. This had implications on how the process and outputs were conceived, facilitated, and implemented. Firstly, by helping to coordinate efforts toward commonly defined goals, ensured the adoption and creation of tools and methods to integrate knowledge domains, while engaging non-academic actors, transcending expert-only-dialogues and fostering creative interactive formats. Secondly, to secure the development of communication/dissemination products, the synthesis of information and the materialization of the co-created knowledge into shareable outputs. Importantly, given that the process was steered mostly by researchers, epistemic hierarchies were undoubtedly at play. However, this was pivotal to sustain this type of collective endeavor, as well as to create a safe space for dialogue while connecting perspectives otherwise positioned as opponents or not valued as valid knowledge. This inherent difficulty in evaluating transdisciplinary processes has been pointed in the literature (Walter et al., 2007). While processes need to be open and flexible to allow for co-leadership of various actors (beyond academics), they also need a starting point from which meaningful collaboration can be enabled. This often requires the initial steering and supporting role of researchers. In transdisciplinary communities of practice, researchers play an important role during the early stages (Matsumoto et al., 2022). Researchers and leaders often provide information, approaches or tools in their boundary crossing and interactive roles (between a diverse assemblage of stakeholders) that help build more autonomous capacities. Later they may shift to a position of support. Careful consideration of the different perspectives, knowledge systems and the types of evidence that count as legitimate or valuable is fundamental for any transdisciplinary coalition (Tengö et al., 2014; Norström et al., 2020). Here, design played this integrative and mediating role, helping cope with the layers of complexity that are added as different actors reconcile, integrate or open new epistemologies (Belcher et al., 2016).

First phase: Preparation and collective exploration (2018–2019)

The SARAS IX Public Conference proposal (2018) planned to develop a two-year cycle that would include a scoping workshop in 2019 and a public event in 2020. An initial participatory workshop aimed to enable a dialogue and generate an "enriched picture" of the problem (Tengö et al., 2014) to

TABLE 3 Description of the 9 projects developed including members, topics and outcomes.

Project name	Topics covered	Co-production process	Actors engaged	Outcomes and products
Ambiente y Desarrollo hacia 100 relatos y 100 datos [Environment and Development: toward 100 stories + 100 facts]	Ideas of development, productive models, science and technology, innovation, national strategy, policy.	Mainly interdisciplinary, science-policy interface. Focus on exploring narratives and pathways, brokering power and navigating differences.	SARAS researchers + members from academia and other institutions (The Food and Agriculture Organization of the United Nations, National Council for Science and Technology Innovation-Uruguay).	Series of online seminars, discussion roundtables, and synthesis videos.
Cocinería Colectiva [Collective Cookery]	Sustainable food habits, emergent initiatives, bottom-up processes, innovation, transitions, action-research, systemic change, collective and reflexive learning.	Transdisciplinary Focus on empowering voices, navigating differences and reframing agency.	SARAS researchers and practitioners/students + representatives of emergent social-innovation initiatives.	Website mapping initiatives, online workshops/conversations, capacity building course. https://cocineriacolectiva.net/
COVID Foodways	Food practices (production and consumption), resistance, persistence and resilience, COVID-19 impacts, agroecology, collective bottom-up action, lived experiences.	Transdisciplinary Focus on navigating differences.	SARAS researchers and artists + participating individuals from around the world (multiple universities, social organizations and networks).	Videos, online workshops/conversations. https://saboreandosostenibilidad.net/2021/09/05/taller-impact-of-covid-19-on-food-systems-international-experiences-of-vulnerability-and-resilience/
Fluruguay Globalimentario	Trade flows, economic flows, material flows, global trade, agri-exports, value chains, commodities (beef, rice, soybean, forestry, fish), land-use change.	Interdisciplinary. Focus on synthesizing and visualizing information, navigating differences.	SARAS researchers, Ph.D. students connected to SARAS network.	Website (online tool with tables and visualizations), online workshop. https://saboreandosostenibilidad.net/proyectos/fluruguay-1/
Huella de un Plato [Footprint of a Dish]	Economic, ecological, and social footprints, sustainable diets, comparative of production models, traditional dish.	Inter and transdisciplinary. Focus on science communication, educational tool, locally-relevant indicators and framework. Researching solutions and brokering power.	SARAS researchers + academic institutions, local and regional networks and organizations.	Website and online tool (interactive video), online workshops. https://saboreandosostenibilidad.net/proyectos/huella-plato/
Book: *"Identidad uruguaya en la cocina"* ["Uruguayan identity in the kitchen"]	Local food culture and national identity, imaginaries and narratives, recipe books historiography.	Interdisciplinary Focus on science communication.	SARAS researchers.	Book. Edition and publication of PhD thesis in general audience book format.

(Continued)

TABLE 3 (Continued)

Project name	Topics covered	Co-production process	Actors engaged	Outcomes and products
Saboreando cambios en la pesca artesanal: innovación, adaptación y transformación en la pesca artesanal en Uruguay [Savoring changes in artisanal fishing in Uruguay: innovation, adaptation and transformation].	Fisheries, artisanal (small-scale) fishing, circular economy, emergent initiatives, local development, resilience, lived experiences and stories, futures.	Transdisciplinary Focus on mapping of emergent initiatives (futures seeds), empowering voices, reframing agency.	SARAS researchers, external academic international collaborators + representatives of initiatives.	Website (online catalog), catalog of initiatives (publication), workshop, scientific paper and newspaper article. https://saboreandosostenibilidad.net/pesca/
Sobremesa podcast	Consumption practices, lived experiences, everyday dilemmas, humor, fictitious character.	Interdisciplinary Focus on relatable experiences, provocation, awareness, general-public engagement, arts integration.	SARAS network members.	Podcast series (audio shows) https://saboreandosostenibilidad.net/proyectos/sobremesa/
Sensibilización y experimentación en capacidades y competencias anticipatorias para expandir el diálogo sobre los futuros de la alimentación [Sensitization and experimentation in anticipatory skills and competencies to expand the dialogue on the futures of food]	Food futures, anticipatory capacities, imagination, collective creativity, food cultures, innovation, food waste, circular economy.	Inter and transdisciplinary. Focus on capacity development, collective dialogue and imagination. Navigating differences and reframing agency.	SARAS network members + local and international guests from academia, institutions, entrepreneurs, etc.	Online workshops and roundtables on different topics. https://saboreandosostenibilidad.net/2021/10/08/taller-alimentos-y-futurosque-cambiamos-exploramos-mundos-posibles/

set priorities for investigation and action rooted in Uruguay. The workshop took place over 3 days in the coastal region of Bella Vista (Uruguay) in December 2019. This "dialogical event"[10] sought to facilitate learning and knowledge transfer in all directions and allow equity, inclusion, respect for differences and the examination of assumptions to take place.

The group of more than 50 participants comprised of stakeholders from civil society (e.g., individual and organized food producers, chefs, artists, activists), the local public sector (e.g., governmental institutions, decision-makers), international and regional non-governmental organizations and institutions (including FAO), the private sector (e.g., gastronomic sector, small businesses) and academia (e.g., local, regional and international artists and researchers; see SARAS Institute, 2019). The selection of participants was carried out purposely (Moser and Korstjens, 2018) by the Organizing Group who identified individuals with whom the CoP members already had connections or ease of access (based on previous collaborations). We sought to achieve a wide diversity of perspectives and interests in terms of knowledge domain and sectors, without however aiming to represent all of them. A guiding principle for selecting actors was to ensure a productive collaborative environment (Howarth et al., 2022). Workshop sessions were structured around group work and plenaries. Groups were organized to represent prominent tensions in the region, namely related to (a) fisheries (small- vs. large-scale sectors), (b) agri-export (large-scale vs. traditional agri-food system, global vs. local dynamics), and (c) agroecology (micro-local production/consumption circuits). Groups were determined by the Organizing Group in a way that could leverage participant's expertize while ensuring diversity. This allowed, for example, the otherwise unlikely encounter of an early-career humanities researcher, a performative artist and the now ex-head of the Uruguayan Ministry of Livestock, Agriculture, and Fisheries (also director of the Rural Association of Uruguay) to debate the role of meat in the productive and cultural landscape. The workshop concluded with a plenary synthesis discussion to explore ideas for future projects addressing the identified needs or gaps, and to co-design the plan for the 2020 Public Conference. The consensus was that this should adopt a festival format with engaging activities that would move away from the typical academic conference format of knowledge dissemination alone, and thus be able to engage a wide range of stakeholders and audiences (SARAS Institute 2019; Juri, 2019).

Second phase: Planning and project development (2020)

The start of this phase coincided with the early stages of the COVID-19 pandemic in March 2020 which meant several disruptions to the institutions and peoples involved. The Organizing Group was forced to propose changes to the timeline and the nature of the activities such as (a) extending the Conference an additional year, and (b) focusing on online activities until conditions were favorable for an in-person event. Most of the work was thus internal as opposed to public and was centered on the development of small-projects based on the results from the 2019 workshop. Out of 14 initial project ideas, nine were fully implemented. Each project was steered by at least one member of the Organizing Group and most often included scholars, artists, practitioners and members from multiple organizations and institutions (see Table 3).

Projects adopted different methodological approaches, from arts-led to inter- and transdisciplinary. Frequent cross-group interactions (e.g., monthly meetings, workshops for cross-fertilization, and the design of the Theory of Change[11]) aimed at ensuring cohesion and goal alignment. An agreed plan for action (vision) emerged and projects advanced their work with products, insights and by synergizing efforts (see Figure 3 for project synergies). For example, the members of a project related to fisheries provided systematized data about this productive chain to another project generating infographics to visualize local/global trade dynamics. Project sub-groups grew in size through exchanges between members of the Organizing Group that contributed to different projects and the recruitment of external actors (from students to civil society organizations).

The pandemic significantly disrupted the arts and humanities-based initiatives envisioned in December 2019, which were mostly designed for in-person events. Although some projects were discontinued, the role of artists and humanists was important in this phase. Their practice and project-based creative explorations were determinant in shaping outputs such as a podcast and multiple audiovisuals (which represent knowledge artifacts in themselves) and helped create a more engaging language. They also ensured a critical engagement with historical and cultural issues.

Third phase: Public events, outputs, and dissemination (2021)

As the pandemic continued into 2021, the team decided to transform the Public Conference into a series of three online

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10   By dialogical, we mean a process of encounter and exchange of diverse and often contradictory ideas or opinions (including the researchers'), allowing the expression of subjectivities without erasing differences that could trump the possibility for mutual learning and transformation (Meban, 2009; Cipolla and Bartholo, 2014).

11   A Theory of Change is an approach and a product that helps to guide complex collaborative processes directed toward action and intentional social change (van Es et al., 2015). This process results in a visualization that encapsulates a definition of a desired change, the actions to be taken, an examination of the assumptions behind these and the strategies to measure its evolution and degree of success (Retolaza Eguren, 2010).

events. Although this meant that the aspiration for an in-person playful participatory experience in the form of a festival had to be reconsidered, the team explored different means of online communication and engagement by using or generating online tools, interfaces and activities. Clear and appealing communication was thus needed to: engage multiple audiences, integrate new voices across the system equitably (systems of knowledge), provoke dialogue and collective creativity, and enable to compete with the large number of online events available at that time. A specific branding for the three online events was developed[12] which was accompanied by the development of a dedicated website. Events were structured to advance three consecutive aims: (a) an introduction to the Cycle, the problem space, and ongoing projects; (b) nurturing conversations through learning from new perspectives and types of practices/knowledge paradigms; and (c) leverage the insights developed to define future visions and outline potential transformative pathways (Table 4). The design and format of each event varied to align to these aims and ranged from presentations and roundtable debates to generative and co-creation workshops.

A program of 14 online workshops was added to ensure meaningful interactions in smaller dialogues. Workshops were proposed and led by members of the Organizing Group, the on-going projects and other SARAS network affiliates. All information and documentation of these activities was communicated *via* a website, and included project results, video recordings, interviews, graphics and textual synthesis of events, among others. The last online event proposed a generative workshop to identify collective visions and "ecologies of interventions" as priorities for action and change. This phase concluded in December 2021 with an assessment and a digital synthesis report.

Results and observations

Over the course of more than 3 years, the group of researchers and artists from SARAS' CoP facilitated a transdisciplinary process anchored on dialogue, knowledge co-creation, coalition, and capacity building around the main themes of "what," "how," and "why" food system transformations is needed in Uruguay. The planning and development of an initial scoping and co-creation workshop [first phase, Section Third phase: Public events, outputs, and dissemination (2021)] helped outline the main priorities, needs, and knowledge gaps. Furthermore, it established critical social connections between diverse stakeholders (i.e., academia, public and private

sectors, civil society organizations) and allowed the collective proposition of ideas (i.e., projects) to address the complexity of food system issues in the region. Through the development of nine projects and their outcomes (second phase, See Second Phase above) and the series of 14 online open events and workshops (third phase, See Third Phase above) the process moved past identifying system knowledge to exploring "target" and "transformational knowledge"[13], collectively outlining priorities, visions and potential change trajectories and actions. Projects involved more than 40 members, including SARAS affiliates and external actors. Collectively these participants converged to approach the complexity around sustainable food system transformations in Uruguay from different angles and strategies.

Some projects resulted in interdisciplinary collaborations while others expanded beyond academia and created alliances or bonds with organizations like the FAO, the National Agroecology and Seed Saving networks, small-scale fishers and entrepreneurs from the gastronomy sector, among others. This in turn resulted in a multiplicity of actions and outputs well-beyond academic papers (see Table 3). Projects aimed to produce socially relevant, effective, and legitimate knowledge[14] that could be translated into products with pedagogical usage potential. For example, in the project "*Fluruguay*" researchers from different disciplines gathered, synthesized, and graphically visualized local and global material flows and resource exchanges of five key contrasting export commodities: rice, soy, fish, beef, and wood pulp. The outcomes were offered as an open learning resource through the project's web page. Another project, "*COVID Foodways*," included an exploratory phase that sought to understand aspects of resilience in how consumption and production practices changed due to social-distancing measures caused by the pandemic. This was captured through a series of interviews and surveys, both locally and internationally, and shared *via* videos and online seminars.

The whole transdisciplinary process achieved the materialization of multiple transmedia outputs such as a podcast, a book, videos, a website, online visualizations, an interactive educational video, an online and physical catalog as well as opinion pieces published in a national newspaper. The

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12 The series of online events that were part of the Food and Sustainability Cycle was publicly branded as "Knowledges on the table: Toward sustainable food systems and practices." See more details at: https://saboreandosostenibilidad.net/.

13 Following Pohl and Hadorn (2007) these concepts reflect an analysis or understanding of the problem space (systems knowledge), the deliberation upon a normative goal or stance that guides action (target knowledge) and the understanding and implementation of courses of action through which to achieve a transformation (transformation knowledge).

14 Belcher et al. (2016) define research quality in transdisciplinary work and outcomes across the following principles: relevance (i.e., significant and useful), credibility (i.e., trustworthy and robust), legitimacy (i.e., fair, ethical, inclusive), and effectiveness (i.e., contribute knowledge or innovations).

TABLE 4 Overview of virtual events during the third public phase: "Knowledges on the table: toward sustainable food systems and practices."

Event and topic	(1) "Food and crises: resiliences"	(2) "Food, society and nature: synergies"	(3) "Food and just futures: transitions"
Date	March 2021	June 2021	October 2021
Format	Presentations, roundtable debates, six workshops, conversation, participatory activities, and prompts	Presentations and discussion	Summary and generative workshop
Participation	Researchers and students from SARAS networks, partner institutions, public policy actors, civil society organizations, artists	Members of SARAS network, organizations, general public	Members of the Organizing Group and SARAS networks. Representatives from local and international organizations (e.g., FAO)
Goals	Introduce the Cycle, projects and preliminary results. Explore the territory from global to local scales and from different perspectives	Expand understanding by including new regional, local and new disciplinary perspectives (e.g., design, anthropology). Increase engagement of new areas and knowledge systems. Introduction of a program of 8 workshops and webinars (developed between July and October)	Review main insights of the process and co-creation of visions and transition pathways. Identification of future questions and actions

dedicated website helped share information, outputs, and act as a roadmap that helped navigate an extensive and multifaceted process for those engaged internally and externally. Outputs sought to layer[15] and translate complex information by avoiding academic jargon and facilitating interpretation. For example, the project *"Huella de un Plato"* attempted to synthesize and educate the public on the concept of the social and environmental footprints of food. This was done by analyzing a traditional local dish and creating an interactive/gamified video tool. The podcast *"Sobremesa"* was conceived as an artistic endeavor which used a fictional character and humor as empathetic and relatable strategies in highlighting the multiple dilemmas food consumers face daily.
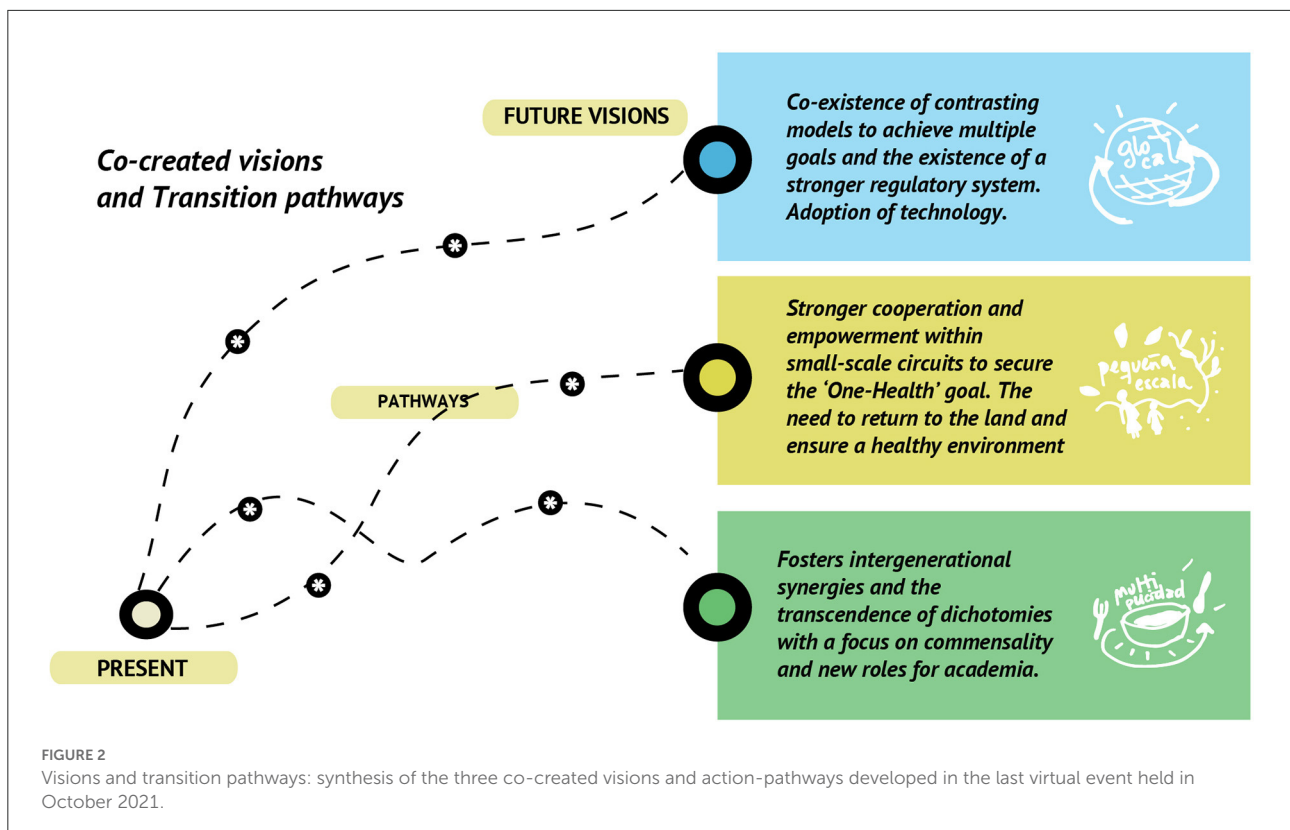
Activities such as roundtable debates and workshops, and some projects, explicitly leveraged and integrated small-scale collectives as examples of social-innovation or bottom-up initiatives (e.g., food-service entrepreneurs, restaurants, small-scale fishers) that could represent "seeds" of the future[16]. They

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15   Layering (Anderson and McLachlan, 2016) means recognizing the different layers of complexity and detail that are needed in the process of communicating ideas with different actors. People will gain a different understanding depending on their knowledge and abilities and this requires careful consideration, for example, in how and when to use technical or academic language.

16   Following Pereira (2021) a seeds approach attempts to collectively identify emergent initiatives of any type (e.g., technological, social) that do not constitute part of the status quo and thus are not consolidated or dominant in the present, while having the potentiality to do so in the longer term.

served to value and integrate local and traditional knowledge and foster sharing. For example, two projects developed online and offline repositories and organized activities where the actors involved in the initiatives synergized and exchanged insights. Multiple new relations resulted from these spaces, including between participants themselves (e.g., through networking) and by forming alliances with new institutions or networks especially focused on education and community outreach. Overall, the workshops were particularly helpful in fostering more intimate exchanges and developing generative/creative outputs. The three main online events organized in 2021 helped keep this process open to the general public. This scaffolded structure (see Table 3) helped: (a) maintain, anchor, and motivate the core community through a calendar of virtual gatherings, (b) reach new individuals with different degrees of interest in the topics, at times, by sparking curiosity, (c) continually integrate new facets or excluded perspectives, and (d) move the process from exploration to propositions.

The last virtual event represented the consolidation of the process from a transformative potential angle. The event was designed to create future visions and pathways through a collective backcasting exercise. Participants were prompted to outline a desirable future vision by considering what is good to preserve and what needs to change, and to suggest the types of actions that would enable us to move toward that vision. Visions imagined food system futures that would: (a) accept the co-existence of contrasting productive models responsive to *glocal* dynamics in a context of strong regulations; (b) focus on stronger/empowered small-scale circuits with a "One Health" overarching goal; and (c) transcend dichotomies

FIGURE 2
Visions and transition pathways: synthesis of the three co-created visions and action-pathways developed in the last virtual event held in October 2021.

via a multiplicity of perspectives enabled by academia, and the re-centering of commensality and intergenerational justice (see Figure 2 and more detailed description in the Supplementary Table 1).
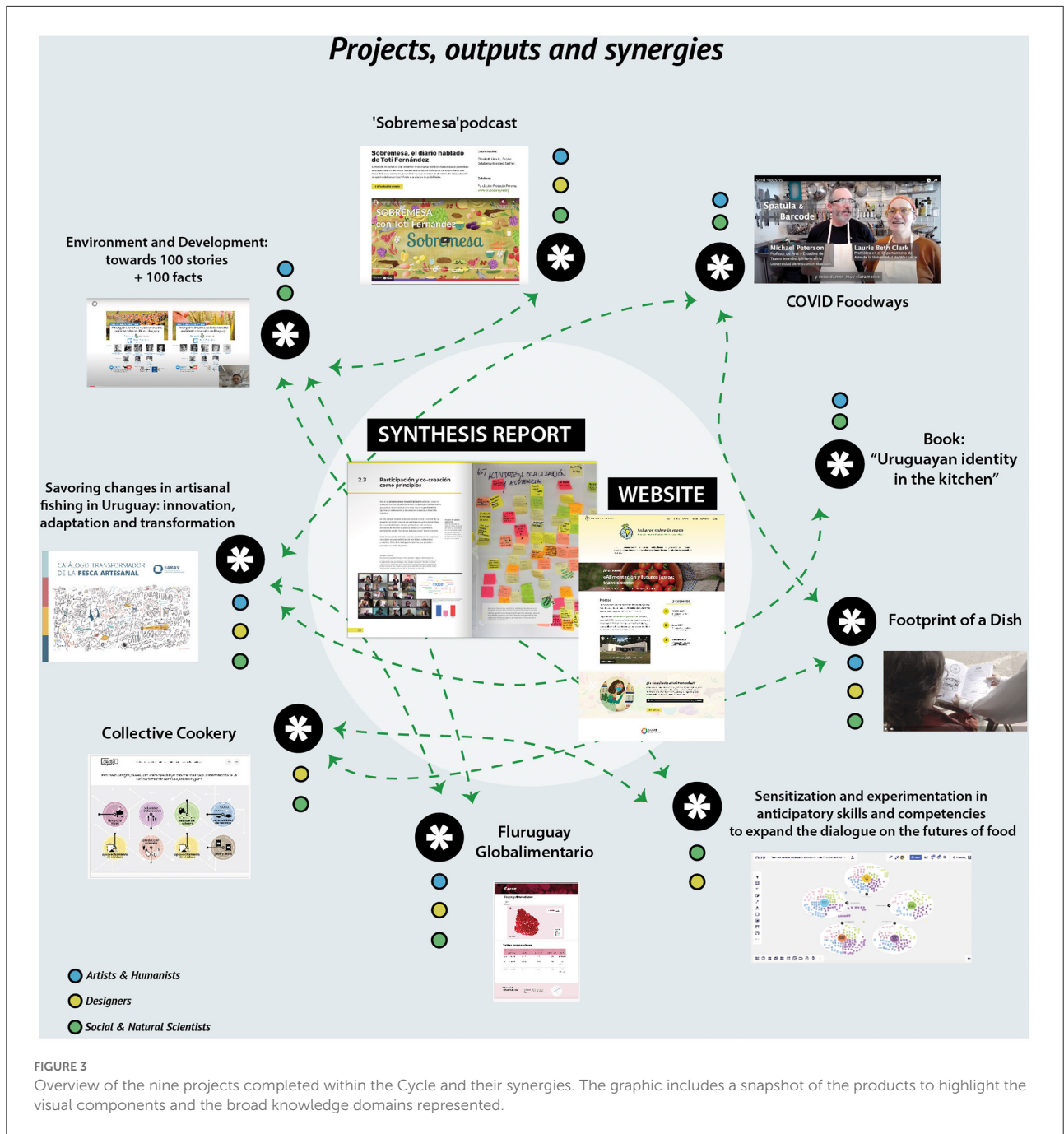
This outcome proves that different values, interests, and perspectives determine what is of most local relevance. This was based on the type of interventions and topics that emerged, ranging from national and global regulatory measures to local and experiential food-literacy practices. While the three resulting visions seem to portray different types of food system futures, four elements emerge as a common thread for the type of change that is deemed important for this region: (a) revising consumption patterns overly reliant on meat products (especially limiting meat production that drives deforestation and land use change); (b) regulating better market flows and exchanges between the local, regional, and global markets while engaging better local and national governments; (c) enabling a wider social dialogue that engages all relevant stakeholders, transcends ideological dichotomies, and considers what positive role contrasting models could achieve if synergized; and (d) leveraging local and even traditional practices (e.g., production or consumption) and knowledges to enable and secure change in desirable, appropriate, and just ways.

The transdisciplinary process concluded with a synthesis report documenting the Cycle and its outcomes (see Juri, 2021 for more details). This offered an overview of all project outputs

and an assessment of the impacts, including statistics and survey results. This report synthesizes part of the co-produced knowledge and was therefore designed to be useful for multiple audiences by being descriptive and analytical, while also visually engaging (see Figure 3).

Our assessment strategy comprised a reflective meeting and an online survey. The evaluation criteria revisited the goals, outcomes, and type of impacts that were collectively defined at different stages of the process (see Table 5). Some of the most significant relevant insights highlight that there was a shared perception that this process enabled participants to expand their understanding of the complexity of the issues around food and sustainability in Uruguay. This often provided new knowledge without drastically changing previously held perceptions. Respondents confirmed acquiring new information and tools, and leaving the transdisciplinary process with an optimistic feeling about the future of food systems in the region even though a lot of work needs to be done to achieve this transformation. The general perception of agency was high. On average, individuals felt they have a role to play in this transformation and were willing to engage in more actions or were already engaged through their daily practices or work contexts. There was a recognition that conditions more conducive to change were sorely needed, including those that transcend the spheres of the personal and daily life.

Respondents highly valued the open, diverse and participatory nature of the activities of the conference.

FIGURE 3
Overview of the nine projects completed within the Cycle and their synergies. The graphic includes a snapshot of the products to highlight the visual components and the broad knowledge domains represented.

Some of the most highly appreciated aspects included the online format that was free of charge, the innovative format and engagement approaches, the developed products, the valorization of local *knowledges*[17] and the opening of spaces for exchange of knowledge, collective reflection

and networking. Half of the respondents mentioned that the tools and information available on the conference website were useful, clear, and accessible. These results are meaningful takeaway messages even when engagement with the survey was low. Students, researchers, participants connected to SARAS networks and representatives of relevant institutions (e.g., FAO) were particularly committed and motivated to sustain participation through the very long process.

17   To speak of plural types of knowledge, we adopted the Spanish the term "saberes." Therefore, here we choose to use a plural version of the term "knowledge" as the closest term to capture this wide concept.

TABLE 5 Breakdown of goals, types of outcomes, and impact sought and our evaluation criteria.

General goals (initial proposal)	Impact sought and outcomes	Evaluation criteria (theory of change)
a) Understanding the needs and desires across different local stakeholders, and the knowledge gaps preventing more sustainable food systems.	a) Degree of enhanced understanding of problems and identification of new alternatives.	a) Be continuous during the process (focused on learning).
b) Developing spaces for dialogue and the creation of new alliances that could inform decision-making across different scales and actors.	b) Creation of new spaces for dialogue.	b) Attend to knowledge co-production.
c) Exploring similarities and differences of what "sustainable food" means for Uruguay in contrast to other parts of the world.	c) Integration of perspectives able to transcend ideological fragmentation.	c) Transcend quantitative statistics based on audience and participation alone.
d) Developing integrative and innovative strategies to approach complex problems and synthesize results.	d) Generation of communication/dissemination products that translate and transcend scientific knowledge.	d) Focus on analyzing the types of collaborations achieved, especially between projects and the Cycle as a whole.
		e) Enable a process of collective meaning-making.

In relation to our goals, this transdisciplinary process was successful in creating new spaces and platforms for facilitating dialogue through the adoption of innovative methods and tools. This meant embarking on a collective process of both learning and imagination. Furthermore, it enabled participants to expand their understanding grasp the breath and complexity of food system transformation, consider alternatives, and access relevant information and tools. While not all stakeholders were engaged and/or represented in the process (e.g., global export/trade companies, large agribusinesses, advocates of technological innovation in agriculture, the forestry sector, indigenous communities), the process still enabled the integration of multiple perspectives and valued plural knowledges and experiences as valid sources of evidence. The frequent interaction and exchange between all components of the transdisciplinary process allowed for an ongoing assessment of the progress, adaptation to changing circumstances, and the emergence of new needs. We believe that simple quantitative statistics such as audience numbers proved misleading and less relevant. For example, the rates of interest during registration to open online activities (>1,000 registered participants across all activities) differed vastly from actual attendance (<50% of registered participants attended), which may be due to a myriad of factors. The continuous online engagement of participants (especially beyond the core group) was difficult to maintain and significantly decreased toward the end of the process. However, beyond these shortcomings, we assert that the goals of achieving a participatory process of knowledge co-production and mobilization were achieved.

Two additional key outcomes were trust-building and creation of new alliances with community organizations, educational institutions, and entrepreneurs. For example, the

FAO entrusted SARAS to lead a research project on the theme of "Agroecological Transitions." Also, three of the Cycle's projects secured external funding which helped to externally validate them as locally relevant, as well as ensure the materialization of their proposed products and create opportunities for previously non-existent institutional alliances. The action-research spaces developed within many projects enabled networking and mutual learning in the process of developing purposeful products or informational tools. Some survey respondents confirmed having adopted these products and tools in educational settings mainly. Projects or workshops that converged multiple knowledge systems and diverse stakeholders also contributed by building social capacity (through competences for systems or anticipatory thinking or collaboration)[18], inspiring action, and potentially contributing to future innovations or behavioral changes. Results also highlight that the process represents a concerted effort that was built on the previous capacity and social capital found within SARAS CoP. This created preconditions for new opportunities for learning and action, which are still unfolding and will take years to fully assess.

Discussion

SARAS' Food and Sustainability Cycle outlined in the previous sections represents the first ambitious transdisciplinary process with a food systems focus in Uruguay. As such, it is

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18 Some of the key competences in sustainability include systems thinking (i.e., grasp of the complexity of a problem constellation across time) and anticipatory competence (i.e., ability for developing future visions and scenarios; Wiek et al., 2011).

only a snapshot of a longer-term process, which is nurtured by SARAS' past and is extending into the future. Our action and participatory-oriented research (Miller et al., 2011) entailed a process of knowledge co-production with outcomes that needed to be contextually relevant and effective in stimulating further innovations, solutions, and actions (Belcher et al., 2016; Norström et al., 2020). This meant transcending epistemic problems alone (Maxwell, 2007; Pohl and Hadorn, 2007) and moving toward intentional (teleological) action, which is a paradigm shift in how scientific research is advanced and positioned within society (Fazey et al., 2020).

Transdisciplinarity and knowledge co-production

Our transdisciplinary process produced different types of knowledge. A prominent goal in some projects (Table 3) and a necessary general starting point was to produce "system knowledge" that sought to enhance understanding and identify causalities and research gaps related to local food systems. To inform and enable change, we produced "target" knowledge (i.e., purpose and goals in the form of normative visions) and "transformational knowledge" (i.e., concrete practices and courses of action; Pohl and Hadorn, 2007). This was achieved through a scaffolded process that advanced in phases, and layers in which different types of co-production took place.

Out of the six ideal-type modes of transdisciplinary co-production proposed by Chambers et al. (2021), four were present in our process as explained below, namely researching solutions, reframing power, navigating differences, and reframing agency. Firstly, although the transdisciplinary process did not aim to actually develop solutions, it created a multifaceted dialogical platform to explore potential avenues and motivate further action toward them. It started from the perception that a lack of integrated knowledge was one barrier for change, and in this sense, offering evidence could help bridge gaps across sectors and inform policy and decision-making. Second, attempts were made at "reframing power" especially during the first scoping workshop in 2019. The different tensions that arose[19] were managed by facilitators that focused on

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19   For example, during the 2019 workshop different tensions arose with representatives from the Rural Association (ranchers and advocates for production and export of beef) and on the other hand, with Slow Food activists, both of which raised concerns that the discussions were biased to support either of those ends of the spectrum (dichotomies) in terms of models of production and consumption at local and global levels. Facilitators brought conversations to less divergent understandings and an opportunity to learn from the different views without assuming either as preferred or true.

opportunities and completed concrete tasks such as the co-creation of a conference plan where all ideas were valued and considered regardless of who had proposed them. Third, the Cycle and many of its projects aimed to "navigate differences" by empowering diverse voices and promoting collaboration. Events, workshops and project activities created a "safe-enough-space" (Pereira et al., 2019) to enable actors engage in a dialogue and transform their perspectives thereby "reframing agency." This created a social learning environment where people were comfortable to share views, which is a requisite for social learning in any CoP context (Tseng and Kuo, 2014; Hernández-Soto et al., 2020). These insights were confirmed in our closing survey both by researchers belonging to the core group and participants of the transdisciplinary process. Importantly, the multifaceted nature of our transdisciplinary process meant that multiple modes of knowledge co-production co-existed but no single project (or the process as a whole) would fall strictly under the ideal types defined by Chambers et al. (2021). The diffuse and emergent nature of our process (without strict pre-defined timelines, project goals, or funding) resulted in an adaptive model particularly useful in supporting (Matsumoto et al., 2022) the initial phases of long-term collective transformational processes. SARAS role was that of "infrastructuring" (Hillgren et al., 2011; Karasti, 2014), which meant creating and facilitating a series of relationships and tools for advancing capacities and agency across scales and sectors with the particular input of participatory design creative approaches (see Björgvinsson et al., 2010).

Allowing a genuine *diálogo de saberes* (i.e., a dialogue of knowledges or wisdom) was key for achieving novel ways for doing action-research and promoting transformative practices (Delgado, 2016; Moreno-Cely et al., 2021). However, the configuration of the Organizing Group and its modes of working still meant that there was a bias toward academic knowledge (with low representation of other knowledge systems) mainly from the natural and social sciences with lower integration of the arts and humanities. Despite their underrepresentation in terms of number of participants/initiatives in the projects and the cycle as a whole, we recognize the value of these domains in their critical reflection, historical reconstruction and speculation on the values and beliefs that underpin societal dilemmas. The study of the media and other cultural artifacts allows us to grasp and open debates around the communicated or reproduced values that shape the task of imagining and realizing changes in new forms of food production and consumption. Indeed, systemic transformations demand cultural change (*via* values, beliefs, narratives, and artifacts), which acts as a strong and necessary lever of change (Meadows, 1997). In our case, a workshop that reunited a panel of literary scholars, a performance artist and a chef-poet was particularly revealing. By aiming to criticize current patterns of food consumption (particularly the loss of food identities/traditions) the underlying "wicked problem" addressed by the panel revolved around their perception of

a loss, if not the waste, of the humanities in public and private cultures, which has been relegated to a vocabulary of sybaritism (wellbeing by means of luxurious representations). A valuable lesson for future processes aiming to transcend the arts-science divide is that not every person engaged in the arts and the humanities is ready-made for a co-production for sustainability (in this occasion, reshaping narratives of food consumption differently to the traditional food narratives in the humanities). Food systems sustainability is not necessarily on their disciplinary agendas, nor is transdisciplinarity and solution-oriented work an established trend (maybe with the exception of film and public performative art). As a result, these constructs and approaches need to be introduced from the onset of the transdisciplinary process.

Finally, while many activities flourished in the online environments[20] (with participants collaborating across multiple countries and regions), this mode is conducive to only certain types of interaction. This essentially limits embodied/multi-sensory experiences and learning. The number of projects in the arts and the humanities dropped when in-person events were restricted. Some projects were able to adapt (e.g., a collage-based workshop was translated to an online format), while others simply lost motivation or their whole purpose (e.g., ideas for food-tasting or cooking experiences). In this respect, it is important to be aware of the pros, cons, and limitations of online experiences. Furthermore, it is necessary to account for the important non-cognitive dimensions of learning and anticipate ways in which to support the adaptability of goals and means across very different knowledge domains and their practices.

Design, facilitation, and the role of dialogical artifacts

SARAS' Cycle was highly facilitated and informed by design-based approaches and methods (Section Research approach). This aligns well with recent postulates of the potential role that the field of Design has in fostering transitions to sustainability (Escobar, 2015; Irwin, 2015; Gaziulusoy and Ryan, 2017; Fry and Tlostanova, 2020). Developing communicational and dialogical spaces and artifacts was a key part of enabling very different "voices" to converge into a space and enrich it by contributing from their lived experiences through their multiple roles in society. Enhancing communication and understanding required the adoption of a "language" that could appeal to (and at the same time engage) multiple audiences. It further meant the need to mobilize skills and methods to build capacities for openness

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20 New conditions enabled by the pandemic became opportunities for two editorial projects: (a) a compilation of narratives by non-academic actors involved in the fisheries sub-group, and (b) the publication of a monograph on the history of Uruguayan identities through its cuisine.

and dialogue so that learning and transformation could occur (Ryan et al., 2016). The range of transmedia products (e.g., websites, publications, interactive videos) constitute "dialogical artifacts," which we conceptualize as material or virtual objects used in the process of (or as the result of) knowledge co-production and mobilization. Similarly to concepts such as boundary objects (Star and Griesemer, 1989), knowledge artifacts or intermediary objects (Cabitza, 2015), these artifacts afforded the possibility to transcend epistemic boundaries by bridging "social worlds." They acted as carriers-of-knowledge (as sharing vehicles) and objects-for-knowing (Cabitza, 2015), enabling the convergence of multiple views into processes of meaning creation and learning. They also helped develop joint work for a common goal and act as inspiration or motivation for further action, as is the case of "transformative boundary objects"—see Tsurusaki et al. (2013) and Sakakibara et al. (2019) as cited by Matsumoto et al. (2022).

As important outputs, these artifacts also acted as prompts for discussion and speculation. In this process they enabled us to contemplate, imagine and materialize visions of the future and offer avenues to understand how to get there (Fazey et al., 2020). Some of these artifacts demanded design skills and creativity (Runco, 2007; Klein, 2017; Montuori and Donnelly, 2020) to innovate and develop them as tools (e.g., graphics, worksheets, presentations). They helped facilitate generative dialogues in virtual events and workshops (Manzini, 2016) and enabled people to express different facets of their own creativity (Sanders and Stappers, 2008). This is key to fostering the political and transformative imagination (Galafassi, 2018; Fry and Tlostanova, 2020) necessary to generate inspiration or develop new alternatives that may transcend the status quo (Gaziulusoy and Ryan, 2017).

The integration and hybridization of plural *knowledges* is visible in the main conference website and report, which share results in text and graphic form (Figure 3). A design researcher assumed a leading and facilitation role from 2020 onwards. This meant that design essentially acted as a "third culture" (Cross, 1982) between the great divide of science and art (Snow, 1959; Halpern, 2012), and academic and non-academic knowledge to foster a type of "consilience" of knowledge (Wilson, 1998).

Moving toward transdisciplinary communities of practice

As a bridging organization, SARAS offered the possibility to foster interactions across sectors, motivate learning and sense-making beyond hierarchical levels and disciplinary boundaries, and enable trust-building and coalition-forming processes, while identifying common and conflicting interests (Hahn et al., 2006). This network leveraged existing relationships

with multiple stakeholders and enabled the creation of new ones. As the members of the Organizing Group converged to collaborate on different goals and products, eventually more peripheral individuals were also integrated. This led to re-invent collaboration and knowledge co-production practices as members were found in new social learning environments, adopting and transforming new/unfamiliar methods or concepts. This is a common outcome of any transdisciplinary CoP. Myriad online gatherings and workshops enabled teams to experiment in ways that enabled them advance and "reify" their goals in tools that go beyond abstract concepts (e.g., a group of natural and social scientists engaged in the design of an interactive gamified video). This led them to hybridize their own expertize and broker knowledge (Hefetz and Ben-Zvi, 2020) from external communities, while simultaneously nurturing and learning from a new practice. Importantly, social connections were enabled through an already existing network of trust, which rests on sensitivities, attitudes, and values guiding the practices and interpersonal relationships within SARAS CoP. This is an important feature which Merçon (2021) conceptualizes as the "ethico-affective dimension" that is fundamental for a transdisciplinary community of practice (TDCoP).

Our case aligns with the experiences reported by Matsumoto et al. (2022), whereby researchers (and in our case artists) played a fundamental role in generating information, tools and the platform needed to cross boundaries, increase interactions, and foster capacity building at the start of a transformational process. SARAS' transdisciplinary process followed similar stages (i.e., understanding potential, coalescing as a community, maturing through learning to outlining future transformative activities) but differed on two main aspects. First, we did not aim to develop solutions or achieve complete consensus within the CoP, while the layered and multifaceted nature of our design (a constellation of projects and workshops) allowed for flexibility giving individual projects or groups enough autonomy to keep opening paths far into the future. Second, our case clearly shows the explicit and prominent role that humanists, artists, and a design-informed facilitation can play, which aligns with recent reports on the emergent potential for design and creativity to contribute to transdisciplinary projects related to food systems (Massari, 2017, 2021). Also, our process was not facilitated by outside researchers and was reliant on the long track of relations and trust that already existed. The engagement of the TDCoP is long-term and is not necessarily characterized by research and traditional academic schemes, especially since most active participants did not receive any funds for engaging in these activities. Indeed, there is no formal ending point for this rather non-traditional "transdisciplinary project," where many projects and cycle participants are still engaged in projects or continue to collaborate in new endeavors.

Significance for food system transformations

The questions around what types of transformations are needed (goals) and how such processes should unfold are ambiguous. This due to the co-existence of often vague ideas of what sustainable food systems means and various competing food production and consumption models and visions. The literature on food system transformation has highlighted that these processes of change need to be understood contextually because: (a) the priorities, goals and the necessary actions vary by region (Stefanovic et al., 2020; Dengerink et al., 2021), (b) the need to carefully account for local and global expectations (Caron et al., 2018), and (c) the contextual governance arrangements (social, ecological, cultural, and political) determine what type of transformation is possible. The complex multi-scalar, socio-political challenges that these processes of change present, demand systemic approaches (Hebinck et al., 2021). These need to consider the multiple types of negotiation and reconfigurations that need to take place (Leeuwis et al., 2021) when new practices, models or actors try to assert change and transform or dismantle the status quo. Engineering-type or sector-specific approaches are often unsuccessful. Deep levers of change need to include system goals, intents and paradigm or cultural shifts (Dorninger et al., 2020). This means shifts in power and agency with a clear future orientation (Anderson et al., 2019; Mangnus et al., 2019; Pereira et al., 2020), which also inevitably includes a change in knowledge systems (Anderson, 2015).

There is a need to create the conditions and build the necessary capacities for this. Collective examples from local multi-stakeholder processes (Herens et al., 2022) or living labs (Gamache et al., 2020) are promising. However, while they can span boundaries and enhance learning and adaptability, they may be less effective for larger food systems change. This highlights the need for work that is cross-scalar and both globally and locally aware. Den Boer et al. (2021) stress that effective approaches to accelerate change require reflexive, integrative and participatory research and innovation processes. However, at present, we lack examples of how these processes are designed and conducted, and what types of methodological and contextual mixes work in each region.

SARAS Cycle aimed to fill this gap and leverage the trajectory already present in its international CoP. Our process aimed not at proposing optimal solutions, but rather a systemic exploration of the solution space (Rosenhead, 1996). This was done through knowledge mobilization (Anderson and McLachlan, 2016) that was heavily reliant on facilitated dialogues (Drimie et al., 2021). Transformations toward sustainability are by default complex and long-term endeavors that cannot be fully controlled, planned or defined by "experts" alone (Miller et al., 2011). They also require adaptability and

creativity to deal with its emergent features (Pereira et al., 2019) and to manage multiple knowledge systems. Our Cycle was creative in that it unfolded and materialized the creation of new connections, boundary crossing and the generation of useful outcomes (Klein, 2017). Balancing flexibility and openness throughout the process design and development, while still adhering to a purpose of enhancing dialogue and communication was important to ensure engagement, translation, and the achievement of goals. Our case confirms insights from elsewhere in the literature, whereby the co-produced outputs of a transdisciplinary process are only one part of the legacy of a TDCoP like the one reported in this paper (Adelle et al., 2021). Arguably, one of the most important achievements has been the generation of a cohesive group that attains a new shared way of knowing, redefining previous practices, and outlining a potential identity that unfolds from dialogue and negotiation.

The transdisciplinary process was also useful in collectively moving from problem-structuring to solution-finding through brokering knowledge, reframing problems and solutions, and reframing agency (Chambers et al., 2021). However, at the same time, the outcomes, especially the visions and potential trajectories of change, represent alternatives that should be used mostly as stimulation for a wider and more engaged political dialogue (Gaziulusoy and Ryan, 2017).This work also shows that leveraging opportunities to collaborate amicably beyond conferences or other established academic formats (e.g., through food-sharing acts, performativity, arts-based, or co-creative experiences) can motivate, inspire and celebrate the transdisciplinary process as transformative in itself. The alliances and newly forged connections can offer promising prospects to develop and take these outcomes forward. Here, the identification of new questions, challenges and insights on what types of future engagements are necessary are of fundamental importance, as is having a set of tangible products that can further inform the dialogue and debate that needs to continue.

The developed visions and pathways suggest that while different interests and values prevail, alternative pathways, narratives and actions (i.e., outcomes) could likely co-exist (Stefanovic et al., 2020). It should be important to avoid narratives and processes that promote or determine singular pathways without accounting for synergies and trade-offs, or are adopted from a naive view that optimal solutions are possible. Therefore, a deeper reflection on narratives and embedded values is still necessary if we aim to enable reflexive and transformative (i.e., double to triple loop) learning (Argyris and Schön, 1997; Peschl, 2007) whether at the level of the transdisciplinary process and institution, or at the level of society. Based on the lessons learned from our transdisciplinary process we argue that artists and humanists should play a key role in this.

We were able to identify a few key messages that are particularly relevant when considering the characteristics and

trajectories of sustainable food transformations in Uruguay (see Table 6). Priority concerns relate to enhancing the resilience of local food systems under the increased influence of global markets, as well as in the context of growing food/nutritional insecurity and diet-related diseases in the country (Section Case study: Food system transformation in Uruguay). For a major food-producing nation, this represents one of the most salient paradoxes and demands further debate.

New research questions or insights for further exploration in the Uruguay context include: (a) identify which aspects of the current food systems should be preserved and which should be transformed while recognizing multiple trade-offs; (b) transcend dichotomous thinking to achieve multiple goals and outcomes for food system transformation; (c) rationalize the role of technological innovations in steering desirable change in food systems (especially in the case of commercialization and access); and (d) understand how to limit the expansion of transnational ownership of land and resources. Some questions and insights from a more socio-cultural lens include: (a) maintain biocultural diversity and avoid the colonization of native ecosystems from exotic species; (b) learn from (and strengthen) synergies between bottom-up or emergent initiatives to enhance a critical mass and a social debate for food system transformation; and (c) consider carefully the rhetoric of discourses that highlight social and cultural dimensions of food and the stories behind them (i.e., the underlying values and types of food system futures that they prefigure). The latter is quite important as it could lead to a market-led "aesthetic" and even "fetichization" of food identities/cultures without a genuine and critical exploration of the role of cultural identity and tradition as leverage points for deeper systemic transformation in food systems.

Challenges, limitations, and next steps

Below we offer a critical reflection about the limitations of the transdisciplinary process and the challenges encountered during its design and implementation. These should inform future activities or represent a transferable model for planning similar transdisciplinary processes, particularly in the context of food system transformation and sustainability.

The Cycle engaged multiple stakeholders across different sectors involved or interested in food systems. However, stakeholders from some sectors were particularly underrepresented or even not represented at al. This led to the lack of some distinctly divergent voices even when those that did participate held different perspectives and values themselves. The most well-represented groups were academia and non-governmental organizations. This forces us to consider whether the process expands a dialogue within a vaguely defined echo-chamber, and points to the need to find strategies to engage excluded actors, or actors holding opposing views. Further efforts should be made to ensure to not just appreciate

TABLE 6   Key points for sustainable food system transformations identified for the Uruguayan context.

Key points for sustainable food system transformations for Uruguay

a) Multiple transition processes are underway in relation to production and consumption practices, the role of technology and the interactions of food systems with other sectors (e.g., energy, forestry, tourism).

b) Uruguay has already implemented mechanisms and practices that ensure quality, transparency, efficient resource use and low-environmental impacts and there is an interest to preserve this trajectory.

c) Food cultures and the identities and narratives attached to them play a critical role in promoting and validating the country's production matrix (livestock, soy) and demand critical reflection as new counter-narratives gain prominence (e.g., plant-based diets).

d) Global/local dynamics have always played a decisive role and presently directly impact the nation's economy, the distribution of capital and its benefits to society and the use, ownership and exploitation of natural resources which are undergoing increased pressure (especially land-use change, biodiversity loss and pollution and degradation of water resources) with additional impact on livelihoods and health.

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but actively engage far more plural voices. For example, in our experience, attempts were made to engage representatives from indigenous communities who expressed interest in this process but did not participate in the end. While we cannot speculate the reasons for this, indigenous and other ethnic minorities did not have a collaborating history with SARAS, which maybe reflects how overarching epistemic and systemic inequalities (Laborde, 2017; Rodríguez and Díaz, 2018; Sans et al., 2021) are hard and slow to subvert.

We acknowledge that the transdisciplinary process presented here is only part of a longer-term process of transformation. In this sense the insights and trajectories outlined serve as starting points to continue a larger dialogue promoting deliberation and further re-framing of the sustainability challenges and solutions in food systems in order to secure and problem-ownership and jointly develop policy and other interventions. We also point out that while social and cultural changes take time, it is still possible to identify seeds of potential futures (in multiple practices and emergent initiatives) that rely on or acknowledge norms and values that prioritize human-nature connections and planetary health and wellbeing.

We cannot claim that this process effectively transformed the food system in Uruguay, but the actions and knowledge informed, inspired, and activated a multiplicity of spaces in which transformations are being actualized or nurtured. As stated elsewhere (Levin, 2008; Belcher et al., 2016; Phipps et al., 2019; Drimie et al., 2021), it is difficult to evaluate a long dialogical transdisciplinary process that consists of multiple elements acting at different spatial and temporal scales. This would require a significant amount of time and resources (e.g., skills, infrastructure, funds), and will likely take years (Walter et al., 2007).

As this transdisciplinary process was mostly steered by academics and considering the low participation of powerful actors with different vested interests and needs entrenched in the food system (particularly agribusinesses or lobbyists that benefit from preserving the status quo), the process has arguably

limited potential to affect large-scale systemic transformation. While not all outcomes of the current globalized industrial food system are negative, some powerful actors may oppose fundamental food system transformations by preserving or accelerating certain dynamics that they find desirable (Anderson and Leach, 2019). Some such examples can include market-driven maximization of production, discounting of externalities, pressure on global geo-politics that determine or preclude land ownership and ecosystem stewardship, or measuring success and development with metrics that exclude certain dimensions such as wellbeing, health, justice, cultural value, or social-ecological resilience (Caron et al., 2018; Stefanovic et al., 2020). Multistakeholder platforms can have transformational potential by raising awareness, aiding to shift narratives and problem framings, and generally supporting processes that may impact policy-making and overall food system governance change (Leeuwis et al., 2021). However, their impact is limited (Herens et al., 2022) if mentioned lock-ins are not subverted and without powerful actors aligning toward significant paradigm changes (Bui, 2021; Ruben et al., 2021).

Beyond the shortcomings outlined above, we particularly highlight: (a) the usefulness of approaching a complex process and topic such as food system transformation in two interacting and mutually reinforcing levels (macro and micro) and (b) the multiple opportunities that are opened and explored by developing a series of diverse projects where actors and knowledge are mobilized, and new alliances can be created. For transformative learning to take place, a TDCoP needs to be open to the public and new perspectives instead of becoming a closed community (Matsumoto et al., 2022). However, at the same time there is a need to keep within a TDCoP the deep and specialist reflections and discussion that are needed for co-production (Adelle et al., 2021). We also stress the positive role that integrative facilitation and leadership combined with Design-skills and methods played in producing artifacts and outputs that capture, create and share knowledge. Finally, here the TDCoP helps guide the development of not just a project geared toward food system transformation, but also

the creation of an experimental and flexible social learning community. This requires not just attending to knowledge but also to values, beliefs, affective bonds/needs. Furthermore, it also stresses "second order" transformative change, not just in daily life and practices, but also in terms of knowledge creation and reflexivity, while developing critical and creative capacities (Grunwald, 2004; Fazey et al., 2018; Den Boer et al., 2021).

Conclusions

Tackling the many interlinked and complex issues preventing food systems from moving toward more sustainable pathways is a serious challenge. It calls for novel approaches that speak to the different priorities and features found in each particular context. Latin America, as a major food-producing region, is at a crossroads with multiple challenges and opportunities for food system transformation. Transformation pathways will likely impact both regional and global food system dynamics in multiple ways. The case study presented here focuses on food system transformation in Uruguay given its contrasting trends of development (e.g., trade-offs related to food production and consumption of beef) and its historical role within the globalized food system.

SARAS Institute, positioned as a bridging institution, developed and steered a 3-year transdisciplinary process that explored how to nurture food system transformations in practice. This collaborative endeavor represents an example of a transdisciplinary community of practice that particularly aimed at bridging the arts/science and science/society divides. In our case, the goal of creating a new dialogical arena was supported and achieved through a series of knowledge and communication products (i.e., material and digital artifacts), which constituted key dialogical objects working internally and externally. In a sense, this represented the generation of a language of collaboration and knowledge mobilization, which was purposefully facilitated and informed by design creativity and integration. Our insights offer a model that could be useful to inform similar processes led by Transdisciplinary Communities of Practice (TDCoP) or bridging institutions in the early stages of transformative work, specifically in relation to food systems and their governance. It also represents an example of change within an institution following the precepts of serving society to achieve sustainability goals, while undergoing adaptation through reflexivity and creativity itself.

Our work confirms that institutions for collective action can initiate food system transformation through transdisciplinary processes. However, knowledge alone is not enough, and multi-stakeholder platforms also have limitations. We also need to keep in mind that the magnitude of food system unsustainability is huge. While many small-scale initiatives to achieve positive change are underway, many aspects of the food system (in Uruguay and Latin America more broadly) have been driven by short-term profit considerations, with little attention to long-term sustainability or social inclusion. It is a big and difficult task to transform the historically rooted injustice and unsustainability in the Uruguayan food system, not the least because there are strong interests seeking to keep the status quo. It is thus clear that our case is only the start of a longer-term process toward capitalizing on insights and coalitions, increasing engagement and ownership, and operationalizing and expanding avenues for change across system levels and sectors. We hope that our dialogue can enhance understanding and create constructive pressure on decision-makers. We also hope that this example helps inspire similar initiatives to imagine and realize not just smart, but also wise sustainable food-system transformations.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author/s.

Author contributions

SJ conceived the article conceptually and structured the draft, presented and analyzed the case study, and developed the graphics and tables. LD, MB, MM, MT, NM, JM, and CZ contributed conceptually and with revisions. MB and EJ analyzed and reported data to characterize the case study context. LD, MT, MB, JM, and NM contributed with significant revisions and reviewing. All authors contributed to the design and evaluation of the process reported in this article.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2022.887034/full#supplementary-material

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