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Perspective

A quest for questions: The JUSTRA as a matrix for navigating just food system transformations in an era of uncertainty

Costanza Conti,[1,12,*] Andrew Hall,[2] Kristiaan Kok,[3] Per Olsson,[1] Michele-Lee Moore,[1] Claire Kremen,[4] Amar Laila,[1] Line J. Gordon,[1] Anne Barnhill,[5] Sofie te Wierik,[6] Anna Norberg,[6] Bianca Carducci,[7] Sumati Bajaj,[8] Matthew Gibson,[9] Thais Diniz Oliveira,[9] A. Charlotte Bunge,[1] Tim G. Williams,[10] Rachel Mazac,[1,11] Mary Scheuermann,[1] and Jessica Fanzo[7]
[1]Stockholm Resilience Centre, Stockholm University, Stockholm, Sweden
[2]Commonwealth Scientific and Industrial Research Organisation, Canberra, ACT, Australia
[3]Athena Institute, VU University Amsterdam, Amsterdam, the Netherlands
[4]Institute for Resources, Environment and Sustainability, University of British Columbia, Vancouver, BC, Canada
[5]Johns Hopkins Berman Institute of Bioethics, Baltimore, MD, USA
[6]Potsdam Institute for Climate Impact Research (PIK), Potsdam, Germany
[7]Columbia University's Climate School, New York, NY, USA
[8]Department of Population Health, London School of Hygiene and Tropical Medicine, London, UK
[9]Food Systems and Global Change, Global Development, College of Agriculture and Life Sciences, Cornell University, Ithaca, NY, USA
[10]Environmental Geography Group, IVM Institute for Environmental Studies, VU University, Amsterdam, the Netherlands
[11]Helsinki Institute for Sustainability Science, Helsinki, Finland
[12]M. S. Swaminathan Research Foundation, Chennai, India
*Correspondence: costanza.conti@su.se
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SUMMARY

A just food system transformation is imperative to meet this century's goals of environmental sustainability, economic fairness, and equitable social well-being. While considerations of justice are beginning to inform food system transformation debates, there remains a lack of conceptual and practical integration of these two historically separate disciplinary perspectives. This perspective therefore proposes the just transformation matrix (JUSTRA), which integrates justice and transformation concerns using an interrogative approach. Interrogatives probe the historical, present, and future intersections of justice with specific food system elements. If used conscientiously, the JUSTRA can assist a wide spectrum of food system actors in strategizing, implementing, and monitoring just food system transformations. It can also help stakeholders to more thoughtfully engage with power imbalances both among users and in the food system more broadly—if used "in bona fides." Thus, while further testing is necessary to fully realize the potential of the JUSTRA, the matrix can become a powerful tool in multi-stakeholder dialogues to navigate unpredictable, diverse, and power-laden complexities of just food system transformations.

INTRODUCTION

There is broad consensus in the international community that food system transformations need to happen.[1,2] This consensus has been mirrored by a flourishing body of literature around the topic,[3,4] including attempting to further understand transformations processes,[5–8] imagining what transformed sustainable food systems could look like,[9,10] and steering debates and progressively building consensus on desirable visions of food systems for the future.[11] As a result, the science-policy community is no longer faced with the question of *whether* a transformation is required[1,12,13] but rather the much more complex question of *how* such transformations can be enabled and supported to deliver multiple and interconnected outcomes of environmental viability, economic fairness, and social inclusion.[14–16]

While a unified vision of what transformed food systems is likely impossible to achieve—as transformations will, by nature, be unpredictable and place diverse—a central tenet of the current transformations agenda is to enshrine equity and justice in future food systems[17–19] Specifically, rectifying, or at least overcoming, patterns of injustice in existing systems, manifesting, for instance, as wealth disparities and extractivism, labor rights violations, and lack of access to healthy food for poor or marginalized communities both in low- to middle-income countries (LMICs) and high-income countries (HICs).[19,20] Justice, therefore, becomes not only a desirable outcome but also a necessary component of any transformation process.[21] It has been argued that without careful consideration of justice, processes aimed at supporting transformations might fail to address inequities, thus perpetuating the very problems they aim to solve.[21] Transformations that are not just would fail to reverse patterns of historical exploitation, inequitable resource access, and wealth accumulation, nor would they protect the rights and opportunities of present and future generations.[22,23]

However, despite the growing recognition of the need for justice to be centered in food system transformations, existing frameworks fall short in adequately integrating justice considerations,[19,24] considering it an outcome rather than an inherent component of the transformation process.[25] This limits the potential to conceptually envision and practically implement just transformation processes.[24] It is necessary to address this core gap to allow for more coherent consideration and more targeted strategies to ensure equity and justice principles in transformations.

In this perspective piece, we propose a framework that can address the abovementioned gap—the just transformation matrix, hereafter JUSTRA. The JUSTRA combines justice and transformation considerations in food systems. Through an expert exercise, the paper deploys the JUSTRA through an interrogative approach, where questions that span across interlinked elements of food systems and justice can be tailored to a variety of geographical locations and points in time. We suggest that the matrix can be used as a way for diverse stakeholders—policymakers, development practitioners, and civil society actors—to more openly reveal past and present issues of injustice in food systems and, consequently, help set out more informed and openly negotiated priorities and strategies for enacting transformations. As explained later in the paper, if the JUSTRA is applied "in bona fides," then these priorities and strategies can concretely support the quest for more context-relevant and uncertainty-responsive pathways. These pathways would no longer be negotiated "in a vacuum"[26] but would instead better take into account the complexity, unpredictability, and systemic nature of transformative processes, as well as the contending interests, visions, and influences of a wide spectrum of stakeholders. Ultimately, the paper calls for further testing and practical application of the matrix as a boundary object in the quest toward sustainable food systems.

JUSTICE IN FOOD SYSTEM TRANSFORMATIONS

The fields of justice, food, and transformations have, over the years, intertwined and interconnected and now encompass a wide number of academic contributions from very different fields and disciplines. Here, we undertake a brief mapping exercise of this literature[27] to give a broad overview of the issues, strands of research, and emerging gaps in this extensive body of literature. We identify two major bodies of research: one mainly related to food justice and the other mainly related to just transformations in food systems and beyond. This review is not intended to be comprehensive and does not aim to depict the totality of the literature on the two topics. However, it does shed light on critical challenges that justify the need for the novel matrix presented in the paper, as it demonstrates that, despite some overlaps, these two bodies of research are often only tangentially linked.

The idea of justice—broadly referring to the fair and impartial treatment of all people[28]—became more commonplace in agriculture and food systems research in the late 1980s/early 1990s, and in the years since, this area of scholarship has come to cover a wide spectrum of issues.[29,30] These include, but are not restricted to, the disproportionate burden the poor bear in terms of exposure to environmental risks[20,31]; the need to reverse racism, exploitation, and oppression in food systems[32–34]; the inadequacy of economic structures and financing mechanisms that have emerged from neoliberalism and capitalism for delivering equity[35–37]; and the disproportionate power some actors hold in the value chain.[35,38] Justice has often been used as a lens to approach systemic issues of food insecurity and sovereignty,[39,40] accompanied by an understanding that the delivery of healthy food for all has increasingly been regarded as "impossible without social justice."[37] Drawing from different fields, such as legal geography,[41,42] climate and environmental justice,[43,44] and political ecology and economy,[45,46] theoretical conceptualizations of justice have aimed to foster an understanding of the features that a just food systems might exhibit. A critical property of these systems is the ability to deliver food to all and distribute profits in an equitable manner, principles long recognized as a key pillar of food justice.[28,47] The need to ensure the involvement of all parties—including, and especially, the most marginalized—in food policy dialogues and the safeguarding of transparency in food-related policies and decisions have been deemed as equally important components.[48–50] More recently, issues relating to not only respect but also the consideration and inclusion of different viewpoints, values, knowledge, and preferences in the food systems space have garnered attention.[51–53] These efforts have been embedded in the increasing acknowledgment that justice has an undeniable subjective connotation that changes in space and time and is dependent on the actors' own perceptions, values, and background, demanding a negotiation and articulation of "what" justice means to different parties.[54,55] The need to address inequities among countries, or even among generations, has also been acknowledged.[22,23] These arguments have led the justice research community to articulate justice as comprised by at least four interconnected dimensions: distributive, procedural, recognitional, and universal justice.[44,56,57] It must be recognized that this conceptualization of justice has its roots in Western-trained epistemologies, and different ways of knowing will have different dimensions to also highlight and add to, or counter, these analyses. For the purpose of this paper and to build upon other notable works, such as the seminal work of McCauley and Heffron,[58,59] we explore the potential of these four dimensions to inform just food system transformations (see Box 1 for their brief explanation).

The other body of literature increasingly interconnected with justice, mainly from the 2010s onwards,[57] is that relating to sustainability transitions and sustainability transformations. Different scholars use these terms in different ways, but generally, sustainability transitions have generated a body of knowledge about how social-technological changes emerge and unfold,[73–75] while sustainability transformations have centered the intertwined nature of social-ecological systems, the human and non-human agency within those intertwined systems, and the multi-phased, multi-dimensional, multi-scale, and multi-generational aspects of transformations processes.[76–78] This literature acknowledges that transformational change also involves tipping dynamics.[79,80] In this paper, we draw from across both strands since, together, these areas of scholarship provide important insights. Across this literature, transformation generally refers to a fundamental shift across multiple elements or relationships of dominant social-technological-ecological systems, altering practices, norms, resource flows, and power dynamics to ensure these systems are restructured and deliver fundamentally different outcomes and configurations of a

Box 1. Justice dimensions in food and other systems

While poorly integrated in food system transformation framework, distributive, procedural, recognitional, and universal justice do, nevertheless, represent key pillars to be addressed for equitable and inclusive food systems.[19,24,60] Some variations might exist in the application and conceptualization of these dimensions (e.g., some authors consider issues of cosmopolitan, intergenerational, and restorative justice as part of distributive justice rather than labeling them as universal justice). However, here we go beyond these terminological differences, providing set definitions below accompanied by examples of what their absence might entail in food systems contexts.

Distributive justice refers to the fair distribution of benefits (including resources) and harms among all members of a society.[56,61] Currently, the prevalence of food insecurity and chronic malnutrition might be linked to inequitable access and distribution of food.[62,63] At the same time, the higher vulnerability of low-income and rural livelihoods to climate change hazards also showcases a lack of distributive justice in food systems, as it distributes harms inequitably across different sections of societies while failing to protect the most vulnerable.[64,65]

Procedural justice (sometimes also labeled as participatory or representational justice) concerns the meaningful involvement of diverse actors in decision-making processes[66] and whether all people can participate in decisions that affect them.[67] Procedural injustices occur when certain actors are purposefully excluded—or their concerns dismissed—due to power imbalances that lead to differentiated incidence in deliberation processes.[39,68,69] While the importance of including all actors in food systems debates is widely acknowledged,[70] recent efforts to involve marginalized groups have often pushed them even further from meaningful participation.[71] For instance, during the recent UN Food Systems Summit, powerful coalitions, such as large multinationals and donors, silenced the voices and concerns of civil society organizations and people's movements instead setting the patterns for even stronger corporate influence in food systems and food security debates.[70]

Recognitional justice addresses whether the rights and perspectives of different agents, ideas, and cultures are acknowledged as valid and equally valuable, regardless of gender, race, religion, ethnicity, or other characteristics.[44,72] It also raises the critical question of whose values and cultures are recognized, considered, and represented in decision-making processes. For instance, Indigenous communities and small-holder farmers, who have developed and held knowledge of agricultural practices for centuries, see this knowledge dismissed in favor of more techno- and productivity-oriented agricultural paradigms or are simply treated as "simple repositories of empirical observations" to fill gaps in scientific frameworks.[53]

systems relationships between people and planet.[81,82] Transformations are understood to involve both the dissolution or "unmaking" of certain system relationships or dynamics that hold a system in a particular state and the generation or "making" of alternative configurations or system states.[83–85]

Within the transformation scholarship, at least two aspects of justice have received much attention. The first is that justice is recognized as part of the need for transformations; that is, redressing the inequities, injustices, and power asymmetries that current system states have created often underpins the rationale for why transformations are urgently needed.[83,85,86] As such, research has shown how existing systems are marginalizing entire groups in many different ways, including the injustices and inequities stemming from large global systems of colonialism and capitalism to more local or context-specific dynamics and asymmetries.[87–91] Collectively, these accounts demonstrate how transformations relate to each of the four dimensions of justice being discussed here. Moreover, transformations research often identifies those resisting and raising awareness about the dynamics of marginalization, which could be understood as contributing to the important work of unmaking, and those creating alternatives that may contribute to the making of transformations.[92]

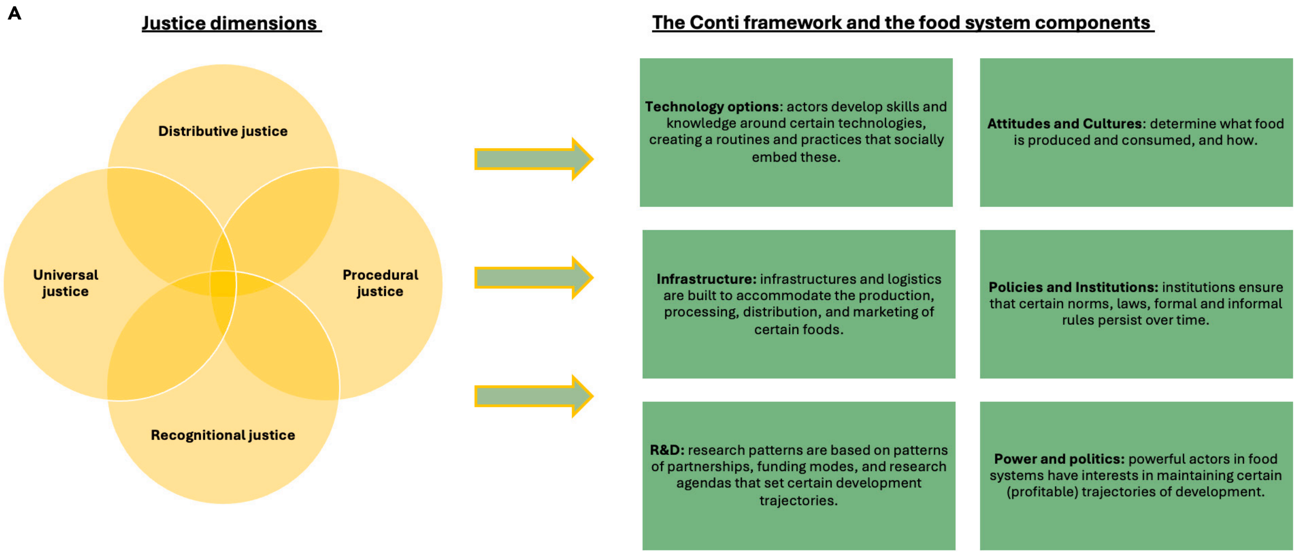
Beyond serving as an important justification for transformations and a more precise understanding of which dynamics need to be transformed, there has also been an enormous investment in finding more just processes for how to support, enable, and generate transformations.[93–95] These have included advances in methods and methodologies to ensure transformations processes include spaces that are themselves already modeling how to change dynamics so as to more justly address the plurality of ways of knowing, being, and doing[96–98] and broader reflexivity about the paradigms and ways of knowing that have shaped the researchers themselves that are engaging in transdisciplinary forms of transformations research.[99,100] Again, highlighting the ongoing unmaking and making aspects of transformations processes, scholars have also critically examined how dynamics of both empowerment and disempowerment may take shape in transformations.[101] Together, these debates have been key in developing the agenda on just transformations—and real-world application[66,102,103]—of just transformation ideas.

While the two bodies of literature do interconnect to some extent, a true integration and appropriate framework integrating food systems justice *within* transformation processes remains absent, to the authors' knowledge. This gap is discussed, together with two additional challenges to this integration, in the next paragraph.

CHALLENGES TO JUST FOOD SYSTEM TRANSFORMATIONS

Many blind spots for issues of inequality (in terms of resources but also in terms of power), exclusion, and injustice exist for achieving transformations.[47,104] This is particularly so in relation to food system transformations, where more careful integration of justice considerations still lags behind in comparison to other fields[24,25] (e.g., energy[58]).

There is agreement that the delivery of justice is critical in food system transformation[18] and can only be achieved through the



(Figure and legend continued on next page)

redesign of interconnected system components—such as policies, behaviors, and infrastructure, among others—but how this systemic redesign can happen is ambiguous.[105] Meanwhile, there is limited understanding of where to intervene in the system—or which system components to target—for addressing interconnected dimensions (presented in Box 1). This has often resulted in recommendations that are too general to guide meaningful systemic redesign of food systems toward justice.[24,106]

Besides, as with any complex system, transforming food systems requires grappling with the inherent complexity of transformation processes *coupled with* the complexity of the food system itself. Food systems are highly diverse and often suffer from shocks that create rapid changes in feedback loops,[107,108] while transformations will inevitably be unpredictable and unknowable *a priori*, and will also suffer from shocks and crises[109,110] and will include backlash dynamics and resistance to change.[82,85,111]

The unclear boundaries of food systems, deeply connected with health, energy, and other domains, and the many scales at which they operate have often acted as a smokescreen in the quest for justice,[112–114] making (in)justice issues appear or disappear depending on the boundaries that are chosen, the scales that are defined, and the stakeholders whose perspectives are considered. For instance, the interconnections between food systems and health might become more pronounced when focusing on localized, low-income communities and might seem less pronounced when examined at the national scale. This has also made it historically difficult to monitor and evaluate progress in implementing different types on interventions.[115,116]

Compounding this challenge, food systems are multi-actor spaces where some actors exercise more power and influence than others, often contributing to setting and maintaining an unsustainable direction of development and creating inequities in how resources and wealth are distributed both within countries and at the global level.[117,118] A lack of understanding of how these power imbalances manifest and how to constructively engage with in the process of transformation[73,93,119] has often led strategies and actions for food (and other) system transformations to do nothing more than "tinker at the margins."[120] Ambitious but naive attempts to achieve inclusion and transdisciplinarity have been, while valuable in intent, relatively ineffective in delivering true inclusion and recognition of all perspectives, possibly reinforcing power imbalances rather than mitigating them.[121,122] This was the case, for example, for the UN Food System Summit (see Box 1).[71,123]

SOLUTION: THE JUSTRA FOR INTERCONNECTED CHALLENGES

A novel framework and a novel approach

These challenges demand more joined-up conceptual thinking and different ways of framing approaches to just food system transformations. We explain those below.

First, to respond to the lack of an integrated framework that examines justice across multiple food systems components, we interconnect the justice dimensions identified in the literature (distributive, procedural, recognitional, and universal) with a framework built upon a systematic review of over 120 publications that identified the core food systems elements to be tackled for transformation (Figure 1A).[124] The Conti et al.[124] framework clearly spells out the elements to be redesigned so that transformation can be achieved. The integration of these two frameworks is presented in Figure 1B, with food systems elements on the left and justice dimensions on the top.

Second, it has been argued that the complex and unpredictable dynamics of transformative change processes require a flexible approach.[76,107] In recent years, interrogative approaches have emerged as a novel way of envisioning transformations. The interrogative approach involves the use of critical questions (i.e., interrogatives) around certain issues and priorities as a way to reveal and challenge preconceived notions and "one-size-fits-all solutions."[125,126] Interrogatives have been used to think through new food systems priorities and strategies,[127] developing checklists for necessary transformation actions[128] and conducting

B

	Distributional justice	Procedural justice	Recognitional justice	Universal Justice
Technology options	Who has mostly benefitted from the adoption of certain technologies in the past? Do all groups of actors involved in technology adoption and use have equal access and equitably distributed benefits? Will training and education of new sustainable technologies be equally accessible for all?	Were all stakeholders provided clear, transparent and accurate information about the advantages or drawbacks of a certain technology? Can objections to the choice of the technology be raised easily in the decision-making process? Will future technology options be agreed democratically?	Did technology options respect the diversity of contexts where they were implemented? Do technology options align with the values of all system players? Will indigenous/local or other forms of knowledge be drawn upon as sources of important insights?	Did the technology cause undesirable spillover effects to certain groups? How are the harms (e.g. environmental and others) of the technologies compensated for? Will there be a discussion in terms of who might be endangered by a certain technology choice, including future generations?
Infrastructure	Were there disparities in access to infrastructure? Are some areas currently harmed by infrastructure development? Will resource access (e.g. land, water) be granted fairly?	When infrastructural arrangements were made, was everyone involved in the debate? Is the existent infrastructure granting the respect of human rights (e.g. no labor abuses)? Will the new infrastructure grant fair wages and working conditions to all?	Did the infrastructure preserve local food culture? Does the current research infrastructure (e.g. lab equipment) constrain research choices? Will novel infrastructure mirror values and preferences of all people in that context?	Did past infrastructure cause harms to certain people/groups? Are some foods, resources and products become less accessible to certain people/areas? The setup of different infrastructure will cause losses to certain sectors (e.g. labour). How will this be accounted for?
Cultures & attitudes	Have harms from certain cultural and behavioural patterns be disproportionately distributed? Are marginal actors ensured equitable benefit-sharing from traditional knowledge and practices? Will all actors have the resources and knowledge to make the production/consumption choices they desire?	Were communities able to express their preferences in terms of what they produce and consume? How are decisions made in terms of what is desirable and preferable forms of production and consumption? How will conflicting views in terms of what is desirable/ culturally appropriate resolved?	Were different identities (be) respected in past food systems? Are diverse epistemologies and ways-of-knowing recognized and represented in producing and consuming the food? How will neglected worldviews /knowledge systems be better integrated in future food systems?	Were the traditional practices of certain groups, and their preferences, and relationships with the land and environment respected? Past production and consumption patterns have caused harms. How is this accounted for in present food systems? New patterns of consumption will result in losses for certain actors/sectors. How will this be compensated for?
Policies & institutions	Did policies distribute benefits equitably in the food system? Are institutions ensuring equitable access to resources, inputs, foods, subsidies and others? Will institutional mechanisms be put in place to tackle income disparities?	Who got to participate in the policy-making process? Are there mechanisms in place for public inputs? Will policies/institutions protect and promote the rights of all people and communities?	Were there explicit mechanisms in place to recognize and value a diversity of knowledges in policies? Are all individuals, no matter their ethnicity, gender etc. equally listened to in decision-making? Will preferences, values, cultures of different groups be respected in new institutions?	Policies have "winners" and "losers". Were there measures in place to compensate losers? What are the negative spillover effects of food systems to other systems (e.g. health, mitigated? Will policies attempt to repair historical harms (e.g. colonial history, gender or ethnic discrimination)?
R&D priorities	Did innovation trajectories disproportionately benefit certain players? How are funding distributed across different disciplines? Will specific types of research priorities disproportionately funded?	Who set the agenda for R&D? Is information about advantages and disadvantages of R&D available to all stakeholders involved? Will equitable access to funding be granted?	Did research priorities give weight to traditional knowledge? Is R&D skewed in terms of certain disciplines and values? Will local stakeholder needs recognized in R&D projects?	Did specific R&D patterns generate disproportionate benefits for some actors? Are R&I priorities attempting to remedy past environmental/ other harms? Will there be efforts to restore historically discarded knowledges?
Political economy	Did trade agreements distribute benefits equitably across demographies/geographies? Is power equitably distributed in the food system? Will economic and other inequalities be addressed?	Were the relationships between corporate and other actors transparent? Who sets priorities? Will the power of large actors be reduced in favour of more equity in decision-making?	Did values and preferences of all actors count equally? Are the dominant socio-economic and other structures underlying food systems questioned transparently? Will marginal/discriminated actors be considered as equal to others?	How did power patterns disproportionately affect some countries? Is historic responsibility and colonial legacy compensated for within and between countries? Will past harms generated by historical power configurations be remedied?

Figure 1. The JUSTRA

(A) Justice dimensions and the Conti et al.[124] framework.

(B) An illustration of the JUSTRA populated with samples of interrogatives, based on an expert exercise. Each cell contains a retrospective (purple), present-day (blue) and forward-looking (green) question.

horizon-scanning exercises to negotiate possible pathways to sustainability.[129] The interrogative approach allows strategies or theories of change to be constructed and tested much more openly and reflexively.[126,128] In this way, the use of interrogatives can support navigating the uncertainty of just food system transformations. Interrogatives remain highly adaptable, as they cannot be separated from the historical, social, ecological, economic, and political contexts in which they operate. They also serve to expose contending interests, values, and visions, often associated with unequal power dynamics that thwart system change.[6,130]

The application of the Conti et al.[124] framework to food systems justice dimensions (Figure 1A) *and* the interrogative

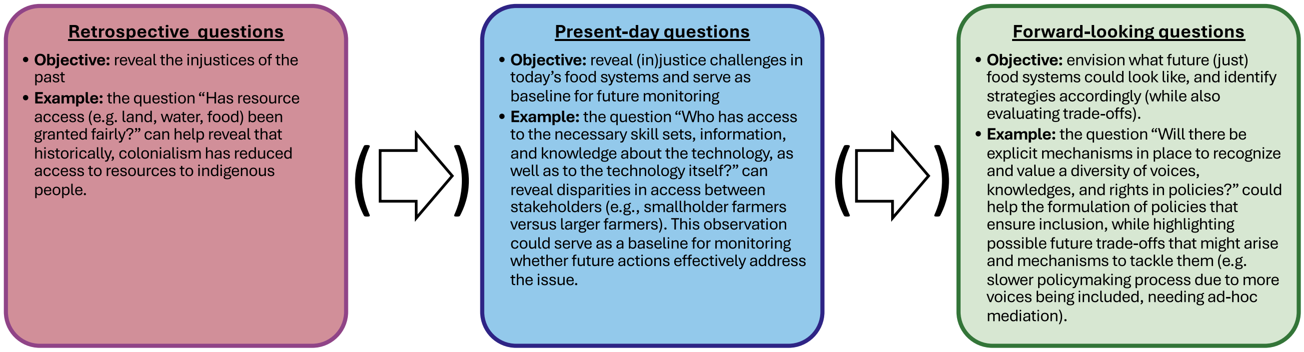


Figure 2. The three uses of the matrix, with their objective and example
The "(→)" symbol suggests that while the three uses could be performed in a tandem, they can also be performed individually.

approach, together, allow us to build the JUSTRA (Figure 1B), which combines food systems justice and food system transformation considerations in a single matrix to be applied for a variety of purposes.

Deploying the JUSTRA: An experts' exercise method

Figure 1B shows the new matrix resulting from the combination of justice aspects and food system elements to be transformed. The matrix can be deployed through the interrogative approach, which not only offers the advantages explained above but is, in this case, useful for bridging different conceptual lenses to explore co-related challenges. Interrogatives can go beyond disciplinary specificity and bridge justice and transformation considerations. For instance, the question "what patterns of injustice exist in food system?" (justice specific) or "what technological path dependencies hamper transformation?" (transformation specific) can be linked to ask much more fundamental questions, such as "how do injustices in technology persist as path dependencies hampering transformation?" or "how can justice be ensured in consumers' food choices?"

To show how these interrogatives can be formulated, we tested the JUSTRA through an interdisciplinary exercise involving multiple experts (more details can be found in the methods section) with different backgrounds and working in various fields, including environmental studies, ecology, public health, modeling, system innovation, transition studies, transformation studies, behavioral nutrition, land system science, and degrowth. All these experts have knowledge of both transformation and justice debates. However, given that this group comes from similar ways of knowing and being, it does not represent the full spectrum of actors who are currently experiencing a range of food injustices. The perspectives and interrogative prompts provided by the experts are necessarily biased and overlook issues that might instead emerge if the JUSTRA was used in transdisciplinary (rather than interdisciplinary) multi-stakeholder settings. Issues of gender, racism, religion, or class, which might be prevalent in many contexts, could not be addressed. Besides, the questions are underpinned by a broad academic understanding of justice—as defined by Murray et al. in a recent review.[28] This might not reflect different connotations emerging from a broader range of actors. The authors intentionally take a relatively agnostic perspective, keeping the interrogatives very general and formulating them for only the purpose of illustrating how the JUSTRA works rather than in an effort to showcase issues belonging to a certain context. Thus, the questions proposed in Figure 1B should be considered "samples" to be revised and expanded in real-world contexts.

During the expert exercise, the experts filled in the matrix and observed how the interconnections of food systems and justice aspects can help uncover three distinct types of questions (see Figure 1B for a few examples).

- Retrospective questions concerning the past—highlighting how injustices have manifested across various system elements, e.g., how did the setup of a certain infrastructure create structural disparities in wealth distribution?
- Present-day questions that regard the present situation—evaluating which injustices persist within current food systems, e.g., are different food systems actors able to express their cultural and historical preferences in terms of what they produce and consume?
- Forward-looking questions that are interested in future developments—and guide the envisioning of more just transformation pathways, e.g., will local stakeholders need be adequately recognized in research and development projects and programs?

We discuss the implications of this for the application of the JUSTRA in the next sections.

Different uses and purposes: Applying the JUSTRA

Whereas the questions in the table shown in Figure 1B, taken in isolation, are still important, the real power of the JUSTRA is its ability to show the interconnections between the multiple questions that cut across system elements and justice components. Below, we present three potential applications of the JUSTRA, which were identified in the expert workshop: (1) generating retrospective questions that challenge "business as usual," (2) formulating present-day questions for food systems justice assessment and baseline for monitoring and evaluation, and (3) envisioning forward-looking questions for designing future pathways and revealing possible trade-offs. Each application can be implemented independently or in tandem (see Figure 2), depending on the specific contextual requirements. In this way, the JUSTRA matrix is not monolithic. *How* and by *whom* the

JUSTRA is used remains open to preferences and needs. It is possible that a certain group of stakeholders might decide to only select specific columns or rows (and not others) of the table shown in Figure 1B to employ (and not others) depending on the issues at stake, such as assessing the justice implication of a specific policy—thus testing only the ''policies and institutions'' row against the different justice columns. Likewise, even though involving a broad range of stakeholders remains desirable and is recommended for reflecting a wider range of perspectives and issues of justice, such a broad involvement might not be possible in some occurrences, e.g., because of time or other limitations. In these cases, the JUSTRA can also be used as a boundary object for smaller stakeholder groups (e.g., policymakers or researchers) to target specific matters for which more aligned and homogeneous agreements are preferable to facilitate or accelerate decisions on certain matters (e.g., in the case of a disaster that disrupts the food systems[131,132]).

(1) Retrospective questions to challenge business as usual

The first type of questions that the JUSTRA can generate are those that probe the deeply entrenched, and often unjust, historical patterns within food systems. For example, colonial dynamics, which have been built and reproduced over centuries, continue to shape food systems, creating unequal access to resources and profits, influencing whose agendas are prioritized, and determining whose knowledge is recognized.[133,134] For instance, in some contexts, the marginalization of Indigenous peoples has led them to experience inequities in food access or rights to food, inferiority in the legal system, and disrespect of their knowledge of traditional agricultural practices and sovereignty of their food systems, overall reinforcing inequalities in resource distribution and decision-making.[135–138] Questions like ''has resource access (e.g., land, water, food) been granted fairly?'' or ''have preferences, values, cultures of different groups been respected in past institutions and if not, how have those responsible been held accountable?'' might shed light on these issues that often still go unmentioned in public debates[139] while also pointing out who wields power in shaping these debates. Only by confronting these issues and revealing historical injustices and path dependencies in food systems can their just transformation take place[53,124]—this can be fostered by the interrogative practices supported by the JUSTRA.

(2) Present-day questions for food systems justice assessment and baseline for monitoring and evaluation

The present-day questions the authors formulated are critical to take stock of the extent to which current food systems (and the relationships, dynamics, and components holding those systems in a particular state) are aligned with justice considerations. Evaluating this alignment can be important to evaluating justice implications of a specific and ongoing event—for instance, revealing how the Ukraine conflict has particularly impacted small-holder farmers and poor consumers[140]—or discussing the configuration of food systems (at different scales) more broadly.[48] These two endeavors can also be essential to capture initial conditions before a certain action is implemented. Therefore, they can serve as a baseline for evaluating the impacts of justice-oriented actions and monitor progress against this starting point. For example, an intervention might aim for the introduction of a new sustainable technology that supports a sustainability shift in a specific region. A pre-intervention, present-day question might ask "who has access to the necessary skill sets, information, and knowledge about the technology, as well as to the technology itself?" If the following assessment shows that certain groups are worse off—a relatively common occurrence[141,142]—then this question can be re-formulated throughout and at the end of the intervention to evaluate whether efforts to include these groups have been effective.

(3) Forward-looking questions for designing future pathways and revealing possible trade-offs

The JUSTRA might also provide a way to design possible pathways to achieve just visions of the food systems and generate discussion on how they can be achieved. For instance, aiming for recognitional justice in future food systems can generate questions such as ''will there be explicit mechanisms in place to recognize and value a diversity of voices, knowledges, and rights in policies?'' or ''will different ways of knowing, being, and doing be respected in the process of shifting consumption and production patterns toward novel dietary pathways?'', which can help set out strategies and pathways to fulfill these objectives. Even though not strictly necessary, it might be easier to conduct this forward-looking exercise following the formulation of past and present questions. This is because identifying and agreeing on possible past injustices, and present issues, can open the way to a more informed discussion on ''where do we go from here?''—or what do we need in future food systems. For instance, opening dialogues around colonialism and its repercussions (as in the case of Indigenous people[89]) can then lead to more thoughtful considerations over ways to repair these issues in future action (e.g., with much more targeted policy and research efforts to valorize Indigenous people's knowledge and views).

During this step, difficult choices and trade-offs can be explored. For instance, questions around the distributive implications of the political economy in food systems might mean aiming for fairer trade agreements.[143] However, these agreements might reduce the benefits of larger actors who previously dominated the market[117] and possibly undermine their willingness to participate in the transformation.[144] These trade-offs might highlight the ''blurred boundaries'' of the food systems: for instance, a shift in more culturally appropriate and local diets—a recognitional justice concern—can create harm for those employed in the food transport sector.[145] Careful handling and transparent discussion so that trade-offs can be openly acknowledged and engaged with must be employed.[146] Besides, adequate capacity building that allows stakeholders to openly engage with contested issues and challenging dynamics might be pre-emptively needed to avoid backlash from some parties who see their interests endangered.[82] In this case, a mediator can have a critical role in helping participants find a common ground (see next section).

OUTLOOK: WHERE DO WE GO FROM HERE?

Building on burgeoning efforts to address justice in food system transformations work, the JUSTRA offers a promising pathway for practically integrating justice into food system transformations. Its three interconnected applications—retrospective, present-day, and forward-looking questioning—show how the matrix can be actioned to do the following.

Generate considerations and pathways for just food system transformations that are context relevant and uncertainty responsive: even though the need for more context specificity has been core in transformation debates, it has yet to be fully implemented.[107,147] There is still a tendency to apply overly general solutions across countries and contexts—overlooking the different histories, values, and conditions.[51,141,148,149] As the interrogatives cannot be generalized without losing their relevance, using the JUSTRA "out of context" is difficult. In particular, if the three steps above are implemented in a sequence, then the contextual understanding provided by the JUSTRA can become even more powerful and shed light on historical resistance and backlash that "block" transformation,[53,80] their present manifestations, and possible future solutions. As in the case of Indigenous people mentioned above, often, their unjust treatment and discrimination has taken root in the colonial period and eroded their ability to access resources, voice their opinions, and deploy their own (food systems) knowledge in the present.[133,150] The JUSTRA helps reveal this, and, even if this particular issue could not be addressed extensively in the paper, we invite further and more in-depth investigation of real-life patterns of exclusion—through and beyond the application of the matrix. Besides, the possibility of routinely re-visiting the interrogatives to keep them relevant to their context (which will evolve over time) also allows an iterative re-assessment of the initially envisioned priorities and actions. This is not only to "check progress"—a major struggle and priority in food system transformation[151]—but also act to counterbalance possible trade-offs that have emerged or take into account unpredictable developments and shocks that might have taken place. Therefore, the JUSTRA can support navigating the uncertainty and non-linearity of food systems innovation processes.

The JUSTRA can reveal the systemic and historical nature of the issues at stake and help to envision the systemic solutions needed. Even if, as explained in the previous sections, the future users of the JUSTRA can still choose to employ it among a small set of actors, or only use it to explore specific issues (e.g., recognitional justice in policies), the value of the JUSTRA lies in its ability to show interconnections across time (past, present, and future) between multiple system elements and justice aspects. Gauging the food systems elements to be tackled (e.g., technologies, infrastructure, and policies) against justice considerations reveals how these elements are deeply intertwined. In other words, the JUSTRA can show how the choices around certain "promising" technologies will require new arrangements (e.g., infrastructure) and new policies that ensure the recognition and protection of multiple interests and preferences. In this way, the JUSTRA highlights that no single-component action can achieve just transformation, but rather, it will be a synchronous "dovetailing" of multiple and balanced actions that can achieve just transformation. This dovetailing will need to be carried out at multiple scales: as previously explained, using the JUSTRA at the local level can reveal different sets of issues than if used at the regional or national level. This is an important indication of the multi-level nature of food systems, which will require just transformation considerations to be managed by different stakeholders (e.g., local instead of national policymakers, or vice versa) through different actions at different scales, depending on context, resources, and desired outcomes. Thus, while the need for systemic action has been widely discussed in the literature,[124,152,153] the matrix helps concretely engage with this systematicity.

Demand answers that do not overlook power imbalances—if used in *bona fides*. As in the case of any multi-stakeholder dialogue or process, power and the dynamics associated with its asymmetrical distribution will inevitably enter into the convened space.[26,120] If the JUSTRA and its interrogatives would be enriched by the participation of many different stakeholders, whose varied perspectives can capture a wide spectrum of justice considerations, then the matrix does not per se guarantee that this participation is either achieved or managed democratically. Often, even when a broad range of actors seem to be involved in decision-making processes, the opinions of a few might still trump the others.[71,123] In the case of the JUSTRA, the perspectives of certain people or groups that might be victims of injustice do not automatically emerge from the matrix. The issue of "injustice for *whom*" can only be truly tackled in an inclusive manner if purposeful efforts are made to listen to these groups—or if justice considerations (procedural and recognitional) are applied in the use of the matrix itself. Similarly, the question of *who* is responsible for past and present harm and who should bear the most burden in remedying them in the future[154] will likely emerge.

Therefore, for actioning the matrix, mediation could be critical for mitigating power struggles and conflicts of interest and harnessing meaningful and constructive—if not always completely amicable—dialogue. Mediation could be used to avoid a "power grab" by some actors and the consequent shaping of debates toward certain lines (e.g., what constitutes transformation and who should enact it), for instance, by ensuring that marginalized voices are prioritized, agendas are set collaboratively, and anonymous feedback channels are instituted.[155,156] Mediation could also avoid the debate ending in a "finger-pointing exercise" (as one of the experts described it) that hampers, rather than supports, action toward transformation by alienating certain actors. In this context, the mediator could both be completely external to the matters in question, and thus fully impartial, or have extensive knowledge of food systems issues, dynamics, and power patterns.[157] Many have suggested that researchers could serve as mediators and facilitators in negotiating transformative pathways.[158–160] In particular, they could ascertain that actors' actions remain well meaning (or in "bona fides") and that responsibilities and commitments are made and carried out transparently. Researchers as mediators could also help build capacities of different actors toward reaching a, if not consensus, at least compromise over possible strategies and actions to solve environmental, social, and economic challenges.[82,158]

CONCLUSIONS

Overall, if this perspective piece presents a preliminary testing of the matrix, then a wider empirical application will be required to demonstrate its value, strengthen and context tailor the interrogative prompts, and identify meaningful ways of balancing power asymmetries and possible disagreements and conflicts likely arising from its use. We suggest that the JUSTRA can be actioned by a broad set of actors in the food systems. For this, it is important to flag that the purpose of the JUSTRA is not to produce "unbiased" or fully "objective" justice considerations. Often, debates on justice have stalled by seeking a way to reduce or eliminate biases and subjectivity, resulting in time-consuming and largely ineffective efforts.[161] Instead, we argue that it might be more productive to acknowledge and better understand this bias (e.g., through Q methodologies[162]) by shifting the focus to how a "common denominator" of acceptable values and shared priorities can be found and agreed upon by relevant stakeholders. In this context, the matrix can serve as a boundary object or a tool that allows a deeper exploration of issues perceived differently or incompletely by different actors—a common occurrence in the envisioning of both justice and transformation—and facilitates a shared—if not unanimous—understanding among actors with different values and views.[163] The matrix can also help practically envision multiple transformation pathways, highlighting trade-offs and monitoring progress toward justice and transformation over time. However, the advantages of the JUSTRA can only truly emerge if the matrix is employed by stakeholders who genuinely want to progress food system transformation.

First, its potential depends on its conscientious application—i.e., not only using the JUSTRA for justice but also using it *justly.* The meaningful use of the JUSTRA can only be underpinned by the actors' own willingness to find compromise and work toward the advancement of food system transformation.

Second, its practical application can only become truly meaningful if it is employed by people who have the agency to make change happen. Compromises might need to be made: for instance, repairing harms of the past might become less important than securing "responsible" actors' support in "doing well in the future" (e.g., focusing on the implementation of fairer labor regulations versus financially compensating the ones who suffered from harms). None of the choices ahead will be easy, and expectation management among disenfranchised groups will be very important, as well as goodwill among more influential actors.

Over time, more inclusive and well-meaning dialogue between many actors could lead to new alliances and new patterns of (more collaborative) behaviors. Yet, only the empirical implementation of the JUSTRA will show whether this will be the case.

METHODS

Initial workshop for building the JUSTRA

To demonstrate the application of the JUSTRA and populate it with initial boundaries, two workshops involving a multi-disciplinary team of scientific experts (the authors of the paper), as well as iterative rounds of feedback, were conducted. The experts had different backgrounds and worked in various fields, including environmental studies, ecology, public health, modeling, system innovation, transition studies, transformation studies, behavioral nutrition, land system science, and degrowth.

The first workshop had the following objectives.

- Evaluate whether the justice dimensions identified through the mapping exercise were satisfactory.
- Assess whether the application of the Conti et al.[124] framework to these different dimensions was relevant and satisfactory to the purpose of the paper.
- Discuss the value of interrogatives and their advantages, deciding to adopt the interrogative approach to deploy the JUSTRA.

Second workshop and refinement of the matrix

Once the JUSTRA, as presented in Figure 1A, was elaborated, the authors met a second time to populate the matrix with questions. Experts were divided into three different groups, each responsible for populating two rows (or food systems elements) of the matrix. The experts observed that past, present, and future questions could emerge from the exercise of filling in the matrix. Then, the three groups reconvened and discussed their questions and observations.

While originally, many more questions were elaborated for each cell, following correspondence and iterative re-visitation of the working draft of the table, it was decided that only three questions per cell would be presented to avoid an overly long table and enhance overall clarity. The three questions would be as follows.

- One regarding the past (retrospective)
- One regarding the present (present day)
- One regarding the future (forward looking)

Once the first author produced a first full draft of the paper, all authors contributed with feedback, suggestions, and in text-additions.

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AUTHOR CONTRIBUTIONS

C.C. conceptualized the paper (assisted by A.H.) and lead the writing in the majority of the sections. All authors participated in the workshops and discussions and provided feedback on the paper iteratively while also contributing to reviewing and editing.

DECLARATION OF INTERESTS

The authors declare no competing interests.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this work, the authors used ChatGPT to correct grammar and spelling. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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